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1973-74

VOLUME
2

ACTIVE COMPONENTS AND FILTERS

CIRCUIT ASSEMBLIES

CONTROLS AND DRIVES

UNITED TECHNICAL PUBLICATIONS

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ELECTRONIC ENGINEERS MASTER

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Volume 2

Active Components and Filters

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Need directory information?

EEM contains four complete directories which provide the most up-to-date information available. These directories are listed and described at the right. They appear in all three volumes, with the exception of the Trade Mark Directory which appears only in Volume 1. Directory references to Volume 4 indicate the 1973 edition, which you received in January. That copy of Volume 4 should be retained to complete the 4-volume set.

Add Volume 4/1973 to your copies of Volumes 1, 2 and 3 to make a complete set of **EEM** for 1973-74.

UNITED TECHNICAL PUBLICATIONS

Included in this volume are:

The Product Index and Directory

The Product Index and Directory (green section, page 9) lists more than 6,000 types of electronic products alphabetically, by product. Under each product heading is a complete, alphabetical listing of manufacturers who make that product. **Bold face** listings indicate which manufacturers have provided catalog data on that product in the white pages.

The Manufacturers and Sales Office Directory

The Manufacturers and Sales Office Directory (starts yellow section of each volume) lists more than 3,000 manufacturers of electronic components, materials, instruments, assemblies, systems, and key services. Provided are complete addresses, phone numbers, sales managers' names, names of application engineers, TWX numbers where applicable, selected distributors. **Bold face** listings indicate that manufacturers have provided catalog data in the white pages and that sales offices are listed.

The Distributor Directory

The Distributor Directory (yellow section, page 1594, with black edge marking) lists more than 1,000 electronic distributors and branch locations, alphabetically by distributor's name, geographically by state and city.

Need catalog information?

For complete catalog information on any product, refer to the Product Index and Directory (green section, page 9, all volumes) which provides a complete listing of all the manufacturers who supply a particular product. Those manufacturers listed in bold face with page and volume number references have provided catalog data on this product in the catalog section (white pages) where you can find the information you need. References to Volume 4 indicate the Volume 4 you received in January and which should be retained to complete your 4-volume set of EEM.

Need additional information in a hurry?

Two special telephone services are being maintained for EEM users to provide extra information you need. If you need to determine a local source of supply, just **D.I.A.L. EEM.** This toll-free service (**D**istributor **I**nformation **A**nd **L**istings), provides you with the name of a sales office or distributor in your area who can provide a needed product.
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Need additional assistance?

Contact the EEM editorial staff, at United Technical Publications, Inc., 645 Stewart Avenue, Garden City, N. Y. 11530, or phone (516) 248-9700.

introduction

The 1973-74 edition of EEM, Volumes 1, 2 and 3, is designed to integrate with Volume 4/'73, published in January 1973. The complete 4-volume set is the largest, most comprehensive edition of EEM ever published, providing catalog data in four separate volumes, all fully cross-referenced:

Volume 1 — Test Instruments / Equipment and Systems

Volume 2 — Active Components / Circuit Assemblies Controls and Drives / Filters

Volume 3 — Passive Components / Materials / Hardware

Volume 4 (1973) — All product categories included in Volumes 1, 2, and 3

The 53 EEM product sections have been individually assigned to their appropriate volume. Product categories within each volume are listed on the cover. A complete listing of the 53 Product Sections appears on page 3 and on the second page of the catalog section in each volume. This listing indicates in which volumes, and on which pages, specific products can be located.

The eem System

United Technical Publications' Time-Saving Product Information System

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- **IC Update Hotline**
  Toll-free phone service to provide daily updating of IC functions available from each manufacturer.
- **Semiannual Product Postcard Mailers**
  Providing additional and updated product data between editions of EEM.
- **Electronic Distributors Master Catalog Program**
  Comprehensive quarterly catalog program for distributors.

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Vol.3 PASSIVE COMPONENTS MATERIALS / HARDWARE

Vol.4 COMBINES PRODUCT CATEGORIES INCLUDED IN VOLS. 1, 2, AND 3

eem — Electronic Engineers Master saves you engineering, specifying and purchasing time. Manufacturers' catalogs are grouped under easy-to-remember headings.

The 53 Product Sections categorize related electronic components, equipment, materials, instruments and systems, and fabrication services, enabling you to quickly compare and evaluate similar items.

To find a specific manufacturer's catalog pages refer to the Index of Manufacturers which appears in two places in this volume, at the beginning of the green section and at the beginning of the white section.

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1800	Vol.3•810		Coils (Inductors, Chokes), Assemblies, Forms
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Product Index and Directory

The Product Index and Directory is designed to help you locate manufacturers of specific types of electronic products. Products are listed alphabetically, with many helpful cross references. This index has been completely revised and updated since the last edition of EEM Many product headings have been changed; many have been added, in an effort to keep the directory current with changing technology. Review it thoroughly for complete information.

Under each product heading there is a complete alphabetical listing of manufacturers who make that product. The first portion of the listing, in **bold face** with volume and page numbers indicated, consist of those manufacturers who have provided catalog data on this specific product in the white pages of EEM. The second part of the listing includes those manufacturers who make this product but have not provided catalog data on it in EEM. **Bold face** names in this portion of the list indicate manufacturers who have catalog pages in EEM but which do not include information about this specific product.

eem
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This directory was completely revised and updated for this edition prior to publication. Thus the information is current as of Spring 1973.
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Engis Corp., Morton Grove, Ill.
Norton Coated Abrasive & Tape Divs., Troy, N.Y.
3M Co., St. Paul, Minn.
Union Carbide, San Diego, Cal.

Absorbers, Shock—See Mounts, Shock & Vibration

Accelerators & Accessories, Particle

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Kaman Sciences Corp., Colorado Springs, Colo.
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Radiation Dynamics, Inc., Westbury, N.Y.
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Advanced Dynamic Instrs. Div., Alexandria, Va.
B & K Instrs., Inc., Cleveland, Ohio
Bell & Howell Co., Pasadena, Calif.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., Davenport, Iowa
Bourns, Inc., Instr. Div., Riverside, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Cole Instrument Corp., Costa Mesa, Cal.
Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Duarte, Cal.
Delco Elctrns. Div., Kokomo, Ind.
Dytronics Co., Columbus, Ohio
Emerson & Cuming, Inc., Canton, Mass.
Endevco, Pasadena, Calif.
Engdahl Enterprises, Costa Mesa, Cal.
General Radio Co., Concord, Mass.
Genisco Technolgy Corp., Instrument Div. (Transducers), Compton, Cal.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Honeywell, Minneapolis, Minn.
Humphrey, Inc., San Diego, Calif.
Impact-O-Graph Corp., Bedford, Ohio
IMPACT-O-GRAPH Div., Bedford, Ohio
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Kulite Semiconductor Prod., Ridgefield, N.J.
Larson Aero Dev., Concord, Calif.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Grand Rapids, Mich.
Metrix Instr. Co., Houston, Tex.
PCB Piezotronics, Inc., Depew, N.Y.
Pickering & Co., Plainview, N.Y.
Poly-Scientific, Blacksburg, Va.
Raymond Engrg. Inc., Middletown, Conn.
Reliance Elec. Co., Cleveland, Ohio
Rohde & Schwarz Sls., Passaic, N.J.
Schaevitz Engrg., Pennsauken, N.J.
Sensotec, Inc., Columbus, Ohio
Shure Bros., Inc., Evanston, Ill.
Singer Co., Little Falls, N.J.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Statham Instrs., Inc., Oxnard, Cal.
Systron-Donner Inertial Division, Concord, Cal.
Teledyne Geotech, Dallas, Tex.
Vibra-Metrics, Inc., E. Haven, Conn.
Vibrac Corp., Chelmsford, Mass.
West Coast Resch. Corp., Los Angeles, Calif.

Acoustic Noise Generators—See Generators, Acoustic, High Intensity Noise

Acoustic Test Chambers—See Chambers, Acoustical Test, High Intensity Noise

Actuators, Servo, Linear

Control Technology Co., L.I.C., N.Y. Vol 2•987
TRW/Globe Motors, Dayton, Ohio Vol 2•667
American Elctrns., Inc., Fullerton, Cal.
Bafco, Inc., Warminster, Pa.
Bendix Corp., N. Hollywood, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Glentek, Inc., Santa Monica, Calif.
Honeywell, Ft. Washington, Pa.
Ind'l. Control Co., Farmingdale, N.Y.
Jordan Controls, Milwaukee, Wisc.
Lear Siegler, Inc., Santa Monica, Calif.
Lisk, G.W. Co., Clifton Springs, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Magnecraft Elec., Chicago, Ill.
Magnedyne Inc., Carlsbad, Calif.
Magnetic Technology, Canoga Pk., Cal.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Metal Bellows Corp., Sharon, Mass.
MPC Prods. Corp., Chicago, Ill.
Precision Mechanisms Corp., Westbury, N.Y.
Raymond Engrg. Inc., Middletown, Conn.
Servotronics, Inc., Buffalo, N.Y.
Skinner Polynoid Div., New Britain, Conn.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Taylor Instr. Process Control Div., Rochester, N.Y.
Torque Systems, Waltham, Mass.
Transicoil, Inc., Worcester, Pa.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.
Western Gear Corp., Pasadena, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Yaskawa Elec. America, Inc., Oak Brook, Ill.
Zonic Tech. Labs., Cincinnati, Ohio

Actuators, Servo, Rotary

Control Technology Co., L.I.C., N.Y. Vol 2•987
Aeroflex Labs., Plainview, N.Y.
Allard Instr. Corp., Westbury, NY
American Elctrns., Inc., Fullerton, Cal.
Bafco, Inc., Warminster, Pa.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., N. Hollywood, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Carco Elctrns., Menlo Park, Calif.
Consolidated Controls Corp., Bethel, Conn.
Gap Instr. Corp., Hauppauge, N.Y.
General Scanning, Watertown, Mass.
Glentek, Inc., Santa Monica, Calif.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
IMC Magnetics Corp., Maywood, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
Jordan Controls, Milwaukee, Wisc.
Lear Siegler, Inc., Santa Monica, Calif.
Lisk, G.W. Co., Clifton Springs, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Magnedyne Inc., Carlsbad, Calif.
Magnetic Technology, Canoga Pk., Cal.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Meltronics Inc., Leeds, Ala.
MPC Prods. Corp., Chicago, Ill.
Northern Precision Labs., Inc., Fairfield, N.J.
Precision Mechanisms Corp., Westbury, N.Y.
Sawyer Inds., Arcadia, Cal.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Taylor Instr. Process Control Div., Rochester, N.Y.
Torque Systems, Waltham, Mass.
Transicoil, Inc., Worcester, Pa.
TRW/Globe Motors, Dayton, Ohio
Varo, Inc., Santa Barbara, Cal.
Vernitech, Deer Pk., N.Y.

Warner Elec. Brake & Clutch Co., Beloit, Wisc.
Western Gear Corp., Pasadena, Cal.
Weston Instruments, Inc., Newark, N.J.
Zonic Tech. Labs., Cincinnati, Ohio

Adapters—See Connector Adapters, Plug Adapters; Socket Adapters; Etc.

Adapters, F-M, Recording

Data-Control Systems, Danbury, Conn.
GC Electronics, Rockford, Ill.
Video Research Corp., Gaithersburg, Md.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Adapters, Panoramic—See Receivers, Panoramic

Adapters, Waveguide

Waveline, Inc., W. Caldwell, N.J. Vol 2•629
Aircom, Inc., Union, N.H.
Americon Microwave Inds., Inc., Waltham, Mass.
Arra Inc., Bay Shore, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Norsal Industries, Inc., Brentwood, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.

Adhesives (All Types)

Cox & Co., Inc., New York, N.Y. Vol 2•1160
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn. ..... Vol 3•1079
Acme Chemical & Insulation Co., New Haven, Conn.
Adhesive Prods. Corp., Bronx, N.Y.
Allaco Prods Div., Watertown, Mass.
Amicon Corp., Lexington, Mass.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Armstrong Cork Co., Lancaster, Pa.
Armstrong Prods. Co., Warsaw, Ind.
Bacon Inds., Watertown, Mass.
Brady, W.H. Co., Milwaukee, Wisc.
Cadilac Plastics & Chems., Detroit, Mich.
Chomerics, Inc., Woburn, Mass.
Conap, Inc., Allegany, N.Y.
Dolph, John C. Co., Monmouth Junction, N.J.
Dow Corning Corp., Midland, Mich.
Eastman Chem. Prods., Kingsport, Tenn.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Electro Mats. Corp. Amer., Mamaroneck, N.Y.
Electro-Science Labs., Pennsauken, N. J.
Emerson & Cuming, Inc., Canton, Mass.
Epoxy Technology, Watertown, Mass.
Epoxylite Corp., Anaheim, Calif.
Fenwal, Inc., Ashland, Mass.
GAF Corp., New York, N.Y.
GC Electronics, Rockford, Ill.
General Elec., Insulating Matl's., Schenectady, N.Y.
General Elec. Co., Waterford, N.Y.
General Elec. Company, Providence, R.I.
Hardman Inc., Belleville, N.J.
Hightemp Resins, Inc., Stamford, Conn.
Hysol Div., Olean, N.Y.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Loctite Corp., Newington, Conn.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
Morgan Adhesives Co., Stow, Ohio
Packaged Resins Div., Watertown, Mass.
Pennsylvania Ind'l. Chem. Corp., Clairton, Pa.
Philadelphia Quartz Co., Phila., Pa.
Randolph Prods. Co., Carlstadt, N.J.
Schjeldahl, G.T. Co., Northfield, Minn.
Sterling, Sewickley, Pa.
SWS Silicones Div., Adrian, Mich.
Tapecon, Inc., Rochester, N.Y.
Tech Spray, Amarillo, Tex.
Techni-Tool, Inc., Philadelphia, Pa.
3M Co., St. Paul, Minn.
Tra-Con, Inc., Medford, Mass.
Uniroyal, Inc., New York, N.Y.
Vigor Co., New York, N.Y.
Wakefield Engrg., Inc., Components Div., Wakefield, Mass.
Waldom Elctrns., Inc., Chicago, Ill.
Whittaker Corp., Los Angeles, Cal.
Wire Cloth Enterprises, Inc., Pittsburgh, Pa.

Air Cleaners & Filters (Shielded & Unshielded)

Evans, George Corp., Moline, Ill. Vol 3•1045
Master Appliance Corp., Racine, Wisc. Vol 3•1241
Agnew-Higgins, Inc., Garden Grove, Calif.
Balston, Inc., Lexington, Mass
Cal-Metex Corp., Inglewood, Cal.
Carey Elctrn. Engrg. Co., Springfield, Ohio
Clean Room Prods., Farmingdale, N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Hollis Engrg., Inc., Nashua, N.H.
Honeywell, Mpls., Minn.
Johnson Corp., Three Rivers, Mich.
Lisk, G.W. Co., Clifton Springs, N.Y.
McLean Engrg. Labs., Princeton Jctn., N.J.
Metex Corp., Edison, N.J.
Midget Louver Co., Norwalk, Conn.
Pall Corp., Glen Cove, N.Y.
Pall Trinity Micro Corp., Cortland, N.Y.
Research Prods. Corp., Madison, Wisc
Torit Corp., St. Paul, Minn.
Union Carbide, Carbon Prods. Div., New York, N.Y.
Zero Mfg. Co., Burbank, Cal.

Air Conditioners (For Equipment)

Electro Impulse, Inc., Red Bank, N.J. Vol 3•1044
Eastern Industries, Hamden, Conn.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Inc., Fountain Valley, California
Standard Environmental Systems, Inc., Totowa, N.J.

Air Filtering & Ventilating Panels (Shielded & Unshielded)—See Air Cleaners & Filters

Alarms & Alarm Systems

Bird Elctrn., Cleveland, Ohio.... Vol 1•396
GRM Corp., Medford, N.J. ..... Vol 1•319
Harrel, Inc., E. Norwalk, Conn. Vol 2•1163
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 2•358
Projects Unlimited, Inc., Dayton, Ohio Vol 2•365
Re-el Circuits, Inc., Saddle Brook, N.J. Vol 1•320
Struthers-Dunn, Inc., Pitman, N.J. Vol 2•881
Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371
Acromag, Inc., Wixom, Mich.
Allied Elctrns., Chicago, Ill.
Alnor Instr. Co., Chicago, Ill.
American Instr. Co., Silver Spring, Md.
AMF Electical Prods., Alexandria, Va.
Amperex Electronic Corp., Hicksville, N.Y.
Applied Control Co., Fairfield, N.J.
Atlas Sound Div., Parsippany, N.J.
Autocon Inds., Inc., Minneapolis, Minn.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autronics Corp., Pasadena, Calif.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Cedar Grove, N.J.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Bogen Div., Paramus, N.J.
Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Brooks Instr. Div., Hatfield, Pa.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
CGS Units, Inc., Rochester, N.Y.
Chatham Controls Corp., Chatham, N.J.
Cognitronics Corp., Stamford, Conn.
Columbia Resch. Labs., Woodlyn, Pa.
Compuline Corp., Paoli, Pa.
Computer Labs, Greensboro, N.C.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Cordover, Carl & Co., Mineola, N.Y.
Cramer Division, Old Saybrook, Conn.
Datacom, Inc., Ft. Walton Bch., Fla.
Delco Elctrns. Div., Kokomo, Ind.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Dukane Corp., St. Charles, Ill.
Eastcraft Security Systems Corp., Melbourne, Fla.
Edison, Instr. Div., W. Orange, N.J.
EG&G, Inc., Bedford, Mass.
El Instruments, Derby, Conn.
Emergency Beacon Corp., New Rochelle, N. Y.
Engdahl Enterprises, Costa Mesa, Cal.
Erdco Engrg. Corp., Addison, Ill.
Esterline Angus Div., Indianapolis, Ind.
Fenwal, Inc., Ashland, Mass.
Foxboro Co., Foxboro, Mass.
GC Electronics, Rockford, Ill.
GTE Lenkurt Inc., San Carlos, Calif.
Guardian California, Culver City, Cal.
Hathaway Instruments, Inc., Denver, Colo.
Heath Co., Benton Harbor, Mich.
Henschel Corp., Amesbury, Mass.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Integrated Systems, Inc., Norcross, Ga.
Int'l. Instrs., Orange, Conn.
ITT Mackay Marine, Elizabeth, N.J.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Kidde, Walter & Co., Belleville, N.J.
Lear Siegler, Inc., Santa Monica, Calif.
Luft Instrs., Inc., Lincoln, Mass.
Mack Elec. Devices, Wyncote, Pa.
Mag-Con, Inc., New Brighton, Minn.
Melpar, Falls Church, Va.
Metra Instruments, Inc., Mt. View, Cal.
Metrix Instr. Co., Houston, Tex.
Micro Instr. Co., Hawthorne, Cal.
Mobil Elctrns., Inc., Anderson, Ind.
New Era Products, Cleveland, Ohio
Paraplegics Mfg., Bensenville, Ill.
Photobell Co., Inc., New York, N.Y.
Pioneer/Instrumentation, Cleveland, Ohio
Power Conversion Prods. Inc., Crystal Lake, Ill.
PPM, Inc., Bedford, Ohio
RCA Govt. & Comm. Sys., Moorestown, N.J.
Scientific Technology, Mountain View, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tapeswitch Corp. Amer., Farmingdale, N.Y.
Telectro Sys. Corp., Corona, N.Y.
Teledyne Geotech, Dallas, Tex.
Tempo Instrument, Inc., Plainview, N.Y.
Tenney Engrg., Inc., Union, N.J.
Theta Instr. Corp., Fairfield, N.J.
3M Co., St. Paul, Minn.
W.V. Industries Inc., Franklin Lakes, N.J.
Webster Elec. Co., Inc., Racine, Wisc.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Alarms, Controls, Photoelectric

Applied Control Co., Fairfield, N.J.
Innovation Industries Inc., Roswell, N.M.
Laser Sys. Corp., Ann Arbor, Mich.
Micro Switch, Freeport, Ill.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Scientific Technology, Mountain View, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
Spectronics, Inc., Richardson, Tex.
Tri-Tronics Co., Oak Brook, Ill.
Triac Elctrn. Sys., Forest Hills, N. Y.
W.V. Industries Inc., Franklin Lakes, N.J.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.

Alligator Clips—See Clips, Alligator

Alloys, Brazing

Alpha Metals, Inc., Jersey City, N.J.
Anaconda American Brass Co., Waterbury, Conn.
Anchor Alloys, Inc., Brooklyn, N.Y.
Cerac, Inc., Butler, Wisc.
Chemetron Corp., Chicago, Ill.
Goldsmith Precious Metals Div., Chicago, Ill.
GTE Sylvania, Inc., Towanda, Pa.
Gte Sylvania Inc., Belmont, Cal.
Handy & Harman, New York, N.Y.
Kawecki Berylco Inds., Inc., New York, N.Y.
Westinghouse Elec., Sykesville, Md.

Alloys, Metal - Ceramic

Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y..... Vol 3•1018
Alpha Metals, Inc., Jersey City, N.J.
Anchor Alloys, Inc., Brooklyn, N.Y.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Centralab Elctrns Div., Milwaukee, Wisc
Cerac, Inc., Butler, Wisc.
Colt Industries, Elizabethtown, Ky.
Gardiner Solder Co., Chicago, Ill.
GTE Sylvania, Inc., Towanda, Pa.
GTE Sylvania Inc., Newark, N.J.
Gulton Inds., Newport Bch., Cal.
Kawecki Berylco Inds., Inc., New York, N.Y.
Leico Inds., Inc., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
National Beryllia Corp., Haskell, N.J.
NL Inds., Inc., Metal Div., New York, N.Y.
Perfection Mica Co., Bensenville, Ill.
Philips Elmet Corp., Lewiston, Me.
Reynolds Metals Co., Richmond, Va.
Union Carbide, San Diego, Cal.
United Mineral & Chem. Corp., New York, N.Y.

Alloys, Metal-To-Glass Sealing—See Seals, Glass-To-Metal

Alphanumeric Keyboards—See Keyboards, Alphanumeric & Decimal

Alphanumeric Readout Tubes—See Tubes, Readout

Alphanumeric Readouts—See Readouts As Modified

Alternators

Eastern Air Devices, Inc., Dover, N.H. Vol 2•640
Georator Corporation, Manassas, Va. Vol 1•690

Aluminizers, Vacuum—See Deposition Equip.; Evaporation Equip.

Ammeters—See Meters, Ampere

Amplifiers, A-F (Excluding Hi-Fi)

CML-Macarr, Inc., Edison, N.J. Vol 1•644
Crown Int'l., Elkhart, Ind. ..... Vol 1•309
Ithaco, Inc., Ithaca, N.Y. ..... Vol 2•317
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Solitron Devices, San Diego, Cal. Vol 2•943
Solitron Devices, Inc., Riviera Bch., Fla. Vol 2•943
Solitron Devices, Inc., Tappan, N.Y. Vol 2•943
ADC Prods., Minneapolis, Minn.
Advanced Dynamic Instrs. Div., Alexandria, Va.
Allison Labs., Inc., Austin, Tex.
Altec Div., Anaheim, Calif.

American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
Arvee Engrg. Co., Torrance, Calif.
Arvin Sys., Inc., Dayton, Ohio
B & K Instrs., Inc., Cleveland, Ohio
Barker & Williamson, Inc., Bristol, Pa.
Bay Labs., Inc., Cleveland, Ohio
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Cedar Grove, N.J.
Bell P/A Prods. Corp., Columbus, Ohio
Biocom, Inc., Culver City, Cal.
Bogen Div., Paramus, N.J.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C-COR Elctrns., State College, Pa.
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Communications Equip. Co., Indianapolis, Ind.
Control Technology Co., L.I.C., N.Y.
Davis J.W. & Co., Dallas, Texas
Digitech Data Inds., Inc., Ridgefield, Conn.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dukane Corp., St. Charles, Ill.
Dynaco, Inc., Philadelphia, Pa.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Ectron Corp., San Diego, Cal.
Edison Elctrns. Div., Manchester, N.H.
Edo Western Corp., Salt Lake City, Utah
Electro/Data, Inc., Garland, Tex.
Elctrn. Assocs., W. Long Branch, N.J.
Elgar Corp., San Diego, Cal.
Encom Prods. Co., Inc., Oxford, Pa.
Executone, Inc., Long Island City, N.Y.
Fairchild Sound Equip., Commack, N.Y.
Junction Modules, Inc., Irvine, Cal.
General Radio Co., Concord, Mass.
GRM Corp., Medford, N.J.
HGA Elctrns., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Hope Elctrns., Clifton, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Intronics, Inc., Newton, Mass.
ISC/Telephonics Div, Huntington, N.Y.
ITI Electronics, Inc., Clifton, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
Krohn-Hite, Cambridge, Mass.
Lear Siegler, Inc., Santa Monica, Calif.
Lithic Systems, Inc., Cupertino, Cal.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Midwest Audio Corp., Chicago, Ill.
Millen, James Mfg., Malden, Mass.
Mini-Circuits Lab., Brooklyn, N.Y.
Mini-Systems, Inc, North Attleboro, Mass.
Murata Corp. of America, Elmsford, N.Y.
Murata Mfg. Co. Ltd., Kyoto, Japan
Newcomb Audio Prods. Co., Sylmar, Calif.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Opamp Labs. Inc., Los Angeles, Cal.
Optimation, Inc., Chatsworth, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
Pulse Techniques, Inc., Teaneck, N.J.
Quan-Tech, Whippany, N.J.
Ratelco, Inc., Seattle, Wash.
RCA Corp., Camden, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Signetics. Corp., Sunnyvale, Calif.
Singer - Tele-Signal, Woodbury, N.Y.
Spectra Sonics, Ogden, Utah
Sprague Elec. Co., No. Adams, Mass.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tektronix, Inc., Beaverton, Ore.
Teledyne Philbrick, Dedham, Mass.
Telex Comm. Div., Minneapolis, Minn.
Trutone Elctrns., Inc., No. Hollywood, Cal.
Unholtz-Dickie Corp., Hamden, Conn.
University Sound, Anaheim, Cal.
Webster Elec. Co., Inc., Racine, Wisc.

Amplifiers, Antenna

Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
Aertech Inds., Sunnyvale, Calif.
AMF Electical Prods., Alexandria, Va.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Arvee Engrg. Co., Torrance, Calif.
BF Elctrns., Solana Beach, Calif.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
C-COR Elctrns., State College, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Comdel, Inc., Beverly, Mass.
Delta-Benco Ltd., Rexdale, Ont., Can.
Electro/Data, Inc., Garland, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Emergency Beacon Corp., New Rochelle, N. Y.
Environmental Communications Inc., Santa Ana, Cal.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
Kaman Sciences Corp., Colorado Springs, Colo.
Lorch Elctrns. Corp., Englewood, N.J.
Millen, James Mfg., Malden, Mass.
Mu-Del Elctrns., Silver Spring, Md.
Radiation Devices Co., Baltimore, Md.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sierra Sys., Mountain View, Cal.
Sitco Antennas, Portland, Ore.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Varian Assocs., Palo Alto, Cal.
Wide Band Engrg. Co., Phoenix, Ariz.

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Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal. ..... **Vol 2•310,311**
Ithaco, Inc., Ithaca, N.Y. ..... **Vol 2•317**
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Advanced Dynamic Instrs. Div., Alexandria, Va.
Bell & Howell Co., Pasadena, Calif.
Columbia Resch. Labs., Woodlyn, Pa.
Dytronics Co., Columbus, Ohio
Ectron Corp., San Diego, Cal.
Endevco, Pasadena, Calif.
Junction Modules, Inc., Irvine, Cal.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Harshaw Chem. Co., Cleveland, Ohio
Intech, Santa Clara, Cal.
Intronics, Inc., Newton, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Kistler Instr. Co., Redmond, Wash.
Metrix Instr. Co., Houston, Tex.
NH Research, Inc., Santa Ana, Calif.
PCB Piezotronics, Inc., Depew, N.Y.
Perry Amplifier, Brookline, Mass.
PPM, Inc., Bedford, Ohio
SSR Instrs. Co., Santa Monica, Cal.
Teledyne Philbrick, Dedham, Mass.
Vibration Instrs. Co., Anaheim, Cal.

Amplifiers, Compressor

Altec Div., Anaheim, Calif.
BF Elctrns., Solana Beach, Calif.
CBS Laboratories, Stamford, Conn.
Comdel, Inc., Beverly, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynascan Corp., Chicago, Ill.
Executone, Inc., Long Island City, N.Y.
Fairchild Sound Equip., Commack, N.Y.
General Radio Co., Concord, Mass.
GRM Corp., Medford, N.J.
Intech, Santa Clara, Cal.
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Lear Siegler, Inc., Santa Monica, Calif.
Lithic Systems, Inc., Cupertino, Cal.
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Scientific Columbus, Columbus, Ohio
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Signetics. Corp., Sunnyvale, Calif.
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Oeco Corp., Portland, Ore.
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Digitech Data Inds., Inc., Ridgefield, Conn.
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Lear Siegler, Inc., Santa Monica, Calif.
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Nuclear Resch. Corp., Southampton, Pa.
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RHG Elctrns. Lab., Deer Park, N.Y.
RIL Elctrns., Inc., Southampton, Pa.
Rohde & Schwarz Sls., Passaic, N.J.
Spectra Sonics, Ogden, Utah
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Tracor, Inc., Austin, Tex.
Vectron Labs., Inc., Norwalk, Conn.
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General Rand Corp., Edison, N.J.
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Hy-Cal Engrg., Santa Fe Springs, Cal.
Inservco, Inc., La Grange, Ohio
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Harshaw Chem. Co., Cleveland, Ohio
HyComp Inc., Maynard, Mass.
Hybrid Sys. Corp., Burlington, Mass.
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Ithaco, Inc., Ithaca, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
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Melcor Elctrns. Corp., Farmingdale, N.Y.
Mini-Systems, Inc, North Attleboro, Mass.
Scientific Measurements, Wilmette, Ill.
Sensor Corp., Scottsdale, Pa.
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Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Systron Donner Computer Systems Div., Concord, Cal.
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Collins Radio Co., Dallas, Tex.
Consolidated Ohmic Devices, Carle Pl., N.Y.
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Dana Labs., Inc., Irvine, Calif.
Dynamic Measurements Corp., Winchester, Ma.
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Fairchild Sound Equip., Commack, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Junction Modules, Inc., Irvine, Cal.
Glentek, Inc., Santa Monica, Calif.
Hope Elctrns., Clifton, N.J.
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Keithley Instrs., Inc., Cleveland, Ohio
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Melcor Elctrns. Corp., Farmingdale, N.Y.
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Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Junction Modules, Inc., Irvine, Cal.
Gould, Inc., Cleveland, Ohio
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Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
McKee-Pedersen Instrs., Danville, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Microphase Corp., Cos Cob, Conn.
Milletron, Inc., Pittsburgh, Pa.
Miteq Inc., Hauppauge, N.Y.
Pacific Meas., Inc., Palo Alto, Calif.
Perry Amplifier, Brookline, Mass.
Quan-Tech, Whippany, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
SSR Instrs. Co., Santa Monica, Cal.
Tektronix, Inc., Beaverton, Ore.
Teledyne Philbrick, Dedham, Mass.
Telonic Inds., Inc., Laguna Beach, Calif.
Texas Instruments, Dallas, Tex.
Thermo Sys., Inc., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.
Wiltron Co., Palo Alto, Calif.

Amplifiers, Magnetic

Acme Elec. Corp., Cuba, N.Y.
Acromag, Inc., Wixom, Mich.
ADC Prods., Minneapolis, Minn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Arnold Magnetics, Culver City, Cal.
Basler Elec. Co., Highland, Ill.
Bell Industries, Compton, Cal.
Biometrics Instrument Corp., Garland, Tex.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Collins Radio Co., Cedar Rapids, Iowa
Cross Electronics Inc., Warrendale, Pa.
Electro-Pacific, Inc., Goleta, Calif.
Electrocom Inds., So. Bend, Indiana
EWC, Inc., Kenilworth, N.J.
Freed Transformer Co., Bklyn., N.Y.
General Magnetics, Bloomfield, N.J.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
HGA Elctrns., Mt. Vernon, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
K.G.S. Elctrns., Pasadena, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
Mag-Con, Inc., New Brighton, Minn.
Magnetico, Inc., E. Northport, N.Y.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Oeco Corp., Portland, Ore.
Polyphase Instr. Co., Bridgeport, Pa.
Queensboro Transformer & Mach., College Pt., N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Square D Co., Park Ridge, Ill.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Telectro Sys. Corp., Corona, N.Y.
Telex Comm. Div., Minneapolis, Minn.
Torwico Elctrns., Inc., Lakewood, N.J.
Transmagnetics Inc., Farmingdale, N. Y.
Varian Assocs., Palo Alto, Cal.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Zaring Inds., Inc., Westfield, Ind.

Amplifiers, Master Antenna—

See Amplifiers, Distribution

Amplifiers, Microphone—

See Amplifiers A-F (Excluding Hi-Fi)

Amplifiers, Microwave

Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
Electro/Data, Inc., Garland, Tex. Vol 1•547
Environmental Communications Inc., Santa Ana, Cal. ..... Vol 2•611
Greenray Inds., Inc., Mechanicsburg, Pa. ..... Vol 2•613
MCL, Inc., La Grange, Ill. Vol 1•551-556,558-560,563,566
RHG Elctrns. Lab., Deer Park, N.Y. Vol 2•618
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal. ..... Vol 1•507
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TRW Semiconductors, Lawndale, Cal. Vol 2•946
Addington Labs., Inc., Sunnyvale, Cal.
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
American Elctrn. Labs., Inc., Lansdale, Pa.
Anzac Elctrns., Waltham, Mass.
Applied Microwave, Westwood, Mass.
Applied Research Inc., Port Washington, N.Y.
Avantek, Inc., Santa Clara, Cal.
C-COR Elctrns., State College, Pa.
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
E & M Laboratories, Inc., Westlake Village, Cal.
Energy Systems, Palo Alto, Cal.
GAF Corp., New York, N.Y.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Microwave Corp., Farmingdale, N.Y.
Hope Elctrns., Clifton, N.J.
HRB-Singer, Inc., State College, Pa.
KMC Semiconductor Corp., Long Valley, N.J.
Litton Inds., San Carlos, Calif.
LNR Communications, Inc., Farmingdale, N.Y.
Loral Elctrn. Sys., Bronx, N.Y.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Power Devices, Plainview, N. Y.
Microwave Semiconductor Corp., Somerset, N.J.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
OPtimax Inc., Colmar, Pa.
Polarad Elctrn. Instrs., Lake Success, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Elctrns. Comps., Harrison, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
Scientific Communications, Garland, Tex.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Technical Research & Mfg. Co., Manchester, N.H.
Teledyne Mec., Palo Alto, Cal.
Teledyne Micronetics, San Diego, Calif.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Varian, Solid State West Division, Palo Alto, Cal.
Vega Precision Labs., Vienna, Va.
Watkins Johnson Co., Palo Alto, Cal.
Wiltron Co., Palo Alto, Calif.

Amplifiers, Mixing

Environmental Communications Inc., Santa Ana, Cal. ..... Vol 2•611
Re-el Circuits, Inc., Saddle Brook, N.J. Vol 1•320
Aertech Inds., Sunnyvale, Calif.
Altec Div., Anaheim, Calif.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Bell & Howell Co., Pasadena, Calif.
Communications Equip. Co., Indianapolis, Ind.
Conic Corp., San Diego, Calif.
Conrac Corp., Cedar Rapids, Iowa
Data-Control Systems, Danbury, Conn.
Executone, Inc., Long Island City, N.Y.
Fairchild Sound Equip., Commack, N.Y.
General Devices, Inc., Princeton, N.J.
Harshaw Chem. Co., Cleveland, Ohio
HGA Elctrns., Mt. Vernon, N.Y.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Newcomb Audio Prods. Co., Sylmar, Calif.
OPtimax Inc., Colmar, Pa.
Pulse Techniques, Inc., Teaneck, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Spectra Sonics, Ogden, Utah
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.

Amplifiers, Narrow-Band

Aertech Inds., Sunnyvale, Calif.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C-COR Elctrns., State College, Pa.
CML-Macarr, Inc., Edison, N.J.
Dana Labs., Inc., Irvine, Calif.
Dynalab Corp., Van Nuys, Cal.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
E & M Laboratories, Inc., Westlake Village, Cal.
Environmental Communications Inc., Santa Ana, Cal.
General Devices, Inc., Princeton, N.J.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
Ithaco, Inc., Ithaca, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Lorch Elctrns. Corp., Englewood, N.J.
Microwave Power Devices, Plainview, N. Y.
Microwave Semiconductor Corp., Somerset, N.J.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Neff Instr. Corp., Duarte, Calif.
OPtimax Inc., Colmar, Pa.
Perry Amplifier, Brookline, Mass.
Princeton Applied Resch. Corp., Princeton, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Special Microwave Devices Oper., Waltham, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Zeltex, Inc., Concord, Calif.

Amplifiers, Null

Preston Scientific, Anaheim, Cal. Vol 2•320,321
Acromag, Inc., Wixom, Mich.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Control Technology Co., L.I.C., N.Y.
General Radio Co., Concord, Mass.
Glentek, Inc., Santa Monica, Calif.
Honeywell, Ft. Washington, Pa.
Ind'l. Control Co., Farmingdale, N.Y.
Intronics, Inc., Newton, Mass.
Jordan Controls, Milwaukee, Wisc.
Keithley Instrs., Inc., Cleveland, Ohio
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Measurements, Wilmette, Ill.
Solid State Elctrns. Corp., Sepulveda, Cal.
Theta Instr. Corp., Fairfield, N.J.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Amplifiers, Operational

Burr-Brown Resch. Corp., Tucson, Ariz. Vol 2•308
ILC Data Device Corp., Hicksville, N.Y. Vol 2•315
Intronics, Inc., Newton, Mass. Vol 2•316
Mini-Systems, Inc, North Attleboro, Mass. ..... Vol 3•1147
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Torque Systems, Waltham, Mass. Vol 2•322
Analogic, Wakefield, Mass.
Bell & Howell, Bridgeport, Conn.

Bell & Howell Co., Pasadena, Calif.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Computer Labs, Greensboro, N.C.
Datel Systems Inc., Canton, Mass.
Digital Equip. Corp., Maynard, Mass.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Junction Modules, Inc., Irvine, Cal.
General Computers, Inc., Los Angeles, Calif.
Glentek, Inc., Santa Monica, Calif.
Gould, Inc., Cleveland, Ohio
GPS Corp., Framingham, Mass.
Halex, Inc., Torrance, Cal.
Heath Co., Benton Harbor, Mich.
Hybrid Sys. Corp., Burlington, Mass.
Ind'l. Test Equip., Clifton, NJ
Intech, Santa Clara, Cal.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kepco, Inc., Flushing, N.Y.
Kinetic Tech., Inc., Santa Clara, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
McFadden Elctrns. Co., South Gate, Calif.
McKee-Pedersen Instrs., Danville, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Precision Monolithics Inc., Santa Clara, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
Radiation Devices Co., Baltimore, Md.
RCA Solid State Div., Somerville, N. J.
Scientific Measurements, Wilmette, Ill.
Signetics. Corp., Sunnyvale, Calif.
Singer Co., Little Falls, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
Sprague Elec. Co., No. Adams, Mass.
Systron Donner Computer Systems Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Teledyne Philbrick, Dedham, Mass.
Texas Instruments, Dallas, Tex.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zeltex, Inc., Concord, Calif.

Amplifiers, Parametric

Scientific Communications, Garland, Tex. ..... Vol 1•567
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Junction Modules, Inc., Irvine, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
LNR Communications, Inc., Farmingdale, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Teledyne Philbrick, Dedham, Mass.
TRG Prods., E. Boston, Mass.
Watkins Johnson Co., Palo Alto, Cal.

Amplifiers, Peak-Limiting

Burr-Brown Resch. Corp., Tucson, Ariz.
CBS Laboratories, Stamford, Conn.
Dynamic Measurements Corp., Winchester, Ma.
Environmental Communications Inc., Santa Ana, Cal.
Hybrid Sys. Corp., Burlington, Mass.
Intech, Santa Clara, Cal.
Lear Siegler, Inc., Santa Monica, Calif.
Miteq Inc., Hauppauge, N.Y.
RCA Corp., Camden, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Amplifiers, Phase-Lock Loop

Clarke - Hess, New York, N.Y.
Elctrn. Assocs., W. Long Branch, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
Lithic Systems, Inc., Cupertino, Cal.
Scientific Technology, Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Varian, Beverly, Mass.
Vibration Instrs. Co., Anaheim, Cal.

Amplifiers, Photocell—See Amplifiers, Transducer

Amplifiers, Power (Excluding Hi-Fi)

American Vector Inc., Springfield, N.J. Vol 1•926
Beckman Instrs., Helipot Div., Fullerton, Cal. ..... Vol 2•588
CML-Macarr, Inc., Edison, N.J. Vol 1•641,642,644
Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
Crown Int'l., Elkhart, Ind. ..... Vol 1•309
Dynalab Corp., Van Nuys, Cal. Vol 2•312
Elctrn. Navigation Inds., Inc., Rochester, N.Y. ..... Vol 2•314
Instrs. For Ind., Inc., Farmingdale, N.Y. Vol 1•461
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Solitron Devices, Inc., Riviera Bch., Fla. Vol 2•943
Solitron Devices, Inc., Tappan, N.Y. Vol 2•943
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Aerospace Avionics, Inc., Bohemia, N.Y.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
Allis, Louis Div., Milwaukee, Wisc.
Altec Div., Anaheim, Calif.
American Elctrn. Labs., Inc., Lansdale, Pa.
Anzac Elctrns., Waltham, Mass.
Applied Control Co., Fairfield, N.J.
Applied Microwave, Westwood, Mass.
Applied Research Inc., Port Washington, N.Y.
Arnold Magnetics, Culver City, Cal.
Arvee Engrg. Co., Torrance, Calif.
Avantek, Inc., Santa Clara, Cal.
Behlman Div., California Instrs., San Diego, Cal
Bell & Howell Co., Pasadena, Calif.
Bell P/A Prods. Corp., Columbus, Ohio
Bogen Div., Paramus, N.J.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
C-COR Elctrns., State College, Pa.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Clarke - Hess, New York, N.Y.
Collins Radio Co., Dallas, Tex.
Constant Voltage Co., Chicago, Ill.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Control Technology Co., L.I.C., N.Y.
Datron Systems, Chatsworth, Cal.
Dukane Corp., St. Charles, Ill.
Dynaco, Inc., Philadelphia, Pa.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Edo Western Corp., Salt Lake City, Utah
Eimac, San Carlos, Calif.
Elctrn. Assocs., W. Long Branch, N.J.
Elgar Corp., San Diego, Cal.
Elin Div., San Diego, Cal.
Energy Systems, Palo Alto, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Fairchild Sound Equip., Commack, N.Y.
General Radio Co., Concord, Mass.
Glentek, Inc., Santa Monica, Calif.
Gotham Audio Corp., New York, N.Y.
Halmar Elctrns., Inc., Columbus, Ohio
Henry Prods. Co., Inc., Inwood, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Honeywell, Ft. Washington, Pa.
Hope Elctrns., Clifton, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
Intech, Santa Clara, Cal.
Kepco, Inc., Flushing, N.Y.
Kistler Instr. Co., Redmond, Wash.
Krohn-Hite, Cambridge, Mass.
Lear Siegler, Inc., Santa Monica, Calif.
Lithic Systems, Inc., Cupertino, Cal.
Lorch Elctrns. Corp., Englewood, N.J.
McFadden Elctrns. Co., South Gate, Calif.
McKee-Pedersen Instrs., Danville, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Melpar, Falls Church, Va.
Microwave Power Devices, Plainview, N.Y.
Millen, James Mfg., Malden, Mass.
Mini-Circuits Lab., Brooklyn, N.Y.
Miteq Inc., Hauppauge, N.Y.
MPC Prods. Corp., Chicago, Ill.
Mu-Del Elctrns., Silver Spring, Md.
Newcomb Audio Prods. Co., Sylmar, Calif.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
OPtimax Inc., Colmar, Pa.
Paraplegics Mfg., Bensenville, Ill.
Perry Amplifier, Brookline, Mass.
RCA Corp., Camden, N.J.
RCA Solid State Div., Somerville, N. J.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Robicon Corp., Pittsburgh, Pa.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Solar Elctrns. Co., Hollywood, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectra Sonics, Ogden, Utah
Sprague Elec. Co., No. Adams, Mass.
SRC Div., Newport Bch., Cal.
Telex Comm. Div., Minneapolis, Minn.
Trutone Elctrns., Inc., No. Hollywood, Cal.
Unholtz-Dickie Corp., Hamden, Conn.
Varian Assocs., Palo Alto, Cal.
Vectrol, Inc., Rockville, Md.
Webster Elec. Co., Inc., Racine, Wisc.
Zonic Tech. Labs., Cincinnati, Ohio

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Amplifiers, Pulse

Elctrn. Navigation Inds., Inc., Rochester, N.Y. ..... Vol 2•314
MCL, Inc., La Grange, Ill. Vol 1•551,560,566
Advanced Kinetics, Costa Mesa, Calif.
Aertech Inds., Sunnyvale, Calif.
American Elctrn. Labs., Inc., Lansdale, Pa.
AMF Electical Prods., Alexandria, Va.
Applied Microwave, Westwood, Mass.
Applied Research Inc., Port Washington, N.Y.
Arvee Engrg. Co., Torrance, Calif.
Avantek, Inc., Santa Clara, Cal.
Bell & Howell Co., Pasadena, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
C-COR Elctrns., State College, Pa.
Chronetics, Inc., Mt. Vernon, N.Y.
CML-Macarr, Inc., Edison, N.J.
Cober Elctrns., Inc., Stamford, Conn.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Dynamic Measurements Corp., Winchester, Ma.
Energy Systems, Palo Alto, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Hamamatsu Corp. (E), Middlesex, N. J.
Harshaw Chem. Co., Cleveland, Ohio
Hope Elctrns., Clifton, N.J.
Infodex, Inc., Waterbury, Conn.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Intronics, Inc., Newton, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Lasermetrics, Inc., Rochelle Park, N.J.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Litton Inds., San Carlos, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Microwave Power Devices, Plainview, N.Y.
Milletron, Inc., Pittsburgh, Pa.
Nuclear Data, Palatine, Ill.
Nuclear Resch. Corp., Southampton, Pa.
Optimation, Inc., Chatsworth, Cal.
Perry Amplifier, Brookline, Mass.
RHG Elctrns. Lab., Deer Park, N.Y.
RIL Elctrns., Inc., Southampton, Pa.
Scientific Measurements, Wilmette, Ill.
Sensor Corp., Scottsdale, Pa.
Signetics. Corp., Sunnyvale, Calif.
Solid State Elctrns. Corp., Sepulveda, Cal.
SRC Div., Newport Bch., Cal.
SSR Instrs. Co., Santa Monica, Cal.
United Detector Technology Inc., Santa Monica, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Vega Precision Labs., Vienna, Va.
Velonex, Santa Clara, Calif.

Amplifiers, Pulse-Limiting

Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
CML-Macarr, Inc., Edison, N.J.
Cober Elctrns., Inc., Stamford, Conn.
Environmental Communications Inc., Santa Ana, Cal.
Microwave Assocs., Inc., Burlington, Mass.
RHG Elctrns. Lab., Deer Park, N.Y.
Sierra Sys., Mountain View, Cal.

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TRW Semiconductors, Lawndale, Cal. Vol 2•947-949
Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
Advanced Energy Conversion, Belmont, Cal.
Advanced Kinetics, Costa Mesa, Calif.
AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
American Elctrn. Labs., Inc., Lansdale, Pa.
AMF Electical Prods., Alexandria, Va.
Amperex Electronic Corp., Hicksville, N.Y.
Anzac Elctrns., Waltham, Mass.
Applied Microwave, Westwood, Mass.
Arvee Engrg. Co., Torrance, Calif.
Arvin Sys., Inc., Dayton, Ohio
Avantek, Inc., Santa Clara, Cal.
Barker & Williamson, Inc., Bristol, Pa.
BF Elctrns., Solana Beach, Calif.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
C-COR Elctrns., State College, Pa.
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
CML-Macarr, Inc., Edison, N.J.
Collins Radio Co., Dallas, Tex.
Comdel, Inc., Beverly, Mass.
Conic Corp., San Diego, Calif.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Dynamic Measurements Corp., Winchester, Ma.
E & M Laboratories, Inc., Westlake Village, Cal.
Eimac, San Carlos, Calif.
Elcom Sys., Deer Pk., N.Y.
Elctrn. Comm., Inc., St. Petersburg, Fla.

Electronic Research Co., Shawnee Mission, Kan.
Emergency Beacon Corp., New Rochelle, N. Y.
Energy Systems, Palo Alto, Cal.
Farinon Electric, San Carlos, Calif.
Heath Co., Benton Harbor, Mich.
Henry Prods. Co., Inc., Inwood, N.Y.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
Johnson E. F. Co., Waseca, Minn.
Kay Elemetrics, Pine Brook, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
KMC Semiconductor Corp., Long Valley, N.J.
Krohn-Hite, Cambridge, Mass.
Lithic Systems, Inc., Cupertino, Cal.
Litton Inds., San Carlos, Calif.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Power Devices, Plainview, N. Y.
Microwave Semiconductor Corp., Somerset, N.J.
Millen, James Mfg., Malden, Mass.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
OPtimax Inc., Colmar, Pa.
Pace Div., Harbor City, Calif.
Perry Amplifier, Brookline, Mass.
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
Radio Resch. Co., Rockaway, N.J.
RCA Solid State Div., Somerville, N. J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Sinclair Radio Labs., Maple, Ont., Can.
Solid State Elctrns. Corp., Sepulveda, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Technical Mat'l., Mamaroneck, N.Y.
Teledyne Mec., Palo Alto, Cal.
Trak Microwave, Tampa, Fla.
TRW Elctrnc. Functions, Candem, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Varian, Beverly, Mass.
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.
Wide Band Engrg. Co., Phoenix, Ariz.
Wiltron Co., Palo Alto, Calif.
Winegard Co., Burlington, Iowa

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Burr-Brown Resch. Corp., Tucson, Ariz. Vol 1•328
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Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa. ..Vol 1•353
Preston Scientific, Anaheim, Cal. Vol 1•369; Vol 2•320,321
American Elctrn. Labs., Inc., Lansdale, Pa.
Analogic, Wakefield, Mass.
Astrosystems, Inc., Lake Success, N.Y.
Bell & Howell, Bridgeport, Conn.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Chronetics, Inc., Mt. Vernon, N.Y.
Circuit Technology, Farmingdale, N.Y.
Clarke - Hess, New York, N.Y.
Computer Conversions Corp., East Northport, N.Y.
Computer Prods., Ft. Lauderdale, Fla.
Datum, Inc., Anaheim, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
E-H Resch. Labs., Inc., Oakland, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Emergency Beacon Corp., New Rochelle, N. Y.
Junction Modules, Inc., Irvine, Cal.
General Microwave Corp., Farmingdale, N.Y.
GPS Corp., Framingham, Mass.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Hybrid Sys. Corp., Burlington, Mass.
Intronics, Inc., Newton, Mass.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Phoenix Data Inc., Phoenix, Ariz.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Teledyne Philbrick, Dedham, Mass.
Transmagnetics Inc., Farmingdale, N. Y.
Varian, Beverly, Mass.
Xerox Data Sys., El Segundo, Cal
Zeltex, Inc., Concord, Calif.

Amplifiers, Servo

Arnold Magnetics, Culver City, Cal. Vol 1•601
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y. Vol 2•984,985
Control Technology Co., L.I.C., N.Y. Vol 2•986
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Torque Systems, Waltham, Mass. Vol 2•322,991
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Advance Instr. Corp., Belmar, N. J.
American Elctrns., Inc., Fullerton, Cal.
American Time Products, Woodside, N.Y.
Applied Control Co., Fairfield, N.J.
A.R.F. Products, Inc., Boulder, Colo.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Bell & Howell Co., Pasadena, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Circuit Technology, Farmingdale, N.Y.
Clifton Precision, Clifton Hgts., Pa.
Collins Radio Co., Dallas, Tex.
Crown Int'l., Elkhart, Ind.
Datron Systems, Chatsworth, Cal.
Datum, Inc., Anaheim, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Electro-Craft Corp, Hopkins, Minn
Elctrn. Assocs., W. Long Branch, N.J.
Esterline Angus Div., Indianapolis, Ind.
Farrand Controls, Inc., Valhalla, N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
Glentek, Inc., Santa Monica, Calif.
Gould, Inc., Cleveland, Ohio
Henschel Corp., Amesbury, Mass.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Innovatek Enterprise, Millerton, N.Y.
Intech, Santa Clara, Cal.
Ithaco, Inc., Ithaca, N.Y.
Jordan Controls, Milwaukee, Wisc.
Kelk, George Ltd., Don Mills, Ont., Canada
Kepco, Inc., Flushing, N.Y.
Kistler Instr. Co., Redmond, Wash.
Lear Siegler, Inc., Santa Monica, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
Linear Instrs. Corp., Costa Mesa, Cal.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Magnetico, Inc., E. Northport, N.Y.
McFadden Elctrns. Co., South Gate, Calif.
McKee-Pedersen Instrs., Danville, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Midland Standard Inc., Elgin, Ill.
Mini-Systems, Inc, North Attleboro, Mass.
MPC Prods. Corp., Chicago, Ill.
NH Research, Inc., Santa Ana, Calif.
Oeco Corp., Portland, Ore.
Opamp Labs. Inc., Los Angeles, Cal.
Orbit Instr. Corp., Syosset, N.Y.
RCA Solid State Div., Somerville, N. J.
Robicon Corp., Pittsburgh, Pa.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Co., Little Falls, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Taylor Instr. Process Control Div., Rochester, N.Y.
Transicoil, Inc., Worcester, Pa.
Westamp, Inc., Santa Monica, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zonic Tech. Labs., Cincinnati, Ohio

Amplifiers, Single-Sideband

Elctrn. Navigation Inds., Inc., Rochester, N.Y. ..... Vol 2•314
Barker & Williamson, Inc., Bristol, Pa.
BF Elctrns., Solana Beach, Calif.
CCA Elctrns. Corp., Gloucester, N.J.
Comdel, Inc., Beverly, Mass.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Eimac, San Carlos, Calif.
Heath Co., Benton Harbor, Mich.
ITT Mackay Marine, Elizabeth, N.J.
Lithic Systems, Inc., Cupertino, Cal.
Marconi Elctrns. Inc., Elmsford, N.Y.
Microwave Power Devices, Plainview, N. Y.
Resdel Engrg. Corp., Arcadia, Cal.
Technical Mat'l., Mamaroneck, N.Y.

Amplifiers, Standing Wave

Bay Labs., Inc., Cleveland, Ohio
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Soltec Corp., No. Hollywood, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

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Amplifiers, Sweep

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C-COR Elctrns., State College, Pa.
Gould Data Systems, Newton Upper Falls, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Intech, Santa Clara, Cal.
Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Microwave Power Devices, Plainview, N. Y.
Millen, James Mfg., Malden, Mass.
Syntronic Instrs., Inc., Addison, Ill.
Wide Band Engrg. Co., Phoenix, Ariz.

Amplifiers, Synchro

Astrosystems, Inc., Lake Success, N.Y. Vol 1•327
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Transmagnetics Inc., Farmingdale, N. Y. Vol 1•379
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C & A Products, Inc., Woodside, N. Y.
Chesapeake Instr. Corp., Shadyside, Md.
Clifton Precision, Clifton Hgts., Pa.
Control Technology Co., L.I.C., N.Y.
Farrand Controls, Inc., Valhalla, N.Y.
Glentek, Inc., Santa Monica, Calif.
ILC Data Device Corp., Hicksville, N.Y.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Oeco Corp., Portland, Ore.
RCA Solid State Div., Somerville, N. J.
Republic Advanced System Technology Group, Chatsworth, Calif.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Co., Little Falls, N.J.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Transicoil, Inc., Worcester, Pa.
Vernitech, Deer Pk., N.Y.

Amplifiers, Telemetering

Scientific Communications, Garland, Tex. ..... Vol 1•567
Acromag, Inc., Wixom, Mich.
Aertech Inds., Sunnyvale, Calif.
Alltech, City of Industry, Cal.
Analogic, Wakefield, Mass.
Applied Research Inc., Port Washington, N.Y.
Astrosystems, Inc., Lake Success, N.Y.
Avantek, Inc., Santa Clara, Cal.
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
C-COR Elctrns., State College, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Conic Corp., San Diego, Calif.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Control Technology Co., L.I.C., N.Y.
Dana Labs., Inc., Irvine, Calif.
Data-Control Systems, Danbury, Conn.
Dynalab Corp., Van Nuys, Cal.
Electronic Research Co., Shawnee Mission, Kan.
Fogg System Co., Denver, Col.
General Devices, Inc., Princeton, N.J.
Gould, Inc., Cleveland, Ohio
Gulton Inds., Inc., Metuchen, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Intronics, Inc., Newton, Mass.
Lithic Systems, Inc., Cupertino, Cal.
MCL, Inc., La Grange, Ill.
Microwave Power Devices, Plainview, N. Y.
Microwave Semiconductor Corp., Somerset, N.J.
Neff Instr. Corp., Duarte, Calif.
OPtimax Inc., Colmar, Pa.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rosemount Inc., Minneapolis, Minn.
Solid State Elctrns. Corp., Sepulveda, Cal.
Soltec Corp., No. Hollywood, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Geotech, Dallas, Tex.
Transmagnetics Inc., Farmingdale, N. Y.
Varian Assocs., Palo Alto, Cal.
Vega Precision Labs., Vienna, Va.
Watkins Johnson Co., Palo Alto, Cal.

Amplifiers, Thermocouple—See Amplifiers/Transducer

Amplifiers, Thyratron

Cober Elctrns., Inc., Stamford, Conn.
Coil Co. of Amer., Northvale, N.J.
Varian Assocs., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

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Ectron Corp., San Diego, Cal... Vol 2•313
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Ithaco, Inc., Ithaca, N.Y. ..... Vol 2•317
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Active Control Instrumentation, E. Northport, NY
Advanced Kinetics, Costa Mesa, Calif.
AMF Electical Prods., Alexandria, Va.
Analogic, Wakefield, Mass.
Arvee Engrg. Co., Torrance, Calif.
Astrosystems, Inc., Lake Success, N.Y.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Bailey Instrs., Inc., Saddle Brook, N.J.
Bell & Howell, Bridgeport, Conn.
Bell & Howell Co., Pasadena, Calif.
Burr-Brown Resch. Corp., Tucson, Ariz.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Circuit Technology, Farmingdale, N.Y.
CML-Macarr, Inc., Edison, N.J.
Coil Co. of Amer., Northvale, N.J.
Columbia Resch. Labs., Woodlyn, Pa.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Control Technology Co., L.I.C., N.Y.
Crown Int'l., Elkhart, Ind.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Datametrics Inc., Wilmington, Mass.
Datum, Inc., Anaheim, Calif.
Davidson Elctrn. Dev. Co., Erie, Pa.
Digiac Corp., Plainview, N.Y.

Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Dytronics Co., Columbus, Ohio
Electronic Modules, Inc., Pasadena, Cal.
Endevco, Pasadena, Calif.
Fogg System Co., Denver, Col.
Junction Modules, Inc., Irvine, Cal.
General Radio Co., Concord, Mass.
Geo Space, Houston, Tex.
Gould, Inc., Cleveland, Ohio
Hawkeye Instrus., Inc., Marion, Iowa
Himmelstein, S. & Co., Elk Grove Village, Ill.
Honeywell, Denver, Colo.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Inservco, Inc., La Grange, Ohio
Intech, Santa Clara, Cal.
Intronics, Inc., Newton, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Kelk, George Ltd., Don Mills, Ont., Canada
Kistler Instr. Co., Redmond, Wash.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Metrix Instr. Co., Houston, Tex.
Midland Standard Inc., Elgin, Ill.
Mini-Systems, Inc, North Attleboro, Mass.
Minnetech Labs, Minneapolis, Minn.
Neff Instr. Corp., Duarte, Calif.
Newport Labs., Inc., Santa Ana, Cal.
Opamp Labs. Inc., Los Angeles, Cal.
PCB Piezotronics, Inc., Depew, N.Y.
Perry Amplifier, Brookline, Mass.
Power Instrs., Skokie, Ill.
PPM, Inc., Bedford, Ohio
Schaevitz Engrg., Pennsauken, N.J.
Sensor Technology, Chatsworth, Cal.
Sensotec, Inc., Columbus, Ohio
Skan-A-Matic Corp., Elbridge, N. Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
SRC Div., Newport Bch., Cal.
Standard Controls, Seattle, Wash.
Statham Instrs., Inc., Oxnard, Cal.
Stow Labs., Inc., Hudson, Mass.
Tektronix, Inc., Beaverton, Ore.
Telex Comm. Div., Minneapolis, Minn.
Telmar, Inc., Columbus, Ohio
Transducers, Inc., Whittier, Ca.
Tri-Tronics Co., Oak Brook, Ill.
United Detector Technology Inc., Santa Monica, Cal.
Validyne Engrg. Corp., Northridge, Cal.
W-F Products, Inc., Denver, Co.
West Coast Resch. Corp., Los Angeles, Calif.
Zeltex, Inc., Concord, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

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Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
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Collins Radio Co., Dallas, Tex.
Energy Systems, Palo Alto, Cal.
Intech, Santa Clara, Cal.
Litton Inds., San Carlos, Calif.
Microwave Assocs., Inc., Burlington, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Sperry Elctrn. Tube, Gainesville, Fla.
Teledyne Mec., Palo Alto, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.

Amplifiers, Tunnel Diode

Aertech Inds., Sunnyvale, Calif.
Miteq Inc., Hauppauge, N.Y.
RCA Elctrns. Comps., Harrison, N.J.

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CML-Macarr, Inc., Edison, N.J. Vol 1•644
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AMF Electical Prods., Alexandria, Va.
Arvee Engrg. Co., Torrance, Calif.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Dukane Corp., St. Charles, Ill.
Intronics, Inc., Newton, Mass.
James Elctrns., Inc., Chicago, Ill.
Krohn-Hite, Cambridge, Mass.
NUSonics, Inc., Paramus, N.J.
Panametrics Inc., Waltham, Mass.
Perry Amplifier, Brookline, Mass.
Quan-Tech, Whippany, N.J.
Signetics. Corp., Sunnyvale, Calif.
Uthe Technology Int'l., Sunnyvale, Cal.
Westinghouse Elec., Sykesville, Md.

Amplifiers, Vibration Pickup—

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Advanced Kinetics, Costa Mesa, Calif.
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AMF Electical Prods., Alexandria, Va.
Arvee Engrg. Co., Torrance, Calif.
Avantek, Inc., Santa Clara, Cal.
Ballantine Laboratories, Inc., Boonton,, N. J.
Bell & Howell, Bridgeport, Conn.
Burr-Brown Resch. Corp., Tucson, Ariz.
C-COR Elctrns., State College, Pa.
CBS Laboratories, Stamford, Conn.
CELCO, Mahwah, N.J.
Clarke - Hess, New York, N.Y.
Collins Radio Co., Dallas, Tex.
Concord Communications Sys., Farmingdale, N.Y.
Dynair Elctrns. Inc., San Diego, Calif.
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Electronic Research Co., Shawnee Mission, Kan.
Energy Systems, Palo Alto, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Gould Data Systems, Newton Upper Falls, Mass.
GRM Corp., Medford, N.J.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Infodex, Inc., Waterbury, Conn.
Intech, Santa Clara, Cal.
Intronics, Inc., Newton, Mass.
ITI Electronics, Inc., Clifton, N.J.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
Kay Elemetrics, Pine Brook, N.J.
Krohn-Hite, Cambridge, Mass.
Lasermetrics, Inc., Rochelle Park, N.J.
Lear Siegler, Inc., Santa Monica, Calif.
Loral Elctrn. Sys., Bronx, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Microphase Corp., Cos Cob, Conn.
Miteq Inc., Hauppauge, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Perry Amplifier, Brookline, Mass.
Radio Resch. Co., Rockaway, N.J.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
RIL Elctrns., Inc., Southampton, Pa.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Communications, Garland, Tex.
Shigoto Inds., Ltd., New York, N.Y.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Solid State Elctrns. Corp., Sepulveda, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
United Detector Technology Inc., Santa Monica, Cal.
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Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.

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Connor-Winfield Corp., West Chicago, Ill.
Datum, Inc., Anaheim, Calif.
Dickson Elctrns. Corp., Scottsdale, Ariz
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Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Glentek, Inc., Santa Monica, Calif.
Holt Instr. Labs., Oconto, Wisc.
Honeywell, Denver, Colo.
Ind'l. Test Equip., Clifton, NJ
Intech, Santa Clara, Cal.
Intronics, Inc., Newton, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Kepco, Inc., Flushing, N.Y.
Mini-Systems, Inc, North Attleboro, Mass.
Neff Instr. Corp., Duarte, Calif.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimation, Inc., Chatsworth, Cal.
Signetics. Corp., Sunnyvale, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zeltex, Inc., Concord, Calif.

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American Vector Inc., Springfield, N.J. Vol 1•926
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Advanced Kinetics, Costa Mesa, Calif.
Aertech Inds., Sunnyvale, Calif.
American Elctrn. Labs., Inc., Lansdale, Pa.
AMF Electical Prods., Alexandria, Va.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Arvee Engrg. Co., Torrance, Calif.
Arvin Sys., Inc., Dayton, Ohio
Avantek, Inc., Santa Clara, Cal.
Baganoff Assocs., Inc., St. Louis, Mo.
Ballantine Laboratories, Inc., Boonton,, N. J.
Bay Labs., Inc., Cleveland, Ohio
Bell & Howell, Bridgeport, Conn.
Bell & Howell Co., Pasadena, Calif.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
C-COR Elctrns., State College, Pa.
CELCO, Mahwah, N.J.
Chronetics, Inc., Mt. Vernon, N.Y.
Clarke - Hess, New York, N.Y.
Collins Radio Co., Dallas, Tex.
Composite Microcircuits, Waltham, Mass.
Computer Labs, Greensboro, N.C.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Dana Labs., Inc., Irvine, Calif.
Data-Control Systems, Danbury, Conn.
Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Elcom Sys., Deer Pk., N.Y.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Energy Systems, Palo Alto, Cal.
Farinon Electric, San Carlos, Calif.
General Devices, Inc., Princeton, N.J.
General Radio Co., Concord, Mass.
GPS Corp., Framingham, Mass.
Halex, Inc., Torrance, Cal.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
HRB-Singer, Inc., State College, Pa.
Hybrid Sys. Corp., Burlington, Mass.
Ind'l. Test Equip., Clifton, NJ
Instrs. For Ind., Inc., Farmingdale, N.Y.
Intech, Santa Clara, Cal.
Intronics, Inc., Newton, Mass.
Ithaco, Inc., Ithaca, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Keithley Instrs., Inc., Cleveland, Ohio
Krohn-Hite, Cambridge, Mass.
Lasermetrics, Inc., Rochelle Park, N.J.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Lithic Systems, Inc., Cupertino, Cal.
Marconi Elctrns. Inc., Elmsford, N.Y.
MCL, Inc., La Grange, Ill.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Microwave Power Devices, Plainview, N. Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Newport Labs., Inc., Santa Ana, Cal.
Opamp Labs. Inc., Los Angeles, Cal.
Optimation, Inc., Chatsworth, Cal.
Perry Amplifier, Brookline, Mass.
Princeton Applied Resch. Corp., Princeton, N.J.
Quan-Tech, Whippany, N.J.
Radiation Devices Co., Baltimore, Md.
Radio Resch. Co., Rockaway, N.J.
Raytheon, Mt. View, Calif.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectra Sonics, Ogden, Utah
SSR Instrs. Co., Santa Monica, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Teledyne Geotech, Dallas, Tex.
Teledyne Philbrick, Dedham, Mass.
Theta-Com CATV, Phoenix, Ariz
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Wide Band Engrg. Co., Phoenix, Ariz.
Zeltex, Inc., Concord, Calif.

Analog-To-Digital Converters

—See Converters, Analog-To-Digital

Analyzers, A-F

Advanced Dynamic Instrs. Div., Alexandria, Va.
A. P. Circuit Corp., New York, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
Kay Elemetrics, Pine Brook, N.J.
Kinetic Tech., Inc., Santa Clara, Cal.
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Nelson Ross Elctrns., Lake Success, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Quan-Tech, Whippany, N.J.
Rockland Sys. Corp., W. Nyack, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Soltec Corp., No. Hollywood, Cal.

Spectral Dynamics Corp. San Diego, San Diego, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Tektronix, Inc., Beaverton, Ore.
Vibration Instrs. Co., Anaheim, Cal.
Voiceprint Laboratories Corp., Somerville, N. J.
Vu-data Corp., San Diego, Cal.
Wiltron Co., Palo Alto, Calif.

Analyzers, Antenna Pattern

Carco Elctrns., Menlo Park, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Vari-L Co., Inc., Denver, Colo.
Watkins Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Analyzers, Coincidence

Beckman Instrs., (AISSD), Fullerton, Cal.
Chronetics, Inc., Mt. Vernon, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
NES, Inc., Itasca, Ill.
Soltec Corp., No. Hollywood, Cal.
3M Co., St. Paul, Minn.

Analyzers, Differential—See Analyzers, Phase & Voltage

Analyzers, Dispersion—See Analyzers, Spectrum

Analyzers, Distortion—See Analyzers, A-F

Analyzers, Engine (Gas & Diesel)

Tektronix, Inc., Beaverton, Ore. Vol 1•513

Analyzers, Frequency—See Analyzers, Spectrum

Analyzers, Frequency Stability—See Meters, Frequency Deviation

Analyzers, Gas

Baganoff Assocs., Inc., St. Louis, Mo.
Barnes Engrg. Co., Stamford, Conn.
Datum, Inc., Anaheim, Calif.
Edwards High Vacuum, Grand Island, N.Y.
Gow-Mac Instr. Co., Madison, N.J.
High Voltage Engrg. Corp., Burlington, Mass.
Lion Precision Corp, Newton, Mass.
Taylor Instr. Process Control Div., Rochester, N.Y.
Uthe Technology Int'l., Sunnyvale, Cal.
Vacumetrics Inc., Waltham, Mass.
Whittaker Corp., Los Angeles, Cal.

Analyzers, Harmonic

A. P. Circuit Corp., New York, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Multimetric Industries, Richmond Hill, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Quan-Tech, Whippany, N.J.
Railway Comm., Raytown, Mo.
Rockland Sys. Corp., W. Nyack, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Vibration Instrs. Co., Anaheim, Cal.
Vu-data Corp., San Diego, Cal.
Weston Instruments, Inc., Newark, N.J.

Analyzers, Interference

Bowmar/ALI, Inc., Acton, Mass.
Federal Sci. Corp., New York, N.Y.
Honeywell, Denver, Colo.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Sprague Elec. Co., No. Adams, Mass.

Analyzers, Intermodulation

Crown Int'l., Elkhart, Ind. ..... Vol 1•309
Collins Radio Co., Cedar Rapids, Iowa
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Spectrum Instrs., Inc., New Rochelle, N.Y.

Analyzers, Magnetic

LDJ Electronics, Troy, Mich...... Vol 1•476
RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Electro-Mechanics Co., Austin, Tex.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Magnaflux Corp., Chicago, Ill.
Oeco Corp., Portland, Ore.
Ohio Semitronics, Columbus, Ohio
Systron-Donner Corp., Concord, Cal.
Thomas & Skinner, Inc., Indianapolis, Ind.
Varian Assocs., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Analyzers, Microwave

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Alford Mfg. Co., Winchester, Mass.
AUL Instrs., Inc., Flushng, N.Y.
Collins Radio Co., Dallas, Tex.
Del Electronics Corp., Mt. Vernon, N.Y.
Electro/Data, Inc., Garland, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Loral Elctrn. Sys., Bronx, N.Y.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rantec Div., Calabasas, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Systron Donner Trygon Elctrns. Sub., Westbury, N.Y.
Tektronix, Inc., Beaverton, Ore.
Tucker Electronics Co., Garland, Tex.
Vari-L Co., Inc., Denver, Colo.
Watkins Johnson Co., Palo Alto, Cal.
Wiltron Co., Palo Alto, Calif.

Analyzers, Noise

Elgenco, Inc., Santa Monica, Cal. Vol 1•436-441
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
A. P. Circuit Corp., New York, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Bearing Inspection, Santa Fe Springs, Cal.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Bowmar/ALI, Inc., Acton, Mass.
Chesterfield Prods. Inc., Saddle Brook, N. J.
Collins Radio Co., Dallas, Tex.
Columbia Resch. Labs., Woodlyn, Pa.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Honeywell, Denver, Colo.
Kay Elemetrics, Pine Brook, N.J.
Milletron, Inc., Pittsburgh, Pa.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Pulsar Instruments, Inc., Redwood City, Cal.
Quan-Tech, Whippany, N.J.
Rockland Sys. Corp., W. Nyack, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Tracor, Inc., Austin, Tex.
Triplett Corp., Bluffton, Ohio
Vibration Instrs. Co., Anaheim, Cal.

Analyzers, Phase & Voltage

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•427
Automated Meas., Oakland, Calif.
Baganoff Assocs., Inc., St. Louis, Mo.
Bowmar/ALI, Inc., Acton, Mass.
Dytronics Co., Columbus, Ohio
E-H Resch. Labs., Inc., Oakland, Cal.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
Feedback, Inc., Berkeley Hghts., N.J.
Frequency Engrg. Labs., Farmingdale, N.J.
Gould, Inc., Cleveland, Ohio
Ithaco, Inc., Ithaca, N.Y.
Micro Instr. Co., Hawthorne, Cal.
NH Research, Inc., Santa Ana, Calif.
North Atlantic Inds., Plainview, N.Y.
Quan-Tech, Whippany, N.J.
Rantec Div., Calabasas, Calif.
Scientific-Atlanta, Inc., Atlanta, Ga.
Signal Analysis Oper., Hauppauge, N.Y.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Theta Instr. Corp., Fairfield, N.J.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vibration Instrs. Co., Anaheim, Cal.
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Analyzers, Probability Density

B & K Instrs., Inc., Cleveland, Ohio
CELCO, Mahwah, N.J.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
Honeywell, Denver, Colo.
Nicolet Instr. Corp., Madison, Wisc.
Quan-Tech, Whippany, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Thermo Sys., Inc., St. Paul, Minn.

Analyzers, Probability Distribution—See Analyzers, Probability Density

Analyzers, Pulse

Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa. .. Vol 1•351
A. D. Data Sys., Inc., Rochester, N.Y.
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
El Instruments, Derby, Conn.
Elsytec, Inc., Syosset, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Micro Instr. Co., Hawthorne, Cal.
Nicolet Instr. Corp., Madison, Wisc.
Nuclear Data, Palatine, Ill.
Nuclear Meas. Corp., Indianapolis, Ind.
Packard Instrument Co., Inc., Downers Grove, Ill.
Quan-Tech, Whippany, N.J.
Soltec Corp., No. Hollywood, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.

Analyzers, Radar

Del Electronics Corp., Mt. Vernon, N.Y.
Electrac, Inc., Anaheim, Calif.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Metric Sys., Ft. Walton Beach, Fla.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Tektronix, Inc., Beaverton, Ore.
Watkins Johnson Co., Palo Alto, Cal.

Analyzers, Servo

Astrosystems, Inc., Lake Success, N.Y.
Bafco, Inc., Warminster, Pa.
Control Technology Co., L.I.C., N.Y.
Datum, Inc., Anaheim, Calif.
Feedback, Inc., Berkeley Hghts., N.J.
Ind'l. Control Co., Farmingdale, N.Y.
Infodex, Inc., Waterbury, Conn.
North Atlantic Inds., Plainview, N.Y.
Orbit Instr. Corp., Syosset, N.Y.
Singer Co., Little Falls, N.J.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tasker Systems, Chatsworth, Cal.

Analyzers, Single-Sideband—See Analyzers, Spectrum

Analyzers, Sonic & Subsonic

Quan-Tech, Whippany, N.J. ..... Vol 1•496
Texscan Corp., Indianapolis, Ind. Vol 1•514
A. P. Circuit Corp., New York, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Baganoff Assocs., Inc., St. Louis, Mo.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Kay Elemetrics, Pine Brook, N.J.
Kinetic Tech., Inc., Santa Clara, Cal.
Multimetric Industries, Richmond Hill, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
NUSonics, Inc., Paramus, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Spectrum Instrs., Inc., New Rochelle, N.Y.
Voiceprint Laboratories Corp., Somerville, N. J.
White Instrs., Inc., Austin, Tex.

Analyzers, Spectrum (Including Oscilloscopes With Plug-Ins)

Bafco, Inc., Warminster, Pa. .... Vol 1•393
Electro/Data, Inc., Garland, Tex. Vol 1•546
Quan-Tech, Whippany, N.J. ..... Vol 1•496
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal. ..... Vol 1•507
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal. ..... Vol 1•507
Systron-Donner Corp., Concord, Cal. Vol 1•510
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•510
Systron-Donner Datapulse Div., Culver City, Cal. ..... Vol 1•510
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal. ..... Vol 1•510
Systron-Donner Microwave Div., Van Nuys, Cal. ..... Vol 1•510
Tektronix, Inc., Beaverton, Ore. Vol 1•512
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
A. P. Circuit Corp., New York, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Baganoff Assocs., Inc., St. Louis, Mo.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bowmar/ALI, Inc., Acton, Mass.
Bowmar Instr. Corp., Ft. Wayne, Ind.

Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Damon Corp., Westwood, Mass.
Dynair Elctrns. Inc., San Diego, Calif.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
Heath Co., Benton Harbor, Mich.
Honeywell, Denver, Colo.
James Elctrns., Inc., Chicago, Ill.
Kay Elemetrics, Pine Brook, N.J.
Marconi Instrs., Englewood, N.J.
Multimetric Industries, Richmond Hill, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
Nicolet Instr. Corp., Madison, Wisc.
Packard Instrument Co., Inc., Downers Grove, Ill.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Soltec Corp., No. Hollywood, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Spectrum Instrs., Inc., New Rochelle, N.Y.
SSR Instrs. Co., Santa Monica, Cal.
Systron Donner Trygon Elctrns. Sub., Westbury, N.Y.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Texscan Corp., Indianapolis, Ind.
Transducer Controls Corp., Covina, Calif.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
Voiceprint Laboratories Corp., Somerville, N. J.
Weston Instruments, Inc., Newark, N.J.

Analyzers, Telemetric Data

ADC Prods., Minneapolis, Minn.
Beukers Labs., Inc., Hauppauge, N.Y.
Elsytec, Inc., Syosset, N.Y.
Metric Sys., Ft. Walton Beach, Fla.
Nelson Ross Elctrns., Lake Success, N.Y.
Signal Analysis Oper., Hauppauge, N.Y.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Tau-Tron, Inc., Lowell, Mass.
Video Research Corp., Gaithersburg, Md.
Watkins Johnson Co., Palo Alto, Cal.

Analyzers, Transfer Function

Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa. .. Vol 1•351
American Elctrn. Labs., Inc., Lansdale, Pa.
Bafco, Inc., Warminster, Pa.
Baganoff Assocs., Inc., St. Louis, Mo.
CELCO, Mahwah, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Federal Sci. Corp., New York, N.Y.
Feedback, Inc., Berkeley Hghts., N.J.
General Radio Co., Concord, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Optics Technology, Palo Alto, Calif.
Quan-Tech, Whippany, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Tasker Systems, Chatsworth, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vari-L Co., Inc., Denver, Colo.
Vibration Instrs. Co., Anaheim, Cal.
Zoomar, Inc., Glen Cove, N.Y.

Analyzers, Ultrasonic

A. P. Circuit Corp., New York, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Chesapeake Instr. Corp., Shadyside, Md.
Elsytec, Inc., Syosset, N.Y.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
Kinetic Tech., Inc., Santa Clara, Cal.
Magnaflux Corp., Chicago, Ill.
Nelson Ross Elctrns., Lake Success, N.Y.
NUSonics, Inc., Paramus, N.J.
Panametrics Inc., Waltham, Mass.
Quan-Tech, Whippany, N.J.
Spectrum Instrs., Inc., New Rochelle, N.Y.
Techsonics, El Prado, N.M.

Analyzers, Vibration

Unholtz-Dickie Corp., Hamden, Conn. Vol 1•530
Advanced Dynamic Instrs. Div., Alexandria, Va.
American Elctrn. Labs., Inc., Lansdale, Pa.
B & K Instrs., Inc., Cleveland, Ohio
Bafco, Inc., Warminster, Pa.
Baganoff Assocs., Inc., St. Louis, Mo.
Bearing Inspection, Santa Fe Springs, Cal.
Bell & Howell Co., Pasadena, Calif.
Bowmar/ALI, Inc., Acton, Mass.
Dytronics Co., Columbus, Ohio
Electrac, Inc., Anaheim, Calif.
Elsytec, Inc., Syosset, N.Y.
Endevco, Pasadena, Calif.
Federal Sci. Corp., New York, N.Y.
General Radio Co., Concord, Mass.
Honeywell, Denver, Colo.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Kay Elemetrics, Pine Brook, N.J.
Lion Precision Corp, Newton, Mass.
Metrix Instr. Co., Houston, Tex.
Nelson Ross Elctrns., Lake Success, N.Y.
Nicolet Instr. Corp., Madison, Wisc.
PCB Piezotronics, Inc., Depew, N.Y.
Quan-Tech, Whippany, N.J.
Reliance Elec. Co., Cleveland, Ohio
Robertshaw Controls Co., Richmond, Va.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Spectrum Instrs., Inc., New Rochelle, N.Y.
Tektronix, Inc., Beaverton, Ore.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vibration Instrs. Co., Anaheim, Cal.

Analyzers, Video—See Analyzers, Spectrum

Analyzers, Waveform—See Analyzers, Harmonic

Anechoic Chambers

Emerson & Cuming, Inc., Canton, Mass.
HRB-Singer, Inc., State College, Pa.
LectroMagnetics, Inc., Los Angeles, Cal.
Rantec Div., Calabasas, Calif.

Annunciators

Aerospace Avionics, Inc., Bohemia, N.Y.
Allard Instr. Corp., Westbury, NY
American Zettler, Irvine, Ca.
AMF Electical Prods., Alexandria, Va.
Applied Control Co., Fairfield, N.J.
Artisan Elctrns. Corp., Parsippany, N.J.
Autocon Inds., Inc., Minneapolis, Minn.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Cognitronics Corp., Stamford, Conn.
Devco Engrg., W. Caldwell, N.J.
Dialight Corp., Brooklyn, N.Y.
Digitron Corp., Norristown, Pa.
Engdahl Enterprises, Costa Mesa, Cal.
Hathaway Instruments, Inc., Denver, Colo.
Henschel Corp., Amesbury, Mass.
Info-Lite Corp., Corona, N.Y.
Integrated Systems, Inc., Norcross, Ga.
Knowles Elctrns., Inc., Franklin Park, Ill.
Korry Mfg. Co., Seattle, Wash.
LVC Inds. Inc., Flushing, N.Y.
Major Data Corp., Costa Mesa, Cal.
Master Specialties, Costa Mesa, Cal.
Metra Instruments, Inc., Mt. View, Cal.
ONAN Div., Mpls., Minn.
Optron, Inc., Carrollton, Tex.
Penn Keystone Corp., Ansonia, Conn.
Re-el Circuits, Inc., Saddle Brook, N.J.
Stacoswitch, Inc., Costa Mesa, Cal.
Staver Co., Inc., Bay Shore, N.Y.
Switchcraft, Inc., Chicago, Ill.
TEC, Inc., Tucson, Ariz.
Worner Elctrn. Devices, Rankin, Ill.

Antenna Coils—See Coils, Antenna Loading

Antenna Couplers—See Couplers Antenna

Antenna Dummy Loads—See Dummy Loads

Antenna Feed Systems

Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Airtron, Morris Plains, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Anaren Microwave, Inc., Syracuse, N.Y.
Andrew Corp., Orland Pk., Ill.
Applied Research Inc., Port Washington, N.Y.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Gabriel Elctrns. Inc., Scarborough, Me.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Lorch Elctrns. Corp., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Nurad, Inc., Baltimore, Md.
Phelps Dodge Comm., North Haven, Conn.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Scientific-Atlanta, Inc., Atlanta, Ga.
Systron-Donner Microwave Div., Van Nuys, Cal.
Tasker Systems, Chatsworth, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.

Antenna Filters—See Filters, Antenna

Antenna Lightning Arresters —See Arresters, Lightning

Antenna Pattern Analyzers—See Analyzers, Antenna Pattern

Antenna Position Indicators—See Indicators, Antenna Position

Antenna Reflectors

Andrew Corp., Orland Pk., Ill.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Cubic Corp., San Diego, Cal.
E-Systems Inc., Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Gabriel Elctrns. Inc., Scarborough, Me.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Microflect Co., Salem, Ore.
Nurad, Inc., Baltimore, Md.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Rohn Mfg., Peoria, Ill.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Stainless, Inc., N. Wales, Pa.
Teledyne Micronetics, San Diego, Calif.
TRG Prods., E. Boston, Mass.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Antenna Rotators (Industrial & Military)

ABA Industries, Inc., Pinellas Pk., Fla.
Alliance Mfg. Co., Alliance, Ohio
Allis, Louis Div., Milwaukee, Wisc.
American Elctrn. Labs., Inc., Lansdale, Pa.
Andrew Corp., Orland Pk., Ill.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Cornell-Dubilier Elctrns., Newark, N.J.
Datron Systems, Chatsworth, Cal.
GC Electronics, Rockford, Ill.
Geo Space Sys., Tampa, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
IE Mfg. Co., Chicago, Ill.
Ind'l. Control Co., Farmingdale, N.Y.
Lance Inds., Sylmar, Calif.
Meltronics Inc., Leeds, Ala.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Saxton Prods., Congers, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Superior Elec., Bristol, Conn.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tasker Systems, Chatsworth, Cal.
Telrex Labs., Asbury Park, N.J.
Tri-Ex Tower Corp., Visalia, Calif.

Antenna Switching Matrices

A. D. Data Sys., Inc., Rochester, N.Y.
Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Andrew Corp., Orland Pk., Ill.
Applied Research Inc., Port Washington, N.Y.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Daico Inds. Inc., Compton, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Kilovac Corp., Santa Barbara, Cal.
LVC Inds. Inc., Flushing, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Transco Prods., Inc., Venice, Cal.
Trompeter Elctrns., Chatsworth, Cal.
Vega Precision Labs., Vienna, Va.

Antenna Towers & Supports

American Elctrn. Labs., Inc., Lansdale, Pa.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Copperweld Bimetallics, Glassport, Pa.
Craig Sys. Corp., Lawrence, Mass.
Elctrn. Comm., Inc., St. Petersburg, Fla.
GC Electronics, Rockford, Ill.
Henry Prods. Co., Inc., Inwood, N.Y.
IE Mfg. Co., Chicago, Ill.
Metric Sys., Ft. Walton Beach, Fla.
Microflect Co., Salem, Ore.
RCA Corp., Camden, N.J.
RF Systems, Inc., Cohasset, Mass.
Rohn Mfg., Peoria, Ill.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sitco Antennas, Portland, Ore.
South River Metal Prods. Co., South River, N.J.
Stainless, Inc., N. Wales, Pa.
Telrex Labs., Asbury Park, N.J.
Titchener, E.H. & Co., Binghamton, N.Y.
Tri-Ex Tower Corp., Visalia, Calif.
Up-Right Scaffolds, Berkeley, Calif.

Antennas, Airborne

Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Aircom, Inc., Union, N.H.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Bendix Corp., Ft. Lauderdale, Fla.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Copperweld Bimetallics, Glassport, Pa.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Emergency Beacon Corp., New Rochelle, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Henry Prods. Co., Inc., Inwood, N.Y.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
Loral Elctrn. Sys., Bronx, N.Y.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Microwave Prods., Inc., Chatsworth, Cal.

New-Tronics Corp., Brookpark, Ohio
Norden Div., Norwalk, Conn.
Nurad, Inc., Baltimore, Md.
Phelps Dodge Comm., North Haven, Conn.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Sinclair Radio Labs., Maple, Ont., Can.
Singer Co., Little Falls, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Titchener, E.H. & Co., Binghamton, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Vega Precision Labs., Vienna, Va.

Antennas, Direction Finding

Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Beukers Labs., Inc., Hauppauge, N.Y.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Electrospace Systems Inc., Richardson, Tex.
Emergency Beacon Corp., New Rochelle, N. Y.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Henry Prods. Co., Inc., Inwood, N.Y.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Nurad, Inc., Baltimore, Md.
Premier Microwave, Port Chester, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Telrex Labs., Asbury Park, N.J.
Thomson-CSF Inc., New York, N.Y.
Titchener, E.H. & Co., Binghamton, N.Y.
TRG Prods., E. Boston, Mass.
Vega Precision Labs., Vienna, Va.

Antennas, Ground Plane

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
Hunter Spring, Hatfield, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Kreckman, Herb Co., Cresco, Pa.
Mobil Elctrns., Inc., Anderson, Ind.
New-Tronics Corp., Brookpark, Ohio
Nurad, Inc., Baltimore, Md.
Phelps Dodge Comm., North Haven, Conn.
Premax Prods. Div., Niagara Falls, N.Y.
Premier Microwave, Port Chester, N.Y.
Ratelco, Inc., Seattle, Wash.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telrex Labs., Asbury Park, N.J.
Thomson-CSF Inc., New York, N.Y.

Antennas, Helical

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Premier Microwave, Port Chester, N.Y.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Sinclair Radio Labs., Maple, Ont., Can.
Tasker Systems, Chatsworth, Cal.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
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Antennas, Log-Periodic

Electro/Data, Inc., Garland, Tex. **Vol 1•547**
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Collins Radio Co., Dallas, Tex.
Continental Elctrns. Mfg. Co., Dallas, Tex.
E-Systems Inc., Dallas, Tex.
Electro-Mechanics Co., Austin, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Electrospace Systems Inc., Richardson, Tex.
GC Electronics, Rockford, Ill.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Lance Inds., Sylmar, Calif.
Marconi Elctrns. Inc., Elmsford, N.Y.
Nurad, Inc., Baltimore, Md.
Phelps Dodge Comm., North Haven, Conn.
Polarad Elctrn. Instrs., Lake Success, N.Y.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Stainless, Inc., N. Wales, Pa.
Telrex Labs., Asbury Park, N.J.
Thomson-CSF Inc., New York, N.Y.
Vega Precision Labs., Vienna, Va.

Antennas, Loop

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Connector Corp., Chicago, Ill.
El-Rad Mfg. Co., Chicago, Ill.
Elctrn. Comm., Inc., St. Petersburg, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
Instrs. For Ind., Inc., Farmingdale, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RCA Parts & Accessories, Deptford, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Saxton Prods., Congers, N.Y.
Thomson-CSF Inc., New York, N.Y.
Tracor, Inc., Austin, Tex.

Antennas, Microwave

Vega Precision Labs., Vienna, Va. **Vol 1•569**
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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Aircom, Inc., Union, N.H.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Electro/Data, Inc., Garland, Tex.
Electro-Mechanics Co., Austin, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Gabriel Elctrns. Inc., Scarborough, Me.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
ITT Gilfillan Div. of ITT, Van Nuys, Calif.
Jerrold Electronics Corp., Philadelphia, Pa.
Loral Elctrn. Sys., Bronx, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Microlab/FXR, Livingston, N.J.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Microwave Prods., Inc., Chatsworth, Cal.
Narda Microwave Corp., Plainview, N.Y.
Nurad, Inc., Baltimore, Md.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
Raytheon Data Systems Co., Norwood, Mass.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
Rohn Mfg., Peoria, Ill.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Singer Co., Little Falls, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Stainless, Inc., N. Wales, Pa.
Systron-Donner Microwave Div., Van Nuys, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Varian Assoc., Solid State East Div., Micro-Link Prods., Beverly, Mass
Waveline, Inc., W. Caldwell, N.J.

Antennas, Parabolic

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American Elctrn. Labs., Inc., Lansdale, Pa.
Andrew Corp., Orland Pk., Ill.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Gabriel Elctrns. Inc., Scarborough, Me.
Geo Space Sys., Tampa, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Lance Inds., Sylmar, Calif.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Nurad, Inc., Baltimore, Md.
Premier Microwave, Port Chester, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Stainless, Inc., N. Wales, Pa.
Tasker Systems, Chatsworth, Cal.
Thomson-CSF Inc., New York, N.Y.
TRG Prods., E. Boston, Mass.
Vega Precision Labs., Vienna, Va.

Antennas, Phased Array

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Airtron, Morris Plains, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Microwave Prods., Inc., Chatsworth, Cal.
Nurad, Inc., Baltimore, Md.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Sitco Antennas, Portland, Ore.
Technical Mat'l., Mamaroneck, N.Y.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Winegard Co., Burlington, Iowa

Antennas, Radar

Vega Precision Labs., Vienna, Va. **Vol 1•569**
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Nucleonics Corp., Woodland Hills, Cal
Andrew Corp., Orland Pk., Ill.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Lockheed Elctrns. Co., Watchung, N.J.
Nurad, Inc., Baltimore, Md.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Co., Little Falls, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Tasker Systems, Chatsworth, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Titchener, E.H. & Co., Binghamton, N.Y.
TRG Prods., E. Boston, Mass.

Antennas, Rhombic

Continental Elctrns. Mfg. Co., Dallas, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Instrs. For Ind., Inc., Farmingdale, N.Y.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Sinclair Radio Labs., Maple, Ont., Can.
Stainless, Inc., N. Wales, Pa.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.
Vega Precision Labs., Vienna, Va.

Antennas, Spiral

Electro/Data, Inc., Garland, Tex. Vol 1•547
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Electro-Mechanics Co., Austin, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Frequency Engrg. Labs., Farmingdale, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
Hunter Spring, Hatfield, Pa.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Teledyne Micronetics, San Diego, Calif.
Telrex Labs., Asbury Park, N.J.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
Vega Precision Labs., Vienna, Va.

Antennas, Telemetry, Tracking

ABA Industries, Inc., Pinellas Pk., Fla.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Andrew Corp., Orland Pk., Ill.
Beukers Labs., Inc., Hauppauge, N.Y.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
E-Systems Inc., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Geo Space Sys., Tampa, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Instrs. For Ind., Inc., Farmingdale, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
Nurad, Inc., Baltimore, Md.
Rantec Div., Calabasas, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Scientific-Atlanta, Inc., Atlanta, Ga.
Stainless, Inc., N. Wales, Pa.
Tasker Systems, Chatsworth, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Vega Precision Labs., Vienna, Va.
Whittaker Corp., Los Angeles, Cal.

Antennas, Telescopic

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Andrew Corp., Orland Pk., Ill.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Craig Sys. Corp., Lawrence, Mass.
Geo Space Sys., Tampa, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hunter Spring, Hatfield, Pa.
K-W Engrg. Works, Menomonee Falls, Wisc.
Materials for Elctrns., Inc., Jamaica, N.Y.
New-Tronics Corp., Brookpark, Ohio
Peerless Industries Inc., Chicago, Ill.
Phelps Dodge Comm., North Haven, Conn.
Premax Prods. Div., Niagara Falls, N.Y.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Thomson-CSF Inc., New York, N.Y.
Tri-Ex Tower Corp., Visalia, Calif.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Antennas, Troposcatter

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Collins Radio Co., Dallas, Tex.
E-Systems Inc., Dallas, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Gabriel Elctrns. Inc., Scarborough, Me.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Marconi Elctrns. Inc., Elmsford, N.Y.
Premier Microwave, Port Chester, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Telrex Labs., Asbury Park, N.J.
TRG Prods., E. Boston, Mass.

Antennas, WHIP & Accessories (Including Marine & Mobile Types)

Instrs. For Ind., Inc., Farmingdale, N.Y.
Pearce-Simpson, Miami, Fla.
Premax Prods. Div., Niagara Falls, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Tracor, Inc., Austin, Tex.

Anti-Static Compounds & Coatings—See Coatings, Anti-Static

Arc Lamp Power Supplies—See Power Supplies, Arc Lamp

Armatures—See Motor & Generator Armatures, Rotors, Stators

Arms, Phono, Transcription—See Phonographs, Parts & Accessories

Arresters, Electrical Surge-Also See Suppressors, Arc; Protectors, Surge

Dale Elctrns., Inc., Yankton, S.D. Vol 2•1047
Kilovolt Corp., Hackensack, N.J. Vol 1•757
Telecommunications Inds. Inc., Copiague, N. Y. Vol 2•1141
Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371
Victoreen Instr., Cleveland, Ohio Vol 2•1193
ATR Elctrns., Inc., St. Paul, Minn.
Basic Ceramics Inc., Hawthorne, N.J.
Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
Electrons Co., Fairfield, N.J.
Integrated Systems, Inc., Norcross, Ga.
International Rectifier, El Segundo, Cal.
Joslyn Elctrn. Sys., Goleta, Cal.
Ross Engrg. Corp., Campbell, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Signalite, Neptune, N.J.
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Transtector Systems, Monterey Park, Cal.

Arresters, Lightning

Telecommunications Inds. Inc., Copiague, N. Y. Vol 2•1141
Basic Ceramics Inc., Hawthorne, N.J.
Birnbach Co., Inc., Freeport, N.Y.
Consolidated Wire & Assoc. Corps., Chicago, Ill.
Dale Elctrns., Inc., Yankton, S.D.
Electrons Co., Fairfield, N.J.
GC Electronics, Rockford, Ill.
Integrated Systems, Inc., Norcross, Ga.
Joslyn Elctrn. Sys., Goleta, Cal.
Lance Inds., Sylmar, Calif.
Landis & Gyr, Inc., Elmsford, N.Y.
Pure Carbon Co., Inc., St. Marys, Pa.
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Signalite, Neptune, N.J.
South River Metal Prods. Co., South River, N.J.
Transtector Systems, Monterey Park, Cal.

Attenuators, Audio

Re-el Circuits, Inc., Saddle Brook, N.J. Vol 1•320
Tech Labs., Inc., Palisades Pk., N.J. Vol 2•1140
Vishay Resistor Prod. Div., Malvern, Pa. Vol 3•1198
ADC Prods., Minneapolis, Minn.
Allen Avionics, Mineola, N.Y.
Allen-Bradley Co., Milwaukee, Wisc.
Altec Div., Anaheim, Calif.
Arra Inc., Bay Shore, N.Y.
Chesterfield Prods. Inc., Saddle Brook, N. J.
Clarostat Mfg. Co., Inc., Dover, N.H.
Components Specialties, Freeport, N.Y.
Duncan Elctrns., Costa Mesa, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elcom Sys., Deer Pk., N.Y.
Electro-Voice, Inc., Buchanan, Mich.
Engelmann Microwave, Montville, N.J.
Fairchild Sound Equip., Commack, N.Y.
General Radio Co., Concord, Mass.
General Resistance, Inc., Mt. Vernon, N.Y.
Gotham Audio Corp., New York, N.Y.
GRM Corp., Medford, N.J.
Hope Elctrns., Clifton, N.J.
Kay Elemetrics, Pine Brook, N.J.
Marconi Instrs., Englewood, N.J.
Merrimac Inds., Inc., West Caldwell, N.J.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
Ohmite Mfg. Co., Skokie, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Sennheiser Elctrn. Corp., New York, NY
Shallco, Inc., Smithfield, N.C.
Texscan Corp., Indianapolis, Ind.
Waters Mfg., Inc., Wayland, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.

Attenuators, Coaxial

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Blonder-Tongue Labs., Inc., Old Bridge, N.J.
CES Elctrns., Brooklyn, N.Y.
Daico Inds. Inc., Compton, Cal.
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E-H Resch. Labs., Inc., Oakland, Cal.
Edison Elctrns. Div., Manchester, N.H.
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EMC Technology Inc, Cherry Hill, N.J.
Engelmann Microwave, Montville, N.J.
Fifth Dimension, Princeton, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
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Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
Nurad, Inc., Baltimore, Md.
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General Resistance, Inc., Mt. Vernon, N.Y.
Hope Elctrns., Clifton, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
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Shallco, Inc., Smithfield, N.C.
Tech Labs., Inc., Palisades Pk., N.J.
Telonic Inds., Inc., Laguna Beach, Calif.
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Applied Research Inc., Port Washington, N.Y.
Arra Inc., Bay Shore, N.Y.
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Cir-Q-Tel, Kensington, Md.
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Edison Elctrns. Div., Manchester, N.H.
Elcom Sys., Deer Pk., N.Y.
Electronautics, Littleton, Mass.
EMC Technology Inc, Cherry Hill, N.J.
Engelmann Microwave, Montville, N.J.
General Microwave Corp., Farmingdale, N.Y.
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GRM Corp., Medford, N.J.
Hope Elctrns., Clifton, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
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Arra Inc., Bay Shore, N.Y.
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Cir-Q-Tel, Kensington, Md.
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Engelmann Microwave, Montville, N.J.
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Jerrold Electronics Corp., Philadelphia, Pa.
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Mini-Circuits Lab., Brooklyn, N.Y.
Narda Microwave Corp., Plainview, N.Y.
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PRD Elctrns., Inc., Westbury, N.Y.
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Shallco, Inc., Smithfield, N.C.
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Special Microwave Devices Oper., Waltham, Mass.
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Centralab Elctrns Div., Milwaukee, Wisc
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Microlab/FXR, Livingston, N.J.
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Narda Microwave Corp., Plainview, N.Y.
Ohmite Mfg. Co., Skokie, Ill.
Premier Microwave, Port Chester, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Shallco, Inc., Smithfield, N.C.
Sinclair Radio Labs., Maple, Ont., Can.
Texscan Corp., Indianapolis, Ind.
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EMC Technology Inc, Cherry Hill, N.J.
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General Microwave Corp., Farmingdale, N.Y.
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GHZ Devices, Inc., So. Chelmsford, Mass.
Maury Microwave Corp., Cucamonga, Calif.
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Microwave Filter Co., Inc., East Syracuse, N.Y.
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Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sealectro Corp., Mamaroneck, N.Y.
Sinclair Radio Labs., Maple, Ont., Can.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Somerset Radiation Lab., Arlington, Va.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
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Transco Prods., Inc., Venice, Cal.
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Anzac Elctrns., Waltham, Mass.
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Altec Div., Anaheim, Calif.
American Aerospace Controls Inc., Farmingdale, N.Y.
Anaren Microwave, Inc., Syracuse, N.Y.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Carter Mfg. Corp., Hudson, Mass.
Centralab Elctrns Div., Milwaukee, Wisc
Clarostat Mfg. Co., Inc., Dover, N.H.
Comdel, Inc., Beverly, Mass.
Delta-Benco Ltd., Rexdale, Ont., Can.
Duncan Elctrns., Costa Mesa, Cal.
E & M Laboratories, Inc., Westlake Village, Cal.
Edison Elctrns. Div., Manchester, N.H.
Electro Impulse, Inc., Red Bank, N.J.
Engelmann Microwave, Montville, N.J.
Fairchild Sound Equip., Commack, N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Gotham Audio Corp., New York, N.Y.
GRM Corp., Medford, N.J.
Ithaco, Inc., Ithaca, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.

Maury Microwave Corp., Cucamonga, Calif.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Mini-Circuits Lab., Brooklyn, N.Y.
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PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
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Sinclair Radio Labs., Maple, Ont., Can.
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Datacom, Inc., Ft. Walton Bch., Fla.
Digital Equip. Corp., Maynard, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
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Junction Modules, Inc., Irvine, Cal.
Intronics, Inc., Newton, Mass.
Nicolet Instr. Corp., Madison, Wisc.
Nuclear Data, Palatine, Ill.
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Spectral Dynamics Corp. San Diego, San Diego, Cal.
Teledyne Philbrick, Dedham, Mass.
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Beckman Instrs., Cedar Grove, N.J.
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Cambridge Thermionic, Cambridge, Mass
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Custom Sci. Instrs., Inc., Whippany, N.J.
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Forma Scientific, Marietta, Ohio
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Julie Research Lab., New York, N.Y.
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Precision Sci. Co., Chicago, Ill.
Procedyne Corp., New Brunswick, N.J.
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Standard Environmental Systems, Inc., Totowa, N.J.
Statham Instrs., Inc., Oxnard, Cal.
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VirTis Co., Gardiner, N.Y.
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Gould, Inc., St. Paul, Minn.
Gould Inc., Trenton, NJ
Power Inc., Burnsville, Minn.
Shigoto Inds., Ltd., New York, N.Y.
Wisco Div., Racine, Wisc.

Batteries, Lead-Dioxide

Gates Energy Prods. Inc., Denver, Colo.
Globe-Union Inc., Milwaukee, Wisc.

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Honeywell, Minneapolis, Minn.
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Bridges, Audio
Altec Div., Anaheim, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
General Radio Co., Concord, Mass.
Marconi Instrs., Englewood, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Wiltron Co., Palo Alto, Calif.

Bridges, Bolometer
General Microwave Corp., Farmingdale, N.Y.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Weinschel Engrg. Co., Gaithersburg, Md.
Weston Instruments, Inc., Newark, N.J.

Bridges, Calorimeter
Electro Impulse, Inc., Red Bank, N.J.
General Microwave Corp., Farmingdale, N.Y.
Hy-Cal Engrg., Santa Fe Springs, Cal.
PRD Elctrns., Inc., Westbury, N.Y.

Bridges, Capacitance
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Freed Transformer Co., Bklyn., N.Y. Vol 1•445
London Co., Cleveland, Ohio .. Vol 1•478
B & K Instrs., Inc., Cleveland, Ohio
Bendix Corp., Davenport, Iowa
Biddle, James G., Plymouth Meeting, Pa.
Boonton Electronics Corp., Parsippany, N.J.
Clippard Instr., Inc., Cincinnati, Ohio
Davidson Elctrn. Dev. Co., Erie, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
Epic, Inc., New York, N.Y.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Guildline Instrs., Inc., Larchmont, N.Y.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Control Co., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Simpson Elec. Co., Chicago, Ill.
Sprague Elec. Co., No. Adams, Mass.
Teradyne, Inc., Boston, Mass.
Wiltron Co., Palo Alto, Calif.

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B & K Instrs., Inc., Cleveland, Ohio
Beckman Instrs., Cedar Grove, N.J.
Cole Instrument Corp., Costa Mesa, Cal.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
General Radio Co., Concord, Mass.
General Resistance, Inc., Mt. Vernon, N.Y.
Julie Research Lab., New York, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Slaughter Co., Ardmore, Okla.
Teradyne, Inc., Boston, Mass.

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Alford Mfg. Co., Winchester, Mass.
B & K Instrs., Inc., Cleveland, Ohio
Boonton Elctrns., Parsippany, N.J.
Bristol Div, Waterbury, Conn
Davidson Elctrn. Dev. Co., Erie, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dytronics Co., Columbus, Ohio
Electro Sci. Inds., Portland, Ore.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Heath Co., Benton Harbor, Mich.
Ind'l. Test Equip., Clifton, NJ
Jerrold Electronics Corp., Philadelphia, Pa.
Leeds & Northrup Corp., No. Wales, Pa.
London Co., Cleveland, Ohio
Millen, James Mfg., Malden, Mass.
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Sennheiser Elctrn. Corp., New York, NY
Telonic Inds., Inc., Laguna Beach, Calif.
Wide Band Engrg. Co., Phoenix, Ariz.
Wiltron Co., Palo Alto, Calif.

Bridges, Inductance
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Davidson Elctrn. Dev. Co., Erie, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
General Radio Co., Concord, Mass.
Ind'l. Test Equip., Clifton, NJ
Marconi Instrs., Englewood, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Simpson Elec. Co., Chicago, Ill.

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Davidson Elctrn. Dev. Co., Erie, Pa.
Electro Sci. Inds., Portland, Ore.
Epic, Inc., New York, N.Y.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Micro Instr. Co., Hawthorne, Cal.
Penn Airborne Prods., Southampton, Pa.
Teradyne, Inc., Boston, Mass.
Vishay Resistor Prod. Div., Malvern, Pa.

Bridges, Limit—See Bridges (Specific Types)

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AUL Instrs., Inc., Flushng, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
Bird Elctrn., Cleveland, Ohio
General Microwave Corp., Farmingdale, N.Y.
Narda Microwave Corp., Plainview, N.Y.
New-Tronics Corp., Brookpark, Ohio
Pace Div., Harbor City, Calif.
PRD Elctrns., Inc., Westbury, N.Y.
Weinschel Engrg. Co., Gaithersburg, Md.

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Beckman Instrs., Cedar Grove, N.J.

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Clippard Instr., Inc., Cincinnati, Ohio
Consolidated Ohmic Devices, Carle Pl., N.Y.
Cox & Co., Inc., New York, N.Y.
Dale Elctrns., Inc., Columbus, Neb.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
Fogg System Co., Denver, Col.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Hipotronics, Inc., Brewster, N.Y.
Ind'l. Test Equip., Clifton, NJ
Keithley Instrs., Inc., Cleveland, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Magnetico, Inc., E. Northport, N.Y.
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
Oxford Instr. Corp., Annapolis, Md.
Penn Airborne Prods., Southampton, Pa.
Precision Standards Corp., Santa Ana, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RFL Inds., Instr. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Rosemount Inc., Minneapolis, Minn.
Simpson Elec. Co., Chicago, Ill.
Slaughter Co., Ardmore, Okla.
Solatron Enterprises, Inglewood, Calif.
Sticht, Herman H. Co., Inc., New York, N.Y.
Teradyne, Inc., Boston, Mass.
Vishay Resistor Prod. Div., Malvern, Pa.
Wiltron Co., Palo Alto, Calif.

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Alford Mfg. Co., Winchester, Mass.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Carco Elctrns., Menlo Park, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Edison Elctrns. Div., Manchester, N.H.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Micro Instr. Co., Hawthorne, Cal.
Millen, James Mfg., Malden, Mass.
Narda Microwave Corp., Plainview, N.Y.
New-Tronics Corp., Brookpark, Ohio
Pace Div., Harbor City, Calif.
Radiation Devices Co., Baltimore, Md.
Rohde & Schwarz Sls., Passaic, N.J.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co., Phoenix, Ariz.
Wiltron Co., Palo Alto, Calif.

Bridges, Schering

Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•796
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Dielectric Instr. Corp., Pittsburgh, Pa.
Epic, Inc., New York, N.Y.
General Radio Co., Concord, Mass.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.

Bridges, Self-Balancing

Beckman Instrs., Cedar Grove, N.J.
Bendix Corp., Davenport, Iowa
Bristol Div, Waterbury, Conn
Davidson Elctrn. Dev. Co., Erie, Pa.
Doric Sci. Corp., San Diego, Calif.
Electro Sci. Inds., Portland, Ore.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
Julie Research Lab., New York, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Micro Instr. Co., Hawthorne, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
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M & H Electronics, Long Branch, N.J.
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Semtech Corp., Newbury Pk., Cal.

Bridges, Strain Gauge

Ailtech, City of Industry, Cal.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Biddle, James G., Plymouth Meeting, Pa.
Biocom, Inc., Culver City, Cal.
Bristol Div, Waterbury, Conn
Doric Sci. Corp., San Diego, Calif.
Fogg System Co., Denver, Col.
Gould, Inc., Cleveland, Ohio
Measurement Sys., Inc., Norwalk, Conn.
PPM, Inc., Bedford, Ohio
Sensotec, Inc., Columbus, Ohio
Tektronix, Inc., Beaverton, Ore.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Transducers, Inc., Whittier, Ca.
West Coast Resch. Corp., Los Angeles, Calif.

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Astrosystems, Inc., Lake Success, N.Y.
Control Technology Co., L.I.C., N.Y.
Julie Research Lab., New York, N.Y.
Singer Co., Little Falls, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Theta Instr. Corp., Fairfield, N.J.

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Beckman Instrs., Cedar Grove, N.J.
Biocom, Inc., Culver City, Cal.
Climatronics Corp., Hauppauge, N.Y.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Cox & Co., Inc., New York, N.Y.
Datametrics Inc., Wilmington, Mass.
Doric Sci. Corp., San Diego, Calif.
Fogg System Co., Denver, Col.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Harrel, Inc., E. Norwalk, Conn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Keithley Instrs., Inc., Cleveland, Ohio
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Omega Engrg., Inc., Stamford, Conn.
RDF Corp., Hudson, N.H.
Rosemount Inc., Minneapolis, Minn.
Simpson Elec. Co., Chicago, Ill.
Thermometrics, Inc., Edison, N.J.
Victory Engrg. Corp., Springfield, N.J.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Bridges, Wheatstone

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Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
McKee-Pedersen Instrs., Danville, Calif.
Penn Airborne Prods., Southampton, Pa.
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Concord Elctrns., New York, N.Y.
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Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Hiram Jones Elctrns., No. Hollywood, Cal.
K & S Engrg. Co., Chicago, Ill.
Keystone Elctrns. Corp., New York, N.Y.
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Lapp Insulator Div., Interpace Corp., LeRoy, N.Y.
MPB Corp., Keene, N.H.
Norelcom Inds., Inc., Farmingdale, N.Y.
Penn Fibre & Specialty, Phila., Pa.
Plastiglide Mfg. Corp., Santa Monica, Cal.
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Beechwood Mfg., Indpls., Ind.
Data General Corp. (E), Southboro, Ma.
Digital Equip. Corp., Maynard, Mass.
Douglas Electronics, Inc., San Leandro, Cal.
Falstrom Co., Passaic, N.J.
Fisher Sci. Co., Pittsburgh, Pa.
Foxboro Co., Foxboro, Mass.
General Devices, Inc., Princeton, N.J.
General Elec. Company, Providence, R.I.
Grant Hardware Co., W. Nyack, N.Y.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
Hoffman Engrg. Co., Anoka, Minn.
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Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Ingersoll Prods., Chicago, Ill.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Janitrol Aero Div., Columbus, Ohio
Kinetron Corp., Asbury Park, N.J.
Lear Siegler, Inc., Santa Monica, Calif.
LMB Heeger, Inc., Los Angeles, Calif.
Lyon Metal Prod., Inc., Aurora, Ill.
Metal Works, Inc., Herman, Mo.
Micrite Metal Mfg., Inc., Canoga Park, Cal.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Midget Louver Co., Norwalk, Conn.
Mobil Elctrns., Inc., Anderson, Ind.
Modpak, Waltham, Mass.
NES, Inc., Itasca, Ill.
Newcomb Audio Prods. Co., Sylmar, Calif.
Panelgraphic Corp., Caldwell, N.J.
Par-Metal Prods. Div., Brooklyn, N.Y.
Perfection Mica Co., Bensenville, Ill.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Procedyne Corp., New Brunswick, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Standard Environmental Systems, Inc., Totowa, N.J.
Stanford Applied Engrg., Santa Clara, Cal.
Sturdilite Sci. Furniture Sys., Plainwell, Mich
TA Mfg. Corp., Los Angeles, Cal.
Tech-Etch, Inc., Hingham, Mass.
Technical Mat'l., Mamaroneck, N.Y.
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Akro-Mils, Inc., Akron, Ohio
Allied Elctrns., Chicago, Ill.
Althor Prods., Brooklyn, N.Y.
Central Plastics Dists., Chicago, Ill.
Dura Plastics N.Y., Inc., Westport, Conn.
Edo Western Corp., Salt Lake City, Utah
Keystone Elctrns. Corp., New York, N.Y.
Miller, W. A. Co., Oquossoc, Me.
Rostone Corp., Lafayette, Ind.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
Smith, Herman H., Inc., Bklyn., N.Y.
Stackbin Corp., Pawtucket, R.I.
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Essex Int'l, Inc., Sycamore, Ill.
General Elec., Bridgeport, Conn
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GTE Sylvania Inc., Newark, N.J.
Hudson Wire Co, Ossining, N.Y.
ITT Surprenant Div., Clinton, Mass.
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Brand-Rex Co., Willimantic, Conn.
Cities Svc. Co., Chester, N.Y.
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Consolidated Wire & Assoc. Corps., Chicago, Ill.
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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dielectric Sciences, Burlington, Mass
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Manhattan Elec. Cable Corp., Brooklyn, N.Y.
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Pace Wire & Cable Corp., Oceanside, N.Y.
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Reynolds Metals Co., Richmond, Va.
Shigoto Inds., Ltd., New York, N.Y.
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Superior Cable Div., Hickory, N.C.
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Consolidated Wire & Assoc. Corps., Chicago, Ill.
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Gore, W.L. & Assocs., Inc., Newark, Del.
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Malco, A Microdot Co., Inc., Chicago, Ill.
Norelcom Inds., Inc., Farmingdale, N.Y.
Phoenix Wire, Inc., S. Hero, Vt.
Revere Elctrn. Div., Wallingford, Conn.
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Victor Wire & Cable, L.A., Cal.
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Wire Research Corp., Chatsworth, Cal.
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Pace Wire & Cable Corp., Oceanside, N.Y.
RCA Corp., Camden, N.J.
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Times Wire & Cable, Wallingford, Conn.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
Victor Wire & Cable, L.A., Cal.
Whitmor Wire & Cable, No. Hollywood, Cal.
Wire Research Corp., Chatsworth, Cal.
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Alpha Wire Corp., Elizabeth, N.J. Vol 3•1323
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Anaconda Wire and Cable Co., New York, N.Y.
Belden Corp. Elctrn. Div., Richmond, Ind.
Birnbach Co., Inc., Freeport, N.Y.
Brand-Rex Co., Willimantic, Conn.
Cities Svc. Co., Chester, N.Y.
Columbia Eletrn. Cables, New Bedford, Mass.
Copperweld Bimetallics, Glassport, Pa.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Hatfield Wire & Cable Div., Linden, N.J.
Lynn Elctrns. Corp., Feasterville, Pa.
Okonite Co., Ramsey, N.J.
Pace Wire & Cable Corp., Oceanside, N.Y.
Phelps Dodge Comm., North Haven, Conn.
Shigoto Inds., Ltd., New York, N.Y.
Standard Wire & Cable, Los Angeles, Cal.
Superior Cable Div., Hickory, N.C.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
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Andrew Corp., Orland Pk., Ill.
Ansley Elctrns. Corp., Doylestown, Pa.
Belden Corp. Elctrn. Div., Richmond, Ind.
Berk Tek, Inc., Reading, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Brand-Rex Co., Willimantic, Conn.
CCA Elctrns. Corp., Gloucester, N.J.
Columbia Eletrn. Cables, New Bedford, Mass.
Consolidated Wire & Assoc. Corps., Chicago, Ill.
Copperweld Bimetallics, Glassport, Pa.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Flexible Circuits, Inc., Warrington, Pa.
Gore, W.L. & Assocs., Inc., Newark, Del.
Hatfield Wire & Cable Div., Linden, N.J.
Hughes Aircraft Co., Connecting Devices, Newport Beach, Cal.
Jerrold Electronics Corp., Philadelphia, Pa.
Judd Wire Div., Burlington, Mass.
Kaman Sciences Corp., Colorado Springs, Colo.
Manhattan Elec. Cable Corp., Brooklyn, N.Y.
Markel, L. Frank & Sons, Norristown, Pa.
Okonite Co., Ramsey, N.J.
Pace Wire & Cable Corp., Oceanside, N.Y.
Phelps Dodge Comm., North Haven, Conn.
Precision Tube, No. Wales, Pa.
Reynolds Metals Co., Richmond, Va.
RF Systems, Inc., Cohasset, Mass.
Standard Wire & Cable, Los Angeles, Cal.
Tensolite, Tarrytown, N.Y.
Times Wire & Cable, Wallingford, Conn.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
Uniform Tubes, Collegeville, Pa.
Victor Wire & Cable, L.A., Cal.
Wire Research Corp., Chatsworth, Cal.
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Belden Corp. Elctrn. Div., Richmond, Ind.
Boston Insulated Wire & Cable Co., Dorchester, Mass.
Brand-Rex Co., Willimantic, Conn.
Cimco Wire & Cable, Allendale, N.J.
Cities Svc. Co., Chester, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
ITT Surprenant Div., Clinton, Mass.
Judd Wire Div., Burlington, Mass.
Malco, A Microdot Co., Inc., Chicago, Ill.
Precision Tube, No. Wales, Pa.
Standard Wire & Cable, Los Angeles, Cal.
Tensolite, Tarrytown, N.Y.
Times Wire & Cable, Wallingford, Conn.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
Victor Wire & Cable, L.A., Cal.
Whitmor Wire & Cable, No. Hollywood, Cal.
Wire Research Corp., Chatsworth, Cal.
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Americon Microwave Inds., Inc., Waltham, Mass.
Amphenol Connector Div., Broadview, Ill.
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Andrew Corp., Orland Pk., Ill.
Ansley Elctrns. Corp., Doylestown, Pa.
ARI Inds., Inc., Franklin Pk., Ill.
Artisan Elctrns. Corp., Parsippany, N.J.
Augat Inc., Attleboro, Mass.
Austin Elctrns., Roselle, N.J.
Automation Dynamics, Northvale, N.J.
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Barker Prods. Co., Saugus, Mass.
Belden Corp. Elctrn. Div., Richmond, Ind.
Bendix Corp., Sidney, N.Y.
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Berg Electronics, New Cumberland, Pa.
Berk Tek, Inc., Reading, Pa.
Boston Insulated Wire & Cable Co., Dorchester, Mass.
Burndy Corp., Norwalk, Conn.
Cable Sys. & Assembly Co., Inc., Everett, Mass.
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Climatronics Corp., Hauppauge, N.Y.
Co-Operative Inds., Inc., Chester, N.J.
Cole Instrument Corp., Costa Mesa, Cal.
Collins Radio Co., Dallas, Tex.
Cross Electronics Inc., Warrendale, Pa.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
De Soto Elec. Prods., De Soto, Mo.
Dearborn Wire & Cable Co., Rosemont, Ill.
Dielectric Sciences, Burlington, Mass
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Elctrn. Molding Corp., Woonsocket, R.I.
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Elgin Elctrns. Inc., Waterford, Pa.
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Gavitt Wire & Cable Div., Brookfield, Mass.
General Lab. Assocs., Norwich, N.Y.
Gore, W.L. & Assocs., Inc., Newark, Del.
GRM Corp., Medford, N.J.
Guardian California, Culver City, Cal.
Halmar Elctrns., Inc., Columbus, Ohio
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IEC Electronics Corp., E. Rochester, N.Y.
IFE Div., E. Providence, R. I.
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Janco Corp., Burbank, Cal.
Jettron Prods., Hanover, N.J.
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Kaman Sciences Corp., Colorado Springs, Colo.
Kates Scientific Instrs., Inc., Watertown, Mass.
Lear Siegler, Inc., Santa Monica, Calif.
Linemaster Switch Corp., Woodstock, Conn.
Lynn Elctrns. Corp., Feasterville, Pa.
Mac Panel Co., High Pt., N.C.
Malco, A Microdot Co., Inc., Chicago, Ill.
Manger Elec. Co., Inc., Stamford, Conn.
Masterite Corp., Torrance, Cal.
Meson Electronics Co. Inc., Rochester, N. Y.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Milletron, Inc., Pittsburgh, Pa.
Panduit Corp., Tinley Pk., Ill.
Paraplegics Mfg., Bensenville, Ill.
Phelps Dodge Comm., North Haven, Conn.
Phoenix Wire, Inc., S. Hero, Vt.
Projects Unlimited, Inc., Dayton, Ohio
Quantrol Elctrns., Inc., El Paso, Tex.
Revere Elctrn. Div., Wallingford, Conn.
Reynolds Inds., Inc., Marina Del Rey, Cal.
Richco Plastic Co., Chicago, Ill.
Rogers Corp., Rogers, Conn.
Sealectro Corp., Mamaroneck, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Signet Scientific Co., Burbank, Cal.
Sitco Antennas, Portland, Ore.
Smith, Herman H., Inc., Bklyn., N.Y.
Spectra-Strip Corp., Garden Grove, Cal.
Standard Wire & Cable, Los Angeles, Cal.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Switchcraft, Inc., Chicago, Ill.
Technical Research & Mfg. Co., Manchester, N.H.
Teledyne Positive Connector, Ansonia, Conn.
3M Co., St. Paul, Minn.
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Viking Inds., Inc., Chatsworth, Calif.
Virginia Panel Corp., Waynesboro, Va.
Weinschel Engrg. Co., Gaithersburg, Md.
Wire Research Corp., Chatsworth, Cal.

Wireflex Inc., Calumet City, Ill.
Wiremold Co., W. Hartford, Conn.
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Xerox Data Sys., El Segundo, Cal
Zaring Inds., Inc., Westfield, Ind.
Zippertubing Co., Los Angeles, Calif.

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Grant Hardware Co., W. Nyack, N.Y.
Hunter Spring, Hatfield, Pa.
Vent-Rak, Indianapolis, Ind.
Zero Mfg. Co., Burbank, Cal.
Zippertubing Co., Los Angeles, Calif.

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Allied Elctrns., Chicago, Ill.
Bowmar/ALI, Inc., Acton, Mass.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Cal-Tex Semiconductor, Santa Clara, Cal.
Cherry Electrical Prods., Waukegan, Ill
Control Equip. Corp., Lowell, Mass.
Eldorado Electrodata, Concord, Cal.
Facit-Addo, Inc., Secaucus, N.J.
HAPCO, Boulder, Colo.
Heath Co., Benton Harbor, Mich.
Innovatek Enterprise, Millerton, N.Y.
Monroe, Calculator Co., Orange, N.J.
Solitron Devices, San Diego, Cal.
Tektronix, Inc., Beaverton, Ore.
Victor Comptometer Corp., Chicago, Ill.
Wang Labs., Inc., Tewksbury, Mass.

Calibration Services—See Services, Calibration & Instrument Repair

Calibrators, Accelerometer

Advanced Dynamic Instrs. Div., Alexandria, Va.
Anchor Specialty Mfg., Teterboro, N.J.
B & K Instrs., Inc., Cleveland, Ohio
Endevco, Pasadena, Calif.
General Radio Co., Concord, Mass.
Kistler Instr. Co., Redmond, Wash.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Unholtz-Dickie Corp., Hamden, Conn.

Calibrators, Attenuation

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Arra Inc., Bay Shore, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Micro-Tel Corp., Baltimore, Md.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Calibrators, Crystal

RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Data-Control Systems, Danbury, Conn.
Drake, R.L., Co., Miamisburg, Ohio
Edison Elctrns. Div., Manchester, N.H.
Fork Standards, W. Chicago, Ill.
Heath Co., Benton Harbor, Mich.
Meloy Laboratories Inc., Springfield, Va.
Microwave/Sys., Inc., E. Syracuse, N.Y.
PPM, Inc., Bedford, Ohio
Rohde & Schwarz Sls., Passaic, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
T-F Electronics, Inc., Austin, Tex.

Calibrators, Current

Optimation, Inc., Chatsworth, Cal. Vol 1• 492
American Aerospace Controls Inc., Farmingdale, N.Y.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electronic Dev. Corp., Boston, Mass.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Ind'l. Test Equip., Clifton, NJ
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
North Hills Elctrns., Inc., Glen Cove, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
United Sys. Corp., Dayton, Ohio

Calibrators, Frequency

Austron, Inc., Austin, Tex. ..... Vol 1•391
American Time Products, Woodside, N.Y.
Collins Radio Co., Dallas, Tex.
Data-Control Systems, Danbury, Conn.
Edison Elctrns. Div., Manchester, N.H.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Micro-Now Instr., Chicago, Ill.
Micro-Tel Corp., Baltimore, Md.
Microwave/Sys., Inc., E. Syracuse, N.Y.
New Era Products, Cleveland, Ohio
Ormond Inc., Santa Fe Springs, Cal.
PPM, Inc., Bedford, Ohio
Riverbank Labs., Geneva, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Tektronix, Inc., Beaverton, Ore.

Calibrators, LVDT

Collins, G.L. Corp., Long Beach, Calif.
Custom Sci. Instrs., Inc., Whippany, N.J.
North Atlantic Inds., Plainview, N.Y.

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Delta-Benco Ltd., Rexdale, Ont., Can.
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LDJ Electronics, Troy, Mich.
RFL Inds., Instr. Div., Boonton, N.J.

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Ballantine Laboratories, Inc., Boonton,, N. J.
E-H Resch. Labs., Inc., Oakland, Cal.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Meloy Laboratories Inc., Springfield, Va.
Tektronix, Inc., Beaverton, Ore.

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RCA Govt. & Comm. Sys., Moorestown, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

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Astrosystems, Inc., Lake Success, N.Y.
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Ind'l. Control Co., Farmingdale, N.Y.
Jonard Inds. Corp., Bronx, N.Y.
Julie Research Lab., New York, N.Y.
North Atlantic Inds., Plainview, N.Y.
Theta Instr. Corp., Fairfield, N.J.

Calibrators, Time-Base

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Automated Meas., Oakland, Calif.
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E-H Resch. Labs., Inc., Oakland, Cal.
Fork Standards, W. Chicago, Ill.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Phelps Dodge Comm., North Haven, Conn.
PPM, Inc., Bedford, Ohio
Specific Products, Monrovia, Cal.
T-F Electronics, Inc., Austin, Tex.
Tektronix, Inc., Beaverton, Ore.

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Beckman Instrs., Cedar Grove, N.J.
Chicago Condenser Corp., Chicago, Ill.
Computer Diode, Fair Lawn, N.J.
Constant Voltage Co., Chicago, Ill.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Electro Sci. Inds., Portland, Ore.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Fogg System Co., Denver, Col.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Ind'l. Test Equip., Clifton, NJ
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kepco, Inc., Flushing, N.Y.
Kistler Instr. Co., Redmond, Wash.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Pioneer Magnetics, Santa Monica, Cal.
Power Designs, Westbury, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
Ross Engrg. Corp., Campbell, Cal.
Simpson Elec. Co., Chicago, Ill.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tektronix, Inc., Beaverton, Ore.
Tempo Instrument, Inc., Plainview, N.Y.
United Sys. Corp., Dayton, Ohio
Weston Instruments, Inc., Newark, N.J.
Westronics, Inc., Ft. Worth, Tex.
Zi-Tech Div., Palo Alto, Cal.

Calibrators, VSWR

Alford Mfg. Co., Winchester, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
Signalite, Neptune, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
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Raytheon Co., Waltham, Mass.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
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Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
CAI Div. Bourns Inc., Barrington, Ill.
Chadwick-Helmuth Co., Inc., Monrovia, Calif.
Cole Instrument Corp., Costa Mesa, Cal.
Fairchild Space & Defense Sys., Syosset, N.Y.
Heitz, Karl, Inc., New York, N.Y.
McDonnell Douglas Electronics Co., St. Charles, Mo.
PSC Technology Inc., Glendale, Cal.
Tech Serv., Inc., Fogelsville, Pa.
Teledyne Camera Sys., Arcadia, Cal.
3M Co., St. Paul, Minn.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Cameras, Image Converter

Advanced Kinetics, Costa Mesa, Calif.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Nuclear Data, Palatine, Ill.
RCA Govt. & Comm. Sys., Moorestown, N.J.
TRW Instrs., El Segundo, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Westinghouse Elec., Elmira, N.Y.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Cameras, Infrared

Barnes Engrg. Co., Stamford, Conn.
Heitz, Karl, Inc., New York, N.Y.
R.C.A. Aerospace Sys. Div., Burlington, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Research Devices, Berkeley Heights, N.J.
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Bioelectric Instrs., Farmingdale, N.Y.
CAI Div. Bourns Inc., Barrington, Ill.
Dumont Oscilloscope Labs., Inc., W. Caldwell, N.J.
General Microwave Corp., Farmingdale, N.Y.
Heitz, Karl, Inc., New York, N.Y.
PSC Technology Inc., Glendale, Cal.
Tech Serv., Inc., Fogelsville, Pa.
Tektronix, Inc., Beaverton, Ore.
Teledyne Camera Sys., Arcadia, Cal.
Test & Measuring Instrs. Inc., Hicksville, N.Y.

Cams

Bunting, Brass & Bronze Co., Toledo, Ohio
Kahle Engrg. Co., Union City, N.J.
Kwikset Powdered Metal Prods., Anaheim, Cal.
Mechanical Engraving Co., Inc., Bronx, N.Y.

Micrite Metal Mfg., Inc., Canoga Park, Cal.
PIC Design Division, Ridgefield,, Conn.
Sterling Instr., New Hyde Pk., NY

Cans, Capacitor, Relay, Semiconductor, Transformer, etc

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GTI Corp. (E), Pittsburgh, Pa.
Kinetron Corp., Asbury Park, N.J.
Magnetic Metals Co., Camden, N.J.
Rostone Corp., Lafayette, Ind.
South Shore Metal Prods., Inc., Farmingdale, N.Y.

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ITT Jennings, Monrovia, Cal.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Sangamo Elec. Co., Pickens, S.C.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
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Shigoto Inds., Ltd., New York, N.Y.
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Stettner-Trush Inc., Cazenovia, N.Y.
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ITT Jennings, Monrovia, Cal.
Lapp Insulator Div., Interpace Corp., LeRoy, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Mallory Capacitor Co., Indpls., Ind.
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
M.I.A.L. U.S.A., Inc., Nutley, N.J.

Microwave Filter Co., Inc., East Syracuse, N.Y.
Murata Mfg. Co. Ltd., Kyoto, Japan
NCI, Inc., W. Palm Beach, Fla.
Nucleonic Prods., Canoga Pk, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
RF Interonics, Bay Shore, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
S & E I Mfg., Northridge, Cal.
San Fernando Elec. Mfg., San Fernando, Cal.
Sangamo Elec. Co., Pickens, S.C.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Tobe Deutschmann Labs., Inc., Canton, Mass.
TRW Capacitors, Ogallala, Neb.
United Mineral & Chem. Corp., New York, N.Y.
USCC/Centralab, Elctrns. Div., Burbank, Cal.
Vitramon, Inc., Bridgeport, Conn.
Wesco Elec. Co., Inc., Greenfield, Mass.

Capacitors, Fixed, Laboratory Standard

American Tech. Ceramics, Huntington Sta., N.Y.
ARCO Elctrns., Inc., Great Neck, N.Y.
Boonton Elctrns., Parsippany, N.J.
Condenser Prods. Corp., Brooksville, Fla.
Electro Sci. Inds., Portland, Ore.
Electrocube, San Gabriel, Cal
Elctrn. Assocs., W. Long Branch, N.J.
F-Dyne Elctrns., Bridgeport, Conn.
Film Capacitors, Inc., Passaic, N.J.
General Radio Co., Concord, Mass.
Mallory Capacitor Co., Indpls., Ind.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
S & E I Mfg., Northridge, Cal.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
TRW Capacitors, Ogallala, Neb.
Vitramon, Inc., Bridgeport, Conn.

Capacitors, Fixed, Mica

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Custom Elctrns., Oneonta, N.Y. Vol 3•411
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Electro Motive Mfg., Willimantic, Conn. Vol 3•441
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Sangamo Elec. Co., Pickens, S.C. Vol 3•498
Soshin Elec. Co., Tokyo, Japan Vol 3•501
Amp Inc., Harrisburg, Pa.
Cornell-Dubilier Elctrns., Newark, N.J.
Erie Technological Prods. (EEM), Erie, Pa.
General Lab. Assocs., Norwich, N.Y.
Materials for Elctrns., Inc., Jamaica, N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Tobe Deutschmann Labs., Inc., Canton, Mass.
United Mineral & Chem. Corp., New York, N.Y.

Capacitors, Fixed, Molded Composition

Airco Speer Elctrns, Div. Airco, Inc., Bradford, Pa. ..... Vol 3•519

Capacitors, Fixed, Monolithic

Republic Elctrns. Corp., Paterson, N.J. Vol 3•495
Varadyne Capacitors, Santa Monica, Cal. ..... Vol 3•512-514
American Tech. Ceramics, Huntington Sta., N.Y.
AVX Ceramics Corp., Myrtle Beach, S.C.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Johanson Mfg. Corp., Boonton, N.J.
Mepco, Inc., Morristown, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
United Mineral & Chem. Corp., New York, N.Y.
USCC/Centralab, Elctrns. Div., Burbank, Cal.

Capacitors, Fixed, Mylar

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Balco Capacitors, Orange, N.J. Vol 3•362,363
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Chicago Condenser Corp., Chicago, Ill.
Condenser Prods. Corp., Brooksville, Fla.
Cornell-Dubilier Elctrns., Newark, N.J.
Electrocube, San Gabriel, Cal
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Concepts, Inc., Eatontown, N.J.
Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
General Instr. Corp., Capacitor Div., Chicopee, Mass.
Hipotronics, Inc., Brewster, N.Y.
Industrial Condenser Corp., Chicago, Ill.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
LectroMagnetics, Inc., Los Angeles, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
M.I.A.L. U.S.A., Inc., Nutley, N.J.
Nucleonic Prods., Canoga Pk, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Paktron Div., Vienna, Va.
Presin Co., Inc., Shelton, Conn.
RF Interonics, Bay Shore, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Sangamo Elec. Co., Pickens, S.C.
Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
Texas Capacitor Co., Inc., Houston, Tex.
Tobe Deutschmann Labs., Inc., Canton, Mass.
United Mineral & Chem. Corp., New York, N.Y.

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Engineered Components Co., Gardena, Cal.
Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
Industrial Condenser Corp., Chicago, Ill.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
LectroMagnetics, Inc., Los Angeles, Cal.
Maxwell Labs., Inc., San Diego, Calif.
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Nucleonic Prods., Canoga Pk, Cal.
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Paktron Div., Vienna, Va.
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Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
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Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
Texas Capacitor Co., Inc., Houston, Tex.
United Mineral & Chem. Corp., New York, N.Y.

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ARCO Elctrns., Inc., Great Neck, N.Y.
Chicago Condenser Corp., Chicago, Ill.
Component Resch., Santa Monica, Cal.
Condenser Prods. Corp., Brooksville, Fla.
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Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
General Radio Co., Concord, Mass.
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Hipotronics, Inc., Brewster, N.Y.
Industrial Condenser Corp., Chicago, Ill.
ITT Jennings, Monrovia, Cal.
Mallory Capacitor Co., Indpls., Ind.
Maxwell Labs., Inc., San Diego, Calif.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
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San Fernando Elec. Mfg., San Fernando, Cal.
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Sprague Elec. Co., No. Adams, Mass.
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ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
RF Interonics, Bay Shore, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
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Stettner-Trush Inc., Cazenovia, N.Y.
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Industrial Condenser Corp., Chicago, Ill.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Nytronics, Inc., Darlington Div., Darlington, S.C.
RF Interonics, Bay Shore, N.Y.
S & E I Mfg., Northridge, Cal.
San Fernando Elec. Mfg., San Fernando, Cal.
Sangamo Elec. Co., Pickens, S.C.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
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Film Capacitors, Inc., Passaic, N.J.
ITT Jennings, Monrovia, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Sprague Elec. Co., No. Adams, Mass.
Tobe Deutschmann Labs., Inc., Canton, Mass.
TRW Capacitors, Ogallala, Neb.
United Mineral & Chem. Corp., New York, N.Y.

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Components Specialties, Freeport, N.Y.
Condenser Prods. Corp., Brooksville, Fla.
Elctrn. Concepts, Inc., Eatontown, N.J.
Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
Industrial Condenser Corp., Chicago, Ill.
Interelectronics Corp., Congers, N.Y.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns., Melville, N.Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
M.I.A.L. U.S.A., Inc., Nutley, N.J.
Nucleonic Prods., Canoga Pk, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Paktron Div., Vienna, Va.
Plastic Capacitors, Inc., Chicago, Ill.
S & E I Mfg., Northridge, Cal.
San Fernando Elec. Mfg., San Fernando, Cal.
Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Soshin Elec. Co., Tokyo, Japan
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
Texas Capacitor Co., Inc., Houston, Tex.
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United Mineral & Chem. Corp., New York, N.Y.

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Elctrn. Concepts, Inc., Eatontown, N.J.
Engineered Components Co., Gardena, Cal.
Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
Industrial Condenser Corp., Chicago, Ill.
Interelectronics Corp., Congers, N.Y.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns., Melville, N.Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
Matsuo Elec. Co., Ltd., Toyonaka-shi, Osaka, Japan
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
Nucleonic Prods., Canoga Pk, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
San Fernando Elec. Mfg., San Fernando, Cal.
Sangamo Elec. Co., Pickens, S.C.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Stettner-Trush Inc., Cazenovia, N.Y.
Texas Capacitor Co., Inc., Houston, Tex.
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Capacitors, Fixed, Polyester

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Electrocube, San Gabriel, Cal
Engineered Components Co., Gardena, Cal.
Film Capacitors, Inc., Passaic, N.J.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Mepco, Inc., Morristown, N.J.
Nucleonic Prods., Canoga Pk, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Stettner-Trush Inc., Cazenovia, N.Y.
TRW Capacitors, Ogallala, Neb.
United Mineral & Chem. Corp., New York, N.Y.
Wesco Elec. Co., Inc., Greenfield, Mass.

Capacitors, Fixed, Polystyrene

ARCO Elctrns., Inc., Great Neck, N.Y. Vol 3•357-359
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Centralab Elctrns Div., Milwaukee, Wisc
Chicago Condenser Corp., Chicago, Ill.
Condenser Prods. Corp., Brooksville, Fla.
Electrocube, San Gabriel, Cal
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Concepts, Inc., Eatontown, N.J.
Engineered Components Co., Gardena, Cal.
Film Capacitors, Inc., Passaic, N.J.
Filtron Co., Flushing, N.Y.
Industrial Condenser Corp., Chicago, Ill.
Interelectronics Corp., Congers, N.Y.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns., Melville, N.Y.
Int'l. Elctrns. Corp., Melville, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
M.I.A.L. U.S.A., Inc., Nutley, N.J.
Nucleonic Prods., Canoga Pk, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Presin Co., Inc., Shelton, Conn.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Texas Capacitor Co., Inc., Houston, Tex.
TRW Capacitors, Ogallala, Neb.
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Capacitors, Fixed, Polysulfone

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Film Capacitors, Inc., Passaic, N.J.
ITT Jennings-Monrovia, San Jose, Cal.
Shigoto Inds., Ltd., New York, N.Y.
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Capacitors, Fixed, Porcelain, Enamel

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Electro-Science Labs., Pennsauken, N. J.
ITT Jennings, Monrovia, Cal.
JFD Elctrns., Bklyn., N.Y.
Johanson/Monolithic Dielectrics Div., Burbank, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
United Mineral & Chem. Corp., New York, N.Y.
Vitramon, Inc., Bridgeport, Conn.

Capacitors, Fixed, Power Factor Correction

Cinefot International Corp., New York, N.Y.
Condenser Prods. Corp., Brooksville, Fla.
Cornell-Dubilier Elctrns., Newark, N.J.
Del Electronics Corp., Mt. Vernon, N.Y.
Elctrn. Concepts, Inc., Eatontown, N.J.
Filtron Co., Flushing, N.Y.
Interelectronics Corp., Congers, N.Y.
ITT Jennings, Monrovia, Cal.
Nytronics, Inc., Darlington Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
RF Interonics, Bay Shore, N.Y.
S & E I Mfg., Northridge, Cal.
Sangamo Elec. Co., Pickens, S.C.
Sprague Elec. Co., No. Adams, Mass.
TRW Capacitors, Ogallala, Neb.
United Mineral & Chem. Corp., New York, N.Y.
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Capacitors, Fixed, Pulse-Forming Network

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Amp Inc., Harrisburg, Pa.
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Cornell-Dubilier Elctrns., Newark, N.J.
Custom Elctrns., Oneonta, N.Y.
Del Electronics Corp., Mt. Vernon, N.Y.
EMC Technology Inc, Cherry Hill, N.J.
F-Dyne Elctrns., Bridgeport, Conn.
Filtron Co., Flushing, N.Y.
General Lab. Assocs., Norwich, N.Y.
Hipotronics, Inc., Brewster, N.Y.
ITT Jennings, Monrovia, Cal.
ITT Jennings-Monrovia, San Jose, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Nucleonic Prods., Canoga Pk, Cal.
Plastic Capacitors, Inc., Chicago, Ill.
San Fernando Elec. Mfg., San Fernando, Cal.
Soshin Elec. Co., Tokyo, Japan
Sprague Elec. Co., No. Adams, Mass.
Tobe Deutschmann Labs., Inc., Canton, Mass.
TRW Capacitors, Ogallala, Neb.
USCC/Centralab, Elctrns. Div., Burbank, Cal.
Vitramon, Inc., Bridgeport, Conn.

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Electro Motive Mfg., Willimantic, Conn.
Erie Technological Prods. (EEM), Erie, Pa.
Materials for Elctrns., Inc., Jamaica, N.Y.
Sangamo Elec. Co., Pickens, S.C.
Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
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North Hills Elctrns., Inc., Glen Cove, N.Y.
Sealectro Corp., Mamaroneck, N.Y.
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Dynamic Measurements Corp., Winchester, Ma.
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Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
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Intronics, Inc., Newton, Mass.
Ledex, Inc., Dayton, Ohio
Metric Sys., Ft. Walton Beach, Fla.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Singer Co., Little Falls, N.J.
Stanford Applied Engrg., Santa Clara, Cal.
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Di/An Controls, Inc., Boston, Mass.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Douglas Electronics, Inc., San Leandro, Cal.
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Integrated Microsystems Inc., Mt. View, Cal.
Kates Scientific Instrs., Inc., Watertown, Mass.
Lear Siegler, Inc., Santa Monica, Calif.
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Metric Sys., Ft. Walton Beach, Fla.
Midland Standard Inc., Elgin, Ill.
Monitor Systems, Ft. Washington, Pa
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Nuclear Data, Palatine, Ill.
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Standard Logic, Santa Ana, Cal.
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Computer Prods., Ft. Lauderdale, Fla.
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Data Technology, Santa Ana, Cal.
Datacom, Inc., Ft. Walton Bch., Fla.
Di/An Controls, Inc., Boston, Mass.
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IFE Div., E. Providence, R. I.
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Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Kinetron Corp., Asbury Park, N.J.
LMB Heeger, Inc., Los Angeles, Calif.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Micrite Metal Mfg., Inc., Canoga Park, Cal.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mobil Elctrns., Inc., Anderson, Ind.
Mupac Corp., Brockton, Mass.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Robinson-Nugent, New Albany, Ind.
Stantron, No. Hollywood, Cal.
Titchener, E.H. & Co., Binghamton, N.Y.
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Zero Mfg. Co., Burbank, Cal.

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Chemicals, Electroplating
Allied Chemical Corp., Morristown, N.J.
Baker, J.T. Chemical Co., Phillipsburg, N.J.
Barco Chem. Prods. Co., Chicago, Ill.
Bariod Div., Houston, Tex.
Conversion Chem. Corp., Rockville, Conn.
Dow Chemical Co., Midland, Mich.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Fidelity Chem. Prods. Corp., Newark, N.J.
GAF Corp., New York, N.Y.
Goldsmith Precious Metals Div., Chicago, Ill.
Harshaw Chem. Co., Cleveland, Ohio
London Chemical Co., Bensenville, Ill.
M & T Chemicals Inc., Rahway, N.J.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Selectrons, Ltd., New York, N.Y.
Sifco Metachemical, Cleveland, Ohio
Technic, Inc., Providence, R.I.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Uniroyal, Inc., New York, N.Y.
United Mineral & Chem. Corp., New York, N.Y.

Chemicals, Epoxy Stripping
Bariod Div., Houston, Tex.
Conversion Chem. Corp., Rockville, Conn.
Hardman Inc., Belleville, N.J.
Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
Mona Inds., Inc., Paterson, N.J.
Ram Chems., Gardena, Calif.

Chemicals, Etching
Air Prods. & Chems., Inc., Allentown, Pa.
Allied Chemical Corp., Morristown, N.J.
Alpha Metals, Inc., Jersey City, N.J.
Baker, J.T. Chemical Co., Phillipsburg, N.J.
Chemplast, Inc., Wayne, N.J.
Conversion Chem. Corp., Rockville, Conn.
Dow Chemical Co., Midland, Mich.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Fidelity Chem. Prods. Corp., Newark, N.J.
GAF Corp., New York, N.Y.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
GC Electronics, Rockford, Ill.
Gore, W.L. & Assocs., Inc., Newark, Del.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Matheson Gas Products, East Rutherford, N.J.
Mona Inds., Inc., Paterson, N.J.
Packaged Resins Div., Watertown, Mass.
Selectrons, Ltd., New York, N.Y.
Union Carbide, Chemicals & Plastics, New York, N.Y.

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Black Light Corp. Amer., San Gabriel, Cal.
Cerac, Inc., Butler, Wisc.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Shannon Luminous Mat'ls., Hollywood, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
United Mineral & Chem. Corp., New York, N.Y.

Chemicals, Metal Stripping
Allied Chemical Corp., Morristown, N.J.
Bariod Div., Houston, Tex.
Conversion Chem. Corp., Rockville, Conn.
Fidelity Chem. Prods. Corp., Newark, N.J.
GAF Corp., New York, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Technic, Inc., Providence, R.I.

Chemicals, Photosensitive
Dow Chemical Co., Midland, Mich.
GC Electronics, Rockford, Ill.

General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Goldsmith Precious Metals Div., Chicago, Ill.
GTE Sylvania, Inc., Towanda, Pa.
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Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
United Mineral & Chem. Corp., New York, N.Y.
Vari-Light Corp., Cincinnati, Ohio

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Air Prods. & Chems., Inc., Allentown, Pa.
Allied Chemical Corp., Morristown, N.J.
Alpha Metals, Inc., Jersey City, N.J.
Baker, J.T. Chemical Co., Phillipsburg, N.J.
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Carborundum Co., Niagara Falls, N.Y.
Cerac, Inc., Butler, Wisc.
CGS Units, Inc., Rochester, N.Y.
GC Electronics, Rockford, Ill.
Materials Resch. Corp., Orangeburg, N.Y.
Matheson Gas Products, East Rutherford, N.J.
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Ferrodyne Corp., Venice, Calif.
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Mag-Con, Inc., New Brighton, Minn.
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Custom Coil & Transformer Co., Zanesville, Ohio
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Del Electronics Corp., Mt. Vernon, N.Y.
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Electrocube, San Gabriel, Cal
Electronic Resch. Assocs., Moonachie, N.J.
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Ferrodyne Corp., Venice, Calif.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
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Bourns Pacific Magnetic Corp., Romoland, Calif.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Cambridge Thermionic, Cambridge, Mass
Coil Specialty Co., Boalsburg, Pa.
Dale Elctrns., Inc., Yankton, S.D.
Delevan Div., Coil Prods., E. Aurora, N.Y.
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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
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Lambda Elctrns., Melville, N.Y.
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Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Millen, James Mfg., Malden, Mass.
Ohmite Mfg. Co., Skokie, Ill.
Pulse Engrg., Inc., San Diego, Cal.
Shallcross, Selma, N.C.
Shigoto Inds., Ltd., New York, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Stanford Applied Engrg., Santa Clara, Cal.
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Bourns Pacific Magnetic Corp., Romoland, Calif.
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Del Electronics Corp., Mt. Vernon, N.Y.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Dietz Design, Inc., Belton, Mo.
Douglas Randall Div., Pawcatuck, Conn.
Eastern Delta Corp., Fair Lawn, N.J.
Electrocube, San Gabriel, Cal
Elgin Elctrns. Inc., Waterford, Pa.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Microtran Co. Inc., Valley Stream, N.Y.
Neshaminy Transformer, Furlong, Pa.
North Electric Co., Galion, Ohio
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Raytheon Co., Waltham, Mass.
Signal Transformer, Bklyn., N.Y.
Stancor, Chicago, Ill.
Todd Systems, Yonkers, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
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Zaring Inds., Inc., Westfield, Ind.

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Airtron, Morris Plains, N.J.
Co-Operative Inds., Inc., Chester, N.J.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
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Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Climatronics Corp., Hauppauge, N.Y.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Elctrn. Applications, S. El Monte, Cal.
Firing Circuits, Norwalk, Conn.
General Magnetics, Bloomfield, N.J.
Graphite Metallizing Corp., Yonkers, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
International Rectifier, El Segundo, Cal.
Ithaco, Inc., Ithaca, N.Y.
James Elctrns., Inc., Chicago, Ill.
Oak Inds. Inc., Crystal Lake, Ill.
Philamon, Inc., Westbury, N.Y.
Power Control Corp., Pittsburgh, Pa.
Raytheon, Mt. View, Calif.
Singer Co., Little Falls, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
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Digital Equip. Corp., Maynard, Mass.
Douglas Electronics, Inc., San Leandro, Cal.
Electrol Co., Inc., York, Pa.
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GTE Sylvania, Muncy, Pa.
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GTI Corp. (E), Pittsburgh, Pa.
Keystone Elctrns. Corp., New York, N.Y.
Lockheed Elctrns. Co., Watchung, N.J.
Methode Elctrns., Inc., Chicago, Ill.
Metric Sys., Ft. Walton Beach, Fla.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Midland Standard Inc., Elgin, Ill.
Pomona Elctrns. Co., Inc., Pomona, Cal.
Power/Mate, Hackensack, N.J.
Rogers Corp., Rogers, Conn.
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Synthane Taylor Corp., Valley Forge, Pa.
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Croven, Ltd., Whitby, Ont., Can.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Cutler-Hammer, Milwaukee, Wisc.
E-T-A Prods. Co. America, Chicago, Ill.
GC Electronics, Rockford, Ill.
GTE Sylvania Inc., Danvers, Mass.
Hartman Electrical Mfg., Mansfield, Ohio
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Mauratron, Inc., Dallas, Tex.
Potter & Brumfield, Princeton, Ind.
Square D Co., Park Ridge, Ill.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Underwriters Safety Device Co., Chicago, Ill.
Wadsworth Elec. Mfg. Co., Inc., Covington, Ky.
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Wood Electric Operations, Danvers, Mass.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

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Ansley Elctrns. Corp., Doylestown, Pa.
Beman Mfg., Inc., New Cumberland, Pa.
Buckbee-Mears Co., St. Paul, Minn.
Bureau Engraving, Inc., Minneapolis, Minn.
Chem Aero, Inc., Wilmington, Cal.
Cinch-Graphik, Oper. of TRW Elctrn. Comps., City of Industry, Cal.
Flex-Link Products, Inc., San Fernando, Cal.
Flexible Circuits, Inc., Warrington, Pa.
Gore, W.L. & Assocs., Inc., Newark, Del.
GTI Corp. (E), Pittsburgh, Pa.
ITT Cannon Electric, Santa Ana, Cal.
Lockheed Elctrns. Co., Watchung, N.J.
Methode Elctrns., Inc., Chicago, Ill.
Rogers Corp., Rogers, Conn.
Schjeldahl, G.T. Co., Northfield, Minn.
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Kates Scientific Instrs., Inc., Watertown, Mass.
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HyComp Inc., Maynard, Mass.
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Integrated Microsystems Inc., Mt. View, Cal.
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Mepco, Inc., Morristown, N.J.
Mica Corporation, Culver City, Calif.
Micro Networks, Worcester, Mass.
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Mini-Systems, Inc, North Attleboro, Mass.
National Semiconductor, Santa Clara, Cal.
Norsal Industries, Inc., Brentwood, N.Y.
Raytheon Co., Quincy, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
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Texas Instruments, Dallas, Tex.
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Motorola Semiconductor Prods., Phoenix, Ariz.
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Precision Monolithics Inc., Santa Clara, Cal.
Raytheon, Mt. View, Calif.
Signetics. Corp., Sunnyvale, Calif.
Solid State Scientific, Montgomeryville, Pa.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Semiconductor, Mountain View, Cal.
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Thin Film Services, Gile, Wisc.
3M Co., St. Paul, Minn.
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Western Coating Co., Royal Oak, Mich.

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Naz-Dar Int'l., Chicago, Ill.
Randolph Prods. Co., Carlstadt, N.J.
Thin Film Services, Gile, Wisc.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Union Carbide, Chemicals & Plastics, New York, N.Y.

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Injectorall Elctrns. Corp., Glen Cove, N.Y.
Krylon, Norristown, Pa.
N L Inds., Inc., Paint Div., New York, N. Y.
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Shannon Luminous Mat'ls., Hollywood, Cal.
3M Co., St. Paul, Minn.

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Dow Chemical Co., Midland, Mich.
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GAF Corp., New York, N.Y.
GC Electronics, Rockford, Ill.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Millen, James Mfg., Malden, Mass.
Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
N L Inds., Inc., Paint Div., New York, N. Y.
Randolph Prods. Co., Carlstadt, N.J.
Sterling, Sewickley, Pa.
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Conap, Inc., Allegany, N.Y.
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Electro Mats. Corp. Amer., Mamaroneck, N.Y.
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Emerson & Cuming, Inc., Canton, Mass.
Epoxy Technology, Watertown, Mass.
GAF Corp., New York, N.Y.
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Hardman Inc., Belleville, N.J.
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Loctite Corp., Newington, Conn.
LPS Research Labs., Los Angeles, Cal.
MacDonald & Co., Glendale, Calif.
Materials Resch. Corp., Orangeburg, N.Y.
Merix Chem. Co., Chicago, Ill.
National Beryllia Corp., Haskell, N.J.
Packaged Resins Div., Watertown, Mass.
Randolph Prods. Co., Carlstadt, N.J.
Sprayon Prods., Inc., Bedford Hgts., Ohio
Stock Drive Prods., New Hyde Pk., N.Y.
SWS Silicones Div., Adrian, Mich.
Tech Spray, Amarillo, Tex.
Thermalloy Co., Inc., Dallas, Tex.
3M Co., St. Paul, Minn.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Union Carbide, San Diego, Cal.
Uniroyal, Inc., New York, N.Y.
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SWS Silicones Div., Adrian, Mich.
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Dietz Design, Inc., Belton, Mo.
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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
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Pulse Engrg., Inc., San Diego, Cal.
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Allen Avionics, Mineola, N.Y.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Bicron Elctrns. Co., Canaan, Conn.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Clippard Instr., Inc., Cincinnati, Ohio
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Components Specialties, Freeport, N.Y.
Computer Comps., Jamaica, N.Y.
Dale Elctrns., Inc., Yankton, S.D.
Dietz Design, Inc., Belton, Mo.
E-Systems, Inc., Memcor Div., Huntington, Ind.
El-Rad Mfg. Co., Chicago, Ill.
Endicott Coil Co., Binghamton, N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Microtran Co. Inc., Valley Stream, N.Y.
Mitsumi Elec. Co., Ltd., Kitatamagun, Tokyo, Japan
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Piconics Inc., Tyngsboro, Mass.
Pulse Engrg., Inc., San Diego, Cal.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Syscon Int'l., Inc., So. Bend, Ind.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.

Coils, Metallized Glass

Dale Elctrns., Inc., Yankton, S.D. Vol 3•524,525
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American Trans-Coil Corp., Richmond Hill, N.Y.
GTE Sylvania Inc., Danvers, Mass.
JFD Elctrns., Bklyn., N.Y.
United Prods. Co., New Hyde Pk., N.Y.

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Aladdin Elctrns., Nashville, Tenn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Arcidy Assocs., Manchester, N. H.
Automation Services Div., Windsor, N. Y.
Bell Industries, Compton, Cal.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cambridge Thermionic, Cambridge, Mass
Coast Coil Co., Los Angeles, Calif.
Component Specialties, Temple City, Cal.
Cosmo Plastics Co., Cleveland, Ohio
Coto-Coil Co., Inc., Providence, R.I.
Dale Elctrns., Inc., Yankton, S.D.
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Endicott Coil Co., Binghamton, N.Y.
EWC, Inc., Kenilworth, N.J.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Kates Scientific Instrs., Inc., Watertown, Mass.
K.G.S. Elctrns., Pasadena, Cal.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Torotron, Mt. Vernon, N.Y.
United Prods. Co., New Hyde Pk., N.Y.

Coils, Oscillator

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Vari-L Co., Inc., Denver, Colo. Vol 3• 1310
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Solid State Elctrns. Corp., Sepulveda, Cal.

Coils, Relay

American Magnetics Corp., Carterville, Ill.
American Trans-Coil Corp., Richmond Hill, N.Y.
Artisan Elctrns. Corp., Parsippany, N.J.
Automation Services Div., Windsor, N. Y.
Coil Co. of Amer., Northvale, N.J.
Coil Specialty Co., Boalsburg, Pa.
Component Specialties, Temple City, Cal.
Computer Comps., Jamaica, N.Y.
Coto-Coil Co., Inc., Providence, R.I.
Custom Coil & Transformer Co., Zanesville, Ohio
Dale Elctrns., Inc., Yankton, S.D.
Dormeyer Inds., Chicago, Ill.
Douglas Randall Div., Pawcatuck, Conn.
El-Rad Mfg. Co., Chicago, Ill.
Elctrn. Assocs., W. Long Branch, N.J.
Electronic Coil Corp., Plainville, Conn.
Endicott Coil Co., Binghamton, N.Y.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Grand Transformers, Grand Haven, Mich.
Guardian California, Culver City, Cal.
Guardian Elec. Mfg. Co., Chicago, Ill.
James Elctrns., Inc., Chicago, Ill.
Kilovac Corp., Santa Barbara, Cal.
Liberty Controls, Inc., Shorewood, Ill.
Oeco Corp., Portland, Ore.
Relay Service Co., Chicago, Ill.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
United Prods. Co., New Hyde Pk., N.Y.
U.S. Elctrns., Long Branch, N.J.

Coils, R-F

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North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 3•533
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan ..... Vol 3•537
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ADC Prods., Minneapolis, Minn.
Aladdin Elctrns., Nashville, Tenn.
Allen Avionics, Mineola, N.Y.
American Time Products, Woodside, N.Y.
American Trans-Coil Corp., Richmond Hill, N.Y.
Arcidy Assocs., Manchester, N. H.
Automatic Coil, New Hyde Pk., N.Y.
Barker & Williamson, Inc., Bristol, Pa.
Bicron Elctrns. Co., Canaan, Conn.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Cambridge Thermionic, Cambridge, Mass
Clippard Instr., Inc., Cincinnati, Ohio
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.
Collins Radio Co., Dallas, Tex.
Computer Comps., Jamaica, N.Y.
Dietz Design, Inc., Belton, Mo.
E-Systems, Inc., Memcor Div., Huntington, Ind.
El-Rad Mfg. Co., Chicago, Ill.
Endicott Coil Co., Binghamton, N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Helix Spring Corp., Long Island City, N.Y.
Johnson E. F. Co., Waseca, Minn.
Kappa Networks, Inc., Carteret, N.J.
Lenox-Fugle Elctrns., Inc., S. Plainfield, N.J.
Mitsumi Elec. Co., Ltd., Kitatamagun, Tokyo, Japan
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Ohmite Mfg. Co., Skokie, Ill.
Piconics Inc., Tyngsboro, Mass.
Pulse Engrg., Inc., San Diego, Cal.
RF Interonics, Bay Shore, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Syscon Int'l., Inc., So. Bend, Ind.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.

Coils, Saturable Reactor

ADC Prods., Minneapolis, Minn.
Aladdin Elctrns., Nashville, Tenn.
Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
American Trans-Coil Corp., Richmond Hill, N.Y.
Bell Industries, Compton, Cal.
Bicron Elctrns. Co., Canaan, Conn.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Cross Electronics Inc., Warrendale, Pa.
Dale Elctrns., Inc., Yankton, S.D.
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Electro-Pacific, Inc., Goleta, Calif.
Electrocom Inds., So. Bend, Indiana
Electrocube, San Gabriel, Cal
Elctrn. Assocs., W. Long Branch, N.J.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Hisonic, Inc., Olathe, Kans.
Huntington Elctrns. Corp., Van Nuys, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
JB Elctrn. Transformers, Inc., Chicago, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Mag-Con, Inc., New Brighton, Minn.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
Neshaminy Transformer, Furlong, Pa.
NWL Transformers, Trenton, N.J.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Phoenix Transformer Co., Phoenix, Ariz.
RtroN Corp., Skokie, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Torotel, Inc., Grandview, Mo.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
United Prods. Co., New Hyde Pk., N.Y.

Coils, Shielded

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Aladdin Elctrns., Nashville, Tenn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Cambridge Thermionic, Cambridge, Mass
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Computer Comps., Jamaica, N.Y.
Dale Elctrns., Inc., Yankton, S.D.
Data Delay Devices, Clifton, N.J.
Dietz Design, Inc., Belton, Mo.
E-Systems, Inc., Memcor Div., Huntington, Ind.
Endicott Coil Co., Binghamton, N.Y.
Lenox-Fugle Elctrns., Inc., S. Plainfield, N.J.
NWL Transformers, Trenton, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Piconics Inc., Tyngsboro, Mass.
Syscon Int'l., Inc., So. Bend, Ind.
Torwico Elctrns., Inc., Lakewood, N.J.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.

Coils, Solenoid

Advanced Kinetics, Costa Mesa, Calif.
American Magnetics Corp., Carterville, Ill.
American Magnetics, Oak Ridge, Tenn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Artisan Elctrns. Corp., Parsippany, N.J.
Automatic Coil, New Hyde Pk., N.Y.
Automation Services Div., Windsor, N. Y.
Bicron Elctrns. Co., Canaan, Conn.
Cambridge Thermionic, Cambridge, Mass
Coil Co. of Amer., Northvale, N.J.
Coil Specialty Co., Boalsburg, Pa.
Component Specialties, Temple City, Cal.
Computer Comps., Jamaica, N.Y.
Coto-Coil Co., Inc., Providence, R.I.
Custom Coil & Transformer Co., Zanesville, Ohio
Dale Elctrns., Inc., Yankton, S.D.
De Soto Elec. Prods., De Soto, Mo.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Dietz Design, Inc., Belton, Mo.
Dormeyer Inds., Chicago, Ill.
Douglas Randall Div., Pawcatuck, Conn.
Electrocom Inds., So. Bend, Indiana
Elctrn. Assocs., W. Long Branch, N.J.
Electronic Coil Corp., Plainville, Conn.
Endicott Coil Co., Binghamton, N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
James Elctrns., Inc., Chicago, Ill.
Ledex, Inc., Dayton, Ohio
Liberty Controls, Inc., Shorewood, Ill.
Lisk, G.W. Co., Clifton Springs, N.Y.
Mag-Con, Inc., New Brighton, Minn.
NWL Transformers, Trenton, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
Piconics Inc., Tyngsboro, Mass.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Staco, Inc., Dayton, Ohio
Torwico Elctrns., Inc., Lakewood, N.J.
United Prods. Co., New Hyde Pk., N.Y.
U.S. Elctrns., Long Branch, N.J.
O. S. Walker Co., Worcester, Mass.
Zaring Inds., Inc., Westfield, Ind.

Coils, Telephone

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ADC Prods., Minneapolis, Minn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Computer Comps., Jamaica, N.Y.
Corcom Inc., Chicago, Ill.
Dale Elctrns., Inc., Yankton, S.D.
Electrocom Inds., So. Bend, Indiana
Elctrn. Assocs., W. Long Branch, N.J.
Electronic Coil Corp., Plainville, Conn.
Endicott Coil Co., Binghamton, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Torotel, Inc., Grandview, Mo.
United Prods. Co., New Hyde Pk., N.Y.
U.S. Elctrns., Long Branch, N.J.

Coils, Telephone Pickup (For Recording)—See Pickups, Telephone

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ADC Prods., Minneapolis, Minn.
Aladdin Elctrns., Nashville, Tenn.
Allen Avionics, Mineola, N.Y.
Allen Elctrns. Div., Macungie, Pa.
Altec Div., Anaheim, Calif.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Barker & Williamson, Inc., Bristol, Pa.
Bicron Elctrns. Co., Canaan, Conn.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Cambridge Thermionic, Cambridge, Mass
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Collins Radio Co., Dallas, Tex.
Corcom Inc., Chicago, Ill.
Cross Electronics Inc., Warrendale, Pa.
De Coursey Engrg. Lab., Culver City, Cal.
Dietz Design, Inc., Belton, Mo.
El-Rad Mfg. Co., Chicago, Ill.
Electro-Pacific, Inc., Goleta, Calif.
Electrocom Inds., So. Bend, Indiana
Electrocube, San Gabriel, Cal
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Flight Sys., Inc., Mechanicsburg, Pa.
Freed Transformer Co., Bklyn., N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Geo Space, Houston, Tex.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Harder, Donald C. Co., Inc., San Diego, Calif.
Huntington Elctrns. Corp., Van Nuys, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Kappa Networks, Inc., Carteret, N.J.
K.G.S. Elctrns., Pasadena, Cal.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
Midwec Corp., Scottsbluff, Neb.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
RF Interonics, Bay Shore, N.Y.
RtroN Corp., Skokie, Ill.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Shallco, Inc., Smithfield, N.C.
Shigoto Inds., Ltd., New York, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Stancor, Chicago, Ill.
Stanford Applied Engrg., Santa Clara, Cal.
Sterling Transformer Corp., Brooklyn, N.Y.
Syscon Int'l., Inc., So. Bend, Ind.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
Triad-Utrad Div., Huntington, Ind.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.
Unitron Inc., Garland, Tex.
White Instrs., Inc., Austin, Tex.
Zaring Inds., Inc., Westfield, Ind.

Coils, Transducer

Altec Div., Anaheim, Calif.
American Trans-Coil Corp., Richmond Hill, N.Y.
Ametek/Instrs. & Controls, Feasterville, Pa.
Bicron Elctrns. Co., Canaan, Conn.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Coto-Coil Co., Inc., Providence, R.I.
Dale Elctrns., Inc., Yankton, S.D.
Elctrn. Assocs., W. Long Branch, N.J.
Electronic Coil Corp., Plainville, Conn.
Endicott Coil Co., Binghamton, N.Y.
Flow Technology, Inc., Tempe, Ariz.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Geo Space, Houston, Tex.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
LDJ Electronics, Troy, Mich.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
Sensor Corp., Scottsdale, Pa.
Torwico Elctrns., Inc., Lakewood, N.J.
United Prods. Co., New Hyde Pk., N.Y.
Waldom Elctrns., Inc., Chicago, Ill.
Zaring Inds., Inc., Westfield, Ind.

Coils, Transformer

ADC Prods., Minneapolis, Minn.
Aladdin Elctrns., Nashville, Tenn.
American Trans-Coil Corp., Richmond Hill, N.Y.
Bell Industries, Compton, Cal.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Coast Coil Co., Los Angeles, Calif.
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.
Component Specialties, Temple City, Cal.
Computer Comps., Jamaica, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Custom Coil & Transformer Co., Zanesville, Ohio
Dale Elctrns., Inc., Yankton, S.D.
Del Electronics Corp., Mt. Vernon, N.Y.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Dietz Design, Inc., Belton, Mo.
Douglas Randall Div., Pawcatuck, Conn.
Electro-Pacific, Inc., Goleta, Calif.
Electrocom Inds., So. Bend, Indiana
Electrocube, San Gabriel, Cal
Electronic Coil Corp., Plainville, Conn.
Endicott Coil Co., Binghamton, N.Y.
EWC, Inc., Kenilworth, N.J.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Huntington Elctrns. Corp., Van Nuys, Cal.
James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Mag-Con, Inc., New Brighton, Minn.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
Midwec Corp., Scottsbluff, Neb.
NWL Transformers, Trenton, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Permaluster, Inc., Burbank, Calif.
Peschel Instrs., Cape Coral, Fla.
Sag Harbor Inds., Inc., Sag Harbor, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Staco, Inc., Dayton, Ohio
Syscon Int'l., Inc., So. Bend, Ind.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.
U.S. Elctrns., Long Branch, N.J.
O. S. Walker Co., Worcester, Mass.
Zaring Inds., Inc., Westfield, Ind.

Coils, TV (All Types)

Amperex Electronic Corp., Hicksville, N.Y. ..... Vol 3•521
Bell Industries, Compton, Cal. Vol 3•532
Allen Avionics, Mineola, N.Y.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Clippard Instr., Inc., Cincinnati, Ohio
Coil Specialty Co., Boalsburg, Pa.
Dale Elctrns., Inc., Yankton, S.D.
Douglas Randall Div., Pawcatuck, Conn.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Mitsumi Elec. Co., Ltd., Kitatamagun, Tokyo, Japan
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Shigoto Inds., Ltd., New York, N.Y.
Syntronic Instrs., Inc., Addison, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
United Prods. Co., New Hyde Pk., N.Y.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Coils, Variable

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Bell Industries, Compton, Cal. Vol 3•532
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Delevan Div. American Precision Ind., E. Aurora, N.Y. ..... Vol 3•526
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Hisonic, Inc., Olathe, Kans. .... Vol 3•1257
Millen, James Mfg., Malden, Mass. Vol 3•527
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 3•533
Sangamo Elec. Co., Pickens, S.C. Vol 3•498
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Allen Avionics, Mineola, N.Y.
Altec Div., Anaheim, Calif.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Bicron Elctrns. Co., Canaan, Conn.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Cambridge Thermionic, Cambridge, Mass
Chesterfield Prods. Inc., Saddle Brook, N. J.
Clippard Instr., Inc., Cincinnati, Ohio
Coil Craft Inc., Bronxville, N.Y.
Coil Specialty Co., Boalsburg, Pa.

Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Component Specialties, Temple City, Cal.
Computer Comps., Jamaica, N.Y.
Corcom Inc., Chicago, Ill.
Dale Elctrns., Inc., Yankton, S.D.
Dietz Design, Inc., Belton, Mo.
E-Systems, Inc., Memcor Div., Huntington, Ind.
El-Rad Mfg. Co., Chicago, Ill.
Electrocom Inds., So. Bend, Indiana
Freed Transformer Co., Bklyn., N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
JFD Elctrns., Bklyn., N.Y.
Johnson E. F. Co., Waseca, Minn.
Kappa Networks, Inc., Carteret, N.J.
Microtran Co. Inc., Valley Stream, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Piconics Inc., Tyngsboro, Mass.
Pulse Engrg., Inc., San Diego, Cal.
San Fernando Elec. Mfg., San Fernando, Cal.
Stanford Applied Engrg., Santa Clara, Cal.
Syscon Int'l., Inc., So. Bend, Ind.
TRW Elctrnc. Functions, Candem, N.J.
United Prods. Co., New Hyde Pk., N.Y.
O. S. Walker Co., Worcester, Mass.

Coils, Vidicon Alignment

American Trans-Coil Corp., Richmond Hill, N.Y.
Amperex Elctronic Corp., Slatersville, R.I.
CELCO, Mahwah, N.J.
Cleveland Elctrns., Inc., Cleveland, Ohio
Syntronic Instrs., Inc., Addison, Ill.

Coincidence Analyzers—See Analyzers, Coincidence

Cold-Cathode Readout Tubes —See Tubes, Readout

Comm. Systems, Carrier Current

CCA Elctrns. Corp., Gloucester, N.J.
Demex, Inc., Kansas City, Mo.
General Devices, Inc., Princeton, N.J.
GTE Lenkurt Inc., San Carlos, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
RFL Inds., Comms. Div., Boonton, N.J.
Talk-A-Phone Co., Chicago, Ill.

Comm. Systems, Data

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Sangamo Elec. Co., Springfield, Ill. Vol 1•371
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A. D. Data Sys., Inc., Rochester, N.Y.
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Analogic, Wakefield, Mass.
Austron, Inc., Austin, Tex.
Autocon Inds., Inc., Minneapolis, Minn.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Bramco Controls, Piqua, Ohio
Bunker-Ramo Corp., Westlake Village, Cal
Burroughs Corp., Pasadena, Cal.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Codex Corp., Newton, Mass.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Computer Conversions Corp., East Northport, N.Y.
Conrac Corp., Fairfield, N.J.
Continental Data Sys., Dayton, Ohio
Cubic Corp., San Diego, Cal.
Data General Corp. (E), Southboro, Ma.
Dataprobe, Inc., So. Hackensack, N.J.
Datex Div., Duarte, Cal.
Demex, Inc., Kansas City, Mo.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitronics Corp., Albertson, N.Y.
E-Systems Inc., Dallas, Tex.
Electrac, Inc., Anaheim, Calif.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Foxboro Co., Foxboro, Mass.
Frederick Electronics Corp., Frederick, Md.
General Data Inds. Inc. Inc., Wilton, Conn.
General Devices, Inc., Princeton, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hathaway Instruments, Inc., Denver, Colo.
Honeywell Information Systems, Waltham, Mass.
Instrumentation Tech. Corp., Northbridge, Cal.
Integrated Systems, Inc., Norcross, Ga.
International Communications Corp., A Milgo Co., Miami, Fla.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Microdata Corp., Irvine, Cal.
NES, Inc., Itasca, Ill.
North Electric Co., Galion, Ohio
Pacific Communications, Santa Ana, Cal.
Pioneer Elec. & Resch. Corp., Forest Park, Ill.
Princeton Elctrn. Prods., New Brunswick, N.J.
Raytheon Data Systems Co., Norwood, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
RCA Service Co., Camden, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Singer Co., Little Falls, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
T-Bar Inc., Wilton, Conn.
Tasker Systems, Chatsworth, Cal.
Teletype Corp., Skokie, Ill.
Texas Instruments, Inc., Houston, Tex.
Theta Instr. Corp., Fairfield, N.J.
Varian Data Machines, Irvine, Cal.
Victor Comptometer Corp., Chicago, Ill.
Vidar Corp., Mountain View, Cal.
Video Research Corp., Gaithersburg, Md.
Warren G-V Communications, Livingston, N.J.
Western Telematic, Inc., Costa Mesa, Cal.

Comm. Systems, F-M

Emergency Beacon Corp., New Rochelle, N. Y. ..... Vol 1•936
Arvin Sys., Inc., Dayton, Ohio
Astro Comm. Lab., Gaithersburg, Md.
Bendix Corp., Ft. Lauderdale, Fla.
Bendix Corp, Towson, Md.
BF Elctrns., Solana Beach, Calif.
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Conic Corp., San Diego, Calif.
Drake, R.L., Co., Miamisburg, Ohio
Elctrn. Comm., Inc., St. Petersburg, Fla.
Electrospace Systems Inc., Richardson, Tex.
Environmental Communications Inc., Santa Ana, Cal.
Farinon Electric, San Carlos, Calif.
General Devices, Inc., Princeton, N.J.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
IEC Electronics Corp., E. Rochester, N.Y.
Integrated Systems, Inc., Norcross, Ga.
ITT Mackay Marine, Elizabeth, N.J.
Johnson E. F. Co., Waseca, Minn.
Lear Siegler, Inc., Santa Monica, Calif.
Mu-Del Elctrns., Silver Spring, Md.
Pace Div., Harbor City, Calif.
Pacific Communications, Santa Ana, Cal.
Pearce-Simpson, Miami, Fla.
Rank Precision Inds., Des Plaines, Ill.
Raytheon Data Systems Co., Norwood, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
Regency Elctrns., Inc., Indianapolis, Ind.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Video Research Corp., Gaithersburg, Md.
Watkins Johnson Co., Palo Alto, Cal.

Comm. Systems, Facsimile

Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Cardion Elctrns., Woodbury, N.Y.
Datalog Div., Litton Sys., Melville, N. Y.
Dranetz Engrg. Labs., So. Plainfield, N.J.
EG&G, Inc., Bedford, Mass.
Frederick Electronics Corp., Frederick, Md.
GTE Lenkurt Inc., San Carlos, Calif.
ITT Mackay Marine, Elizabeth, N.J.
3M Co., St. Paul, Minn.
Victor Comptometer Corp., Chicago, Ill.

Comm. Systems, Frequency Shift

A.R.F. Products, Inc., Boulder, Colo.
Arvin Sys., Inc., Dayton, Ohio
Autocon Inds., Inc., Minneapolis, Minn.
Bramco Controls, Piqua, Ohio
Cardion Elctrns., Woodbury, N.Y.
Collins Radio Co., Dallas, Tex.
Electrocom Inds., So. Bend, Indiana
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Frederick Electronics Corp., Frederick, Md.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Integrated Systems, Inc., Norcross, Ga.
ITT Mackay Marine, Elizabeth, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Video Research Corp., Gaithersburg, Md.

Comm. Systems, Intercom—See Intercom Systems

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GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
ITT Gilfillan Div. of ITT, Van Nuys, Calif.
Optical Communications, Inc., Orlando, Fla.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Union Carbide, San Diego, Cal.

Comm. Systems, Microwave

Vari-L Co., Inc., Denver, Colo. Vol 2•585
Andrew Corp., Orland Pk., Ill.
Applied Research Inc., Port Washington, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Avantek, Inc., Santa Clara, Cal.
Camusat Gueguen Telecom. Int'l., White Plains, N.Y.
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Cubic Corp., San Diego, Cal.
Energy Systems, Palo Alto, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Farinon Electric, San Carlos, Calif.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Melpar, Falls Church, Va.
Microwave Assocs., Inc., Burlington, Mass.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
OPtimax Inc., Colmar, Pa.
Pacific Communications, Santa Ana, Cal.
Raytheon Data Systems Co., Norwood, Mass.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Tasker Systems, Chatsworth, Cal.
Terado Corp., St. Paul, Minn.
Vega Precision Labs., Vienna, Va.
Watkins Johnson Co., Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Comm. Systems, Multiplex

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Applied Research Inc., Port Washington, N.Y.
Autocon Inds., Inc., Minneapolis, Minn.
Bendix Corp., N. Hollywood, Calif.
Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Data-Control Systems, Danbury, Conn.
Electrocom Inds., So. Bend, Indiana
Elctrn. Comm., Inc., St. Petersburg, Fla.
Farinon Electric, San Carlos, Calif.
Fifth Dimension, Princeton, N.J.
General Data Inds. Inc. Inc., Wilton, Conn.
General Devices, Inc., Princeton, N.J.
GTE Lenkurt Inc., San Carlos, Calif.
Hathaway Instruments, Inc., Denver, Colo.
Henry Prods. Co., Inc., Inwood, N.Y.
Integrated Systems, Inc., Norcross, Ga.
ISC/Telephonics Div, Huntington, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
NES, Inc., Itasca, Ill.
Raytheon Data Systems Co., Norwood, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Singer Co., Little Falls, N.J.
T-Bar Inc., Wilton, Conn.
Varian Data Machines, Irvine, Cal.
Video Research Corp., Gaithersburg, Md.

Comm. Systems, Radiotelephone

Bowmar Instr. Corp., Ft. Wayne, Ind.
Brelonix, Inc., Seattle, Wash
Collins Radio Co., Dallas, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Electrospace Systems Inc., Richardson, Tex.
Emergency Beacon Corp., New Rochelle, N. Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Henry Prods. Co., Inc., Inwood, N.Y.
Intech, Santa Clara, Cal.
Intricate Circuit Corp., Port Chester, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Linear Sys., Inc., Watsonville, Calif.
Mobil Elctrns., Inc., Anderson, Ind.
Pace Div., Harbor City, Calif.
Pearce-Simpson, Miami, Fla.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
RCA Service Co., Camden, N.J.

Comm. Systems, Selective Paging

Altec Div., Anaheim, Calif.
Bogen Div., Paramus, N.J.
Bramco Controls, Piqua, Ohio
Dukane Corp., St. Charles, Ill.
Emergency Beacon Corp., New Rochelle, N. Y.
Executone, Inc., Long Island City, N.Y.
Intricate Circuit Corp., Port Chester, N.Y.
Johnson E. F. Co., Waseca, Minn.
Lear Siegler, Inc., Santa Monica, Calif.
Mobil Elctrns., Inc., Anderson, Ind.
North Electric Co., Galion, Ohio
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
Talk-A-Phone Co., Chicago, Ill.
University Sound, Anaheim, Cal.
Webster Elec. Co., Inc., Racine, Wisc.

Comm. Systems, Single-Sideband

Arvin Sys., Inc., Dayton, Ohio
Barker & Williamson, Inc., Bristol, Pa.
Bendix Corp, Towson, Md.
Brelonix, Inc., Seattle, Wash
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Drake, R.L., Co., Miamisburg, Ohio
Electrac, Inc., Anaheim, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Henry Prods. Co., Inc., Inwood, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Johnson E. F. Co., Waseca, Minn.
Linear Sys., Inc., Watsonville, Calif.
Micro-Tel Corp., Baltimore, Md.
Pace Div., Harbor City, Calif.
Pearce-Simpson, Miami, Fla.
Raytheon Data Systems Co., Norwood, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Technical Mat'l., Mamaroneck, N.Y.
Watkins Johnson Co., Palo Alto, Cal.

Comm. Systems, Telemetering

Emergency Beacon Corp., New Rochelle, N. Y. ..... Vol 1•936
GRM Corp., Medford, N.J. ..... Vol 1•319
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Analogic, Wakefield, Mass.
Andrew Corp., Orland Pk., Ill.
Applied Research Inc., Port Washington, N.Y.
Astro Comm. Lab., Gaithersburg, Md.
Autocon Inds., Inc., Minneapolis, Minn.
Baganoff Assocs., Inc., St. Louis, Mo.
BF Elctrns., Solana Beach, Calif.
Biocom, Inc., Culver City, Cal.
Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Continental Data Sys., Dayton, Ohio
Data-Control Systems, Danbury, Conn.
Dataprobe, Inc., So. Hackensack, N.J.
Electrac, Inc., Anaheim, Calif.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Fairchild Space & Defense Sys., Syosset, N.Y.
Fifth Dimension, Princeton, N.J.
General Devices, Inc., Princeton, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
Hathaway Instruments, Inc., Denver, Colo.
Integrated Systems, Inc., Norcross, Ga.
Leeds & Northrup Corp., No. Wales, Pa.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Monitor Systems, Ft. Washington, Pa
NES, Inc., Itasca, Ill.
Pacific Communications, Santa Ana, Cal.
Phoenix Data Inc., Phoenix, Ariz.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Solid State Elctrns. Corp., Sepulveda, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Tasker Systems, Chatsworth, Cal.
3M Co., St. Paul, Minn.
Vega Precision Labs., Vienna, Va.
Video Research Corp., Gaithersburg, Md.
Watkins Johnson Co., Palo Alto, Cal.

Comm. Systems, Telephone

GRM Corp., Medford, N.J. ..... Vol 1•319
ADC Prods., Minneapolis, Minn.
Altec Div., Anaheim, Calif.
BECO, Inc., Salem, Va.
Bogen Div., Paramus, N.J.
Communications Equip. Co., Indianapolis, Ind.
Continental Data Sys., Dayton, Ohio
Digitronics Corp., Albertson, N.Y.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dukane Corp., St. Charles, Ill.
Electrospace Systems Inc., Richardson, Tex.
Elgin Elctrns. Inc., Waterford, Pa.
Encom Prods. Co., Inc., Oxford, Pa.
Executone, Inc., Long Island City, N.Y.
Farinon Electric, San Carlos, Calif.
GTE Automatic Elec., Northlake, Ill.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
International Communications Corp., A Milgo Co., Miami, Fla.
ITT Telecommunications, Corinth, Miss.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Mobil Elctrns., Inc., Anderson, Ind.
North Electric Co., Galion, Ohio
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
Re-el Circuits, Inc., Saddle Brook, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Singer Co., Little Falls, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
T-Bar Inc., Wilton, Conn.
Tasker Systems, Chatsworth, Cal.
Terado Corp., St. Paul, Minn.
Warren G-V Communications, Livingston, N.J.
Webster Elec. Co., Inc., Racine, Wisc.

Comm. Systems, Teletype

Re-el Circuits, Inc., Saddle Brook, N.J. Vol 1•320
Collins Radio Co., Dallas, Tex.
Computer Terminal Sys., Plainview, N.Y.
Continental Data Sys., Dayton, Ohio
Demex, Inc., Kansas City, Mo.
Digitech Data Inds., Inc., Ridgefield, Conn.
Electrocom Inds., So. Bend, Indiana
Frederick Electronics Corp., Frederick, Md.
GRM Corp., Medford, N.J.
GTE Lenkurt Inc., San Carlos, Calif.
ITT Mackay Marine, Elizabeth, N.J.
Lear Siegler, Anaheim, Cal.
NES, Inc., Itasca, Ill.
Pioneer Elec. & Resch. Corp., Forest Park, Ill.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Teletype Corp., Skokie, Ill.

Commutators

Airflyte Elctrns. Co., Bayonne, N.J.
Nippert Co., Delaware, Ohio
Phoenix Data Inc., Phoenix, Ariz.

Comparators, Analog—See Comparators, Voltage

Comparators, Attenuation

Alford Mfg. Co., Winchester, Mass.
General Microwave Corp., Farmingdale, N.Y.
Inservco, Inc., La Grange, Ohio
Mann, David W. Co., Burlington, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Narda Microwave Corp., Plainview, N.Y.
Struthers-Dunn, Inc., Bettendorf, Iowa
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co., Phoenix, Ariz.

Comparators, Capacitance—See Bridges, Capacitance

Comparators, Density—See Densitometers, Electronic

Comparators, Digital

NES, Inc., Itasca, Ill. ..... Vol 1•363
Anadex Instrs., Inc., Van Nuys, Calif.
Automated Meas., Oakland, Calif.
Automation Dynamics, Northvale, N.J.
Chemical Etching Equip. & Supply, Alexandria, Va.
Consolidated Controls Corp., Bethel, Conn.
Datacom, Inc., Ft. Walton Bch., Fla.
Datascan, Inc., Clifton, N.J.
Digilin, Inc., Glendale, Cal.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Dytro Corp., Hicksville, N.Y.
E-H Resch. Labs., Inc., Oakland, Cal.
Electronic Research Co., Shawnee Mission, Kan.
Gap Instr. Corp., Hauppauge, N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
IEC Electronics Corp., E. Rochester, N.Y.
Innovatek Enterprise, Millerton, N.Y.
Instrumentation Tech. Corp., Northbridge, Cal.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Keltron Corp., Waltham, Mass.
LFE Corp., Waltham,, Mass.
Micro Instr. Co., Hawthorne, Cal.
Midland Standard Inc., Elgin, Ill.
Minnetech Labs, Minneapolis, Minn.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
MSI Electronics, Inc., Woodside, N.Y.
Newport Labs., Inc., Santa Ana, Cal.
Norden Div., Norwalk, Conn.
Northern Precision Labs., Inc., Fairfield, N.J.
Olympus Corp. America, New Hyde Park, N.Y.
Precision Dynamics Corp., Burbank, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Signetics. Corp., Sunnyvale, Calif.
Singer - Tele-Signal, Woodbury, N.Y.
Spatial Data Systems, Inc., Goleta, Cal.
Specific Products, Monrovia, Cal.
SRC Div., Newport Bch., Cal.
Struthers-Dunn, Inc., Pitman, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Texas Instruments, Dallas, Tex.
Theta Instr. Corp., Fairfield, N.J.
Thiem Industries, Inc., Torrance, Cal.
United Sys. Corp., Dayton, Ohio

Comparators, Frequency

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Anaren Microwave, Inc., Syracuse, N.Y.
Collins Radio Co., Dallas, Tex.
Engelmann Microwave, Montville, N.J.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Geo Space Sys., Tampa, Fla.
Hi-G, Windsor Locks, Conn.
Rohde & Schwarz Sls., Passaic, N.J.
Signal Analysis Oper., Hauppauge, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Tracor, Inc., Austin, Tex.
Weston Instruments, Inc., Newark, N.J.

Comparators, Impedance—See Bridges, Impedance

Comparators, Inductance—See Bridges, Inductance

Comparators, Phase

Anaren Microwave, Inc., Syracuse, N.Y. Vol 4•438*
Hi-G, Windsor Locks, Conn. .... Vol 2•796
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Alford Mfg. Co., Winchester, Mass.
American Nucleonics Corp., Woodland Hills, Cal
Collins Radio Co., Dallas, Tex.
Diversified Elctrns., Evansville, Ind
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynalab Corp., Van Nuys, Cal.
Dytronics Co., Columbus, Ohio
Engelmann Microwave, Montville, N.J.
Frequency Elctrns., New Hyde Pk., N.Y.
Geo Space Sys., Tampa, Fla.
Ind'l. Control Co., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
Merrimac Inds., Inc., West Caldwell, N.J.
Microwave Development Labs., Inc., Needham Hgts., Mass.
North Atlantic Inds., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Rantec Div., Calabasas, Calif.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Struthers-Dunn, Inc., Bettendorf, Iowa
Theta Instr. Corp., Fairfield, N.J.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vari-L Co., Inc., Denver, Colo.
Varian Assocs., Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.
Wiltron Co., Palo Alto, Calif.

Comparators, Q

Dranetz Engrg. Labs., So. Plainfield, N.J.
J-Omega Co., Mountain View, Calif.

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Applied Control Co., Fairfield, N.J.
Beckman Instrs., Cedar Grove, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Constant Voltage Co., Chicago, Ill.
Control Technology Co., L.I.C., N.Y.
Diversified Elctrns., Evansville, Ind
Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Dytro Corp., Hicksville, N.Y.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
General Magnetics, Bloomfield, N.J.
GPS Corp., Framingham, Mass.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
ILC Data Device Corp., Hicksville, N.Y.
Intech, Santa Clara, Cal.
J-Omega Co., Mountain View, Calif.
Jerrold Electronics Corp., Philadelphia, Pa.
Julie Research Lab., New York, N.Y.
LDJ Electronics, Troy, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
Luft Instrs., Inc., Lincoln, Mass.
Midland Standard Inc., Elgin, Ill.
Mini-Systems, Inc, North Attleboro, Mass.
Natel Engrg. Co., Canoga Pk., Cal.
NES, Inc., Itasca, Ill.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Precision Monolithics Inc., Santa Clara, Cal.
Raytheon, Mt. View, Calif.
Scientific Measurements, Wilmette, Ill.
Signetics. Corp., Sunnyvale, Calif.
Solid State Elctrns. Corp., Sepulveda, Cal.
Struthers-Dunn, Inc., Pitman, N.J.
Tektronix, Inc., Beaverton, Ore.
Tempo Instrument, Inc., Plainview, N.Y.
Weston Instruments, Inc., Newark, N.J.

Zeltex, Inc., Concord, Calif.
Zi-Tech Div., Palo Alto, Cal.

Compounds, Encapsulating, Molding, Potting-Also See Plastic Raw Materials

3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn. ..... Vol 3•1082-1087
Acme Chemical & Insulation Co., New Haven, Conn.
Adhesive Prods. Corp., Bronx, N.Y.
Allaco Prods Div., Watertown, Mass.
Amicon Corp., Lexington, Mass.
Amphenol Cadre Div., Endicott, N.Y.
Anchor Alloys, Inc., Brooklyn, N.Y.
Armstrong Cork Co., Lancaster, Pa.
Armstrong Prods. Co., Warsaw, Ind.
Bacon Inds., Watertown, Mass.
Brand Dielectrics, Inc., N. Windham, Conn.
Chemical Prods. Corp., E. Providence, R.I.
Chemtronics, Inc., Brooklyn, N.Y.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Dolph, John C. Co., Monmouth Junction, N.J.
Dow Chemical Co., Midland, Mich.
Dow Corning Corp., Midland, Mich.
Eastman Chem. Prods., Kingsport, Tenn.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Electro-Science Labs., Pennsauken, N. J.
Emerson & Cuming, Inc., Canton, Mass.
Epoxy Technology, Watertown, Mass.
Epoxylite Corp., Anaheim, Calif.
General Elec., Insulating Matl's., Schenectady, N.Y.
General Elec. Co., Waterford, N.Y.
Glastic Corp., Cleveland, Ohio
Hardman Inc., Belleville, N.J.
Hightemp Resins, Inc., Stamford, Conn.
Hysol Div., Olean, N.Y.
MacDonald & Co., Glendale, Calif.
Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
National Beryllia Corp., Haskell, N.J.
Packaged Resins Div., Watertown, Mass.
Pennsylvania Ind'l. Chem. Corp., Clairton, Pa.
Ram Chems., Gardena, Calif.
Rostone Corp., Lafayette, Ind.
Seal-Peel, Inc., Troy, Mich.
Semicon Assoc., Inc., Lexington, Ky.
Sterling, Sewickley, Pa.
SWS Silicones Div., Adrian, Mich.
Teledyne Penn-Union Elec., Edinboro, Pa.
Thiokol Chemical Div., Trenton, N.J.
3M Co., St. Paul, Minn.
Tra-Con, Inc., Medford, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Uniroyal, Inc., New York, N.Y.
Western Coating Co., Royal Oak, Mich.
Westinghouse Elec., W. Mifflin, Pa.

Compressors, Data

Analogic, Wakefield, Mass.
NES, Inc., Itasca, Ill.

Computer Logic Circuits—See Cards, Logic; Circuits, Hybrid; Circuits, Integrated; Modules, Logic

Computer Memory Testers—See Testers, Computer Memory

Computer Tape Recorders—See Data Recorders, Computer

Computer Type Indicators—See Lights; Dials; Readouts

Computers, Analog

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AMF Electical Prods., Alexandria, Va.
Austin Elctrns., Roselle, N.J.
Aviation Elec., Ltd., Montreal 379, Que., Can.
Baganoff Assocs., Inc., St. Louis, Mo.
Bailey Meter Co., Wickliffe, Ohio
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Div, Waterbury, Conn
C & A Products, Inc., Woodside, N. Y.
Datron Systems, Chatsworth, Cal.
Foxboro Co., Foxboro, Mass.
Gap Instr. Corp., Hauppauge, N.Y.
General Computers, Inc., Los Angeles, Calif.
General Magnetics, Bloomfield, N.J.
Heath Co., Benton Harbor, Mich.
Honeywell, Ft. Washington, Pa.
Hybrid Sys. Corp., Burlington, Mass.
iLC Data Device Corp., Hicksville, N.Y.
Lear Siegler, Grand Rapids, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Reliance Elec. Co., Cleveland, Ohio
Scientific Measurements, Wilmette, Ill.
Singer Co., Little Falls, N.J.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Systron Donner Computer Systems Div., Concord, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Telectro Sys. Corp., Corona, N.Y.
Toledo Scale, Toledo, Ohio

Computers, Desk Top (Digital)

Beckman Instrs., (AISSD), Fullerton, Cal.
Burroughs Corp., Pasadena, Cal.
Computer Automation, Inc., Irvine, Cal.
Digital Equip. Corp., Maynard, Mass.
Eldorado Electrodata, Concord, Cal.
Microdata Corp., Irvine, Cal.
Monroe, Calculator Co., Orange, N.J.
NES, Inc., Itasca, Ill.
Texas Instruments, Dallas, Tex.
Toledo Scale, Toledo, Ohio
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Wang Labs., Inc., Tewksbury, Mass.

Computers, Digital (General Purpose)

Bailey Meter Co., Wickliffe, Ohio
Bendix Aerospace-Elctrns., Teterboro, N.J.
Burroughs Corp., Pasadena, Cal.
Cincinnati Milacron, Lebanon, Ohio
Computer Automation, Inc., Irvine, Cal.
Data General Corp. (E), Southboro, Ma.
Digital Equip. Corp., Maynard, Mass.
Eldorado Electrodata, Concord, Cal.
GRI Computer Corporation, Newton, Mass.
Honeywell Information Systems, Waltham, Mass.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Interdata, Oceanport, N.J.
Lear Siegler, Grand Rapids, Mich.
Lockheed Elctrns. Co., Watchung, N.J.
Lockheed Elctrns. Co., Los Angeles, Cal.
Microdata Corp., Irvine, Cal.
NES, Inc., Itasca, Ill.
Nuclear Data, Palatine, Ill.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Republic Advanced System Technology Group, Chatsworth, Calif.
Singer Co., Little Falls, N.J.
Texas Instruments, Inc., Houston, Tex.
Toledo Scale, Toledo, Ohio
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Victor Comptometer Corp., Chicago, Ill.
Wang Labs., Inc., Tewksbury, Mass.
Xerox Data Sys., El Segundo, Cal

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Bailey Meter Co., Wickliffe, Ohio
Beckman Instrs., (AISSD), Fullerton, Cal.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Beukers Labs., Inc., Hauppauge, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bunker-Ramo Corp., Westlake Village, Cal
Collins Radio Co., Cedar Rapids, Iowa
Computer Automation, Inc., Irvine, Cal.
Control Equip. Corp., Lowell, Mass.
Counterscan Systems, Sutton, Neb.
Data Technology Inc., Watertown, Mass.
Datascan, Inc., Clifton, N.J.
Datum, Inc., Anaheim, Calif.
Davidson Elctrn. Dev. Co., Erie, Pa.
Delco Elctrns. Div., Kokomo, Ind.
Design Automation, Inc., Lexington, Mass.
Design Elements, Columbus, Ohio
Di/An Controls, Inc., Boston, Mass.
Digiac Corp., Plainview, N.Y.
Dynapar Corp., Gurnee, Ill.
Dytro Corp., Hicksville, N.Y.
Eldorado Electrodata, Concord, Cal.
Fairchild Space & Defense Sys., Syosset, N.Y.
Foxboro Co., Foxboro, Mass.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Minneapolis, Minn.
Honeywell Information Systems, Waltham, Mass.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Instrumentation Tech. Corp., Northbridge, Cal.
Interdata, Oceanport, N.J.
Keuffel & Esser Co., Morristown, N.J.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Lear Siegler, Grand Rapids, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Major Data Corp., Costa Mesa, Cal.
Microdata Corp., Irvine, Cal.
Nicolet Instr. Corp., Madison, Wisc.
Nuclear Data, Palatine, Ill.
Perkin-Elmer Corp., Instr. Div., Norwalk, Conn.
Raytheon Data Systems Co., Norwood, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Missile & Surface Radar Div., Moorestown, N.J.
Republic Advanced System Technology Group, Chatsworth, Calif.
Scientific Measurements, Wilmette, Ill.
Signal Analysis Oper., Hauppauge, N.Y.
Singer Co., Little Falls, N.J.
Singer Co., Glendale, Cal.
Spatial Data Systems, Inc., Goleta, Cal.
SSR Instrs. Co., Santa Monica, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tech Serv., Inc., Fogelsville, Pa.
Texas Instruments, Inc., Houston, Tex.
Theta Instr. Corp., Fairfield, N.J.
Toledo Scale, Toledo, Ohio
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Veeder-Root, Hartford, Conn.
Victor Comptometer Corp., Chicago, Ill.
Wang Labs., Inc., Tewksbury, Mass.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Wyle Computer Prods., Inc., El Segundo, Calif.

Computers, Hybrid, Analog-Digital

Austin Elctrns., Roselle, N.J.
Bailey Meter Co., Wickliffe, Ohio
Bowmar Instr. Corp., Ft. Wayne, Ind.
Davidson Elctrn. Dev. Co., Erie, Pa.
Design Automation, Inc., Lexington, Mass.
Dytro Corp., Hicksville, N.Y.
General Computers, Inc., Los Angeles, Calif.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Hybrid Sys. Corp., Burlington, Mass.
Lear Siegler, Grand Rapids, Mich.
NES, Inc., Itasca, Ill.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Singer Co., Little Falls, N.J.
Systron Donner Computer Systems Div., Concord, Cal.
Toledo Scale, Toledo, Ohio
Xerox Data Sys., El Segundo, Cal

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Conductive Plastic Materials

Acme Chemical & Insulation Co., New Haven, Conn.
Chomerics, Inc., Woburn, Mass.
Electro Mats. Corp. Amer., Mamaroneck, N.Y.
Epoxy Technology, Watertown, Mass.
Merix Chem. Co., Chicago, Ill.
Triac Elctrn. Sys., Forest Hills, N. Y.
Zippertubing Co., Los Angeles, Calif.

Conduit, Electrical

Anaconda American Brass Co., Waterbury, Conn.
Co-Operative Inds., Inc., Chester, N.J.
Ideal Industries, Inc., Sycamore, Ill.
Reynolds Metals Co., Richmond, Va.
Wiremold Co., W. Hartford, Conn.
Zippertubing Co., Los Angeles, Calif.

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Air-O-Tronics Prods., Morrisville, N.Y.
Alford Mfg. Co., Winchester, Mass.
Americon Microwave Inds., Inc., Waltham, Mass.
Amp Inc., Harrisburg, Pa.
Amphenol Ind'l. Div., Chicago, Ill.
APM-Hexseal, Englewood, N.J.
Ark-Les Switch Corp., Watertown, Mass.
Barker Prods. Co., Saugus, Mass.
Beman Mfg., Inc., New Cumberland, Pa.
Bendix Corp., Sidney, N.Y.
Bird Elctrn., Cleveland, Ohio
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Burndy Corp., Norwalk, Conn.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Chromalloy-Alcon Inc., Chicago, Ill.
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Connector Corp., Chicago, Ill.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Elctrn. Molding Corp., Woonsocket, R.I.
General Elec. Company, Providence, R.I.
General Radio Co., Concord, Mass.
GTE Sylvania Inc., Warren, Pa.
Henry Prods. Co., Inc., Inwood, N.Y.
Hughes Aircraft Co., Connecting Devices, Newport Beach, Cal.
Hypertronics Corp., Watertown, Mass.
ITT Cannon Electric, Santa Ana, Cal.
Jettron Prods., Hanover, N.J.
Kistler Instr. Co., Redmond, Wash.
Lemosa, Inc., San Francisco, Cal.
Malco, A Microdot Co., Inc., Chicago, Ill.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Phelps Dodge Comm., North Haven, Conn.
Reynolds Inds., Inc., Marina Del Rey, Cal.
Rohde & Schwarz Sls., Passaic, N.J.

Rowe Inds., Div., Toledo, Ohio
Samarius, Inc., Derby, Conn.
Sealectro Corp., Mamaroneck, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Smith, Herman H., Inc., Bklyn., N.Y.
Specialty Connector, Indpls., Ind.
Stanford Applied Engrg., Inc., Santa Ana, Cal.
Superior Elec., Bristol, Conn.
Switchcraft, Inc., Chicago, Ill.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Viking Inds., Inc., Chatsworth, Calif.

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Bud Radio, Willoughby, Ohio
EI Instruments, Derby, Conn.
National Tel-Tronics, Meadville, Pa.
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Viking Inds., Inc., Chatsworth, Calif.
Wadsworth Elec. Mfg. Co., Inc., Covington, Ky.

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Accurate Elctrns. Corp., Elyria, Ohio
Americon Microwave Inds., Inc., Waltham, Mass.
Amp Inc., Harrisburg, Pa.
Amphenol Connector Div., Broadview, Ill.
Amphenol Ind'l. Div., Chicago, Ill.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
Avibank Mfg. Inc., Burbank, Calif.
Bead Elctrns., Bridgeport, Conn.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Ceramaseal, Inc., New Lebanon Center, N.Y.
Concord Elctrns., New York, N.Y.
Control Data, Westlake Village, Cal.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
GC Electronics, Rockford, Ill.
General Radio Co., Concord, Mass.
Geo Space, Houston, Tex.
Glenair, Inc., Glendale, Calif.
GTE Sylvania Inc., Warren, Pa.
Gulton Inds., Newport Bch., Cal.
Henry Prods. Co., Inc., Inwood, N.Y.
Hoffman Industrial Prods., Farmingdale, N.Y.
Hollingsworth Solderless Terminal, Phoenixville, Pa.
Hypertronics Corp., Watertown, Mass.
Ico/Rally, Palo Alto, Cal.
IFE Div., E. Providence, R. I.
ITT Cannon Electric, Santa Ana, Cal.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Lemosa, Inc., San Francisco, Cal.
Magnum Elec. Corp., Erie, Mich.
Malco, A Microdot Co., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
North Electric Co., Galion, Ohio
Program Data Co., Carson, Cal.
Robinson-Nugent, New Albany, Ind.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Sjoberg, C. & Son, Inc., Cranston, R.I.
Smith, Herman H., Inc., Bklyn., N.Y.
Specialty Connector, Indpls., Ind.
Teledyne Penn-Union Elec., Edinboro, Pa.
Thomas & Betts Co., Elizabeth, N.J.
3M Co. Electro Prods. Div., St. Paul, Minn.
3M Co., St. Paul, Minn.
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Underwriters Safety Device Co., Chicago, Ill.
Useco Div., Van Nuys, Cal.
Vernitron Elec. Comps., Laconia, N.H.
Viking Inds., Inc., Chatsworth, Calif.
Winchester Elctrns., Oakville, Conn.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Elco, Willow Grove, Pa.
Keystone Elctrns. Corp., New York, N.Y.
National Tel-Tronics, Meadville, Pa.
Priority Services, Burbank, Cal.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
Saxton Prods., Congers, N.Y.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
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GC Electronics, Rockford, Ill.
Keystone Elctrns. Corp., New York, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
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Smith, Herman H., Inc., Bklyn., N.Y.
Teledyne Penn-Union Elec., Edinboro, Pa.
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Amp Inc., Harrisburg, Pa.
Bendix Corp., Sidney, N.Y.
Burndy Corp., Norwalk, Conn.
Collins Radio Co., Cedar Rapids, Iowa
Concord Elctrns., New York, N.Y.
Control Data, Westlake Village, Cal.
Dale Elctrns., Inc., Yankton, S.D.
Elco, Willow Grove, Pa.
Elctrn. Molding Corp., Woonsocket, R.I.
ETC, Div. ITT, Cleveland, Ohio
GC Electronics, Rockford, Ill.
GTE Sylvania Inc., Warren, Pa.
Hermetic Seal Corp., Rosemead, Cal.
Hypertronics Corp., Watertown, Mass.
Johnson E. F. Co., Waseca, Minn.
Lemosa, Inc., San Francisco, Cal.
Magnum Elec. Corp., Erie, Mich.
Malco, A Microdot Co., Inc., Chicago, Ill.
Methode Elctrns., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
Mupac Corp., Brockton, Mass.
National Tel-Tronics, Meadville, Pa.
North Electric Co., Galion, Ohio
Sennheiser Elctrn. Corp., New York, NY
Stanford Applied Engrg., Inc., Santa Ana, Cal.

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Elco, Willow Grove, Pa.
Elctrn. Molding Corp., Woonsocket, R.I.
Fansteel Inc., N Chicago, Ill.
Flex-Link Products, Inc., San Fernando, Cal.
GTE Sylvania Inc., Delmont, Pa.
GTE Sylvania Inc., Warren, Pa.
Hughes Aircraft Co., Connecting Devices, Newport Beach, Cal.
ITT Cannon Electric, Santa Ana, Cal.
Hiram Jones Elctrns., No. Hollywood, Cal.
Keystone Elctrns. Corp., New York, N.Y.
Malco, A Microdot Co., Inc., Chicago, Ill.
Mallory Metallurgical, Indianapolis, Ind.
Metex Corp., Edison, N.J.
Methode Elctrns., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
Ohio Carbon Co., Cleveland, Ohio
Ostby & Barton Co., Providence, R.I.
Philips Elmet Corp., Lewiston, Me.
Precision Metal Prods. Co., Stoneham, Mass.
Pure Carbon Co., Inc., St. Marys, Pa.
Pylon Co., Inc., Attleboro, Mass.
Servometer Corp., Clifton, N.J.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Stackpole Carbon Co., Carbon Div., St. Marys, Pa.
Stanford Applied Engrg., Inc., Santa Ana, Cal.
Superior Carbon Prods., Inc., Cleveland, Ohio
Texas Instruments, Attleboro, Mass.
Union Carbide, Carbon Prods. Div., New York, N.Y.
Useco Div., Van Nuys, Cal.
Veeder-Root, Hartford, Conn.
Viking Inds., Inc., Chatsworth, Calif.
Waldom Elctrns., Inc., Chicago, Ill.

Containers, Shielded (All Types)

Micrite Metal Mfg., Inc., Canoga Park, Cal. ..... Vol 3•1036
Pomona Elctrns. Co., Inc., Pomona, Cal. Vol 3•740-750
Cal-Metex Corp., Inglewood, Cal.
Calabro Unitrack, Upper Darby, Pa.
Craig Sys. Corp., Lawrence, Mass.
Estes Engrg. Co., Gardena, Calif.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Kinetron Corp., Asbury Park, N.J.
LectroMagnetics, Inc., Los Angeles, Cal.
Magnetic Metals Co., Camden, N.J.
Metex Corp., Edison, N.J.
M M Elctrn. Enclosures, Hicksville, N.Y.
Modpak, Waltham, Mass.
Perfection Mica Co., Bensenville, Ill.
Precision Paper Tube Co., Wheeling, Ill.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
South Shore Metal Prods., Inc., Farmingdale, N.Y.
TA Mfg. Corp., Los Angeles, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Warwick Prods. Co., Independence, Ohio
Zero Mfg. Co., Burbank, Cal.

Containers, Shipping, Metal & Fiberglass (Reusable)-Also See Transit Cases

American Aluminum Co., Mountainside, N.J.
Lewis G. B. Co, Watertown, Wisc
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
M M Elctrn. Enclosures, Hicksville, N.Y.
N L Inds., Inc., Granite City, Ill.
NVF Co., Yorklyn, Del.
Parabam, Inc., Compton, Cal.
Perfection Mica Co., Bensenville, Ill.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
TA Mfg. Corp., Los Angeles, Cal.
Zero Mfg. Co., Burbank, Cal.

Containers, Storage

Akro-Mils, Inc., Akron, Ohio
Althor Prods., Brooklyn, N.Y.
American Aluminum Co., Mountainside, N.J.
Bay Prods., Phila., Pa.
Lewis G. B. Co, Watertown, Wisc
Lyon Metal Prod., Inc., Aurora, Ill.
Metropolitan Wire Goods, Wilkes-Barre, Pa.
M M Elctrn. Enclosures, Hicksville, N.Y.
N L Inds., Inc., Granite City, Ill.
NVF Co., Yorklyn, Del.
Parabam, Inc., Compton, Cal.
Perfection Mica Co., Bensenville, Ill.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
Stackbin Corp., Pawtucket, R.I.
TA Mfg. Corp., Los Angeles, Cal.
Uniroyal, Inc., New York, N.Y.
Vlchek Plastics Co., Middlefield, Ohio
Zero Mfg. Co., Burbank, Cal.

Containers, Transit—See Transit Cases

Controllers, Programmable

Slaughter Co., Ardmore, Okla. Vol 1•505
Square D Co., Park Ridge, Ill... Vol 2•367
Luft Instrs., Inc., Lincoln, Mass.

Control Panels & Systems, Computer—See Boards, Programming

Controls, Capacitance Operated

Automatic Timing & Controls, Inc., King of Prussia, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Davidson Elctrn. Dev. Co., Erie, Pa.
Delavan Electronics, Scottsdale, Ariz.
Dynamic Data Corp., Columbus, Ohio
Electron-Machine Corp., Umatilla, Fla.
Foxboro Co., Foxboro, Mass.
Lion Precision Corp, Newton, Mass.
Micro Instr. Co., Hawthorne, Cal.
Photobell Co., Inc., New York, N.Y.
Robertshaw Controls Co., Richmond, Va.
Sensor Corp., Scottsdale, Pa.

Controls, Carbon—See Potentiometers; Rheostats

Controls, Constant Impedance—See Attenuators

Controls, Counting and Sorting

Abrams Instr., Lansing, Mich.
Applied Control Co., Fairfield, N.J.
Control Technology Co., L.I.C., N.Y.
Controlcraft Corp., West Chicago, Ill.
Dynapar Corp., Gurnee, Ill. .
Luft Instrs., Inc., Lincoln, Mass.
Micro Switch, Freeport, Ill.
Photobell Co., Inc., New York, N.Y.
Presin Co., Inc., Shelton, Conn.
Scientific Technology, Mountain View, Cal.
Tenor Co., Inc., New Berlin, Wisc.
Triac Elctrn. Sys., Forest Hills, N. Y.

Controls, Density

Davidson Elctrn. Dev. Co., Erie, Pa.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Electron-Machine Corp., Umatilla, Fla.
Foxboro Co., Foxboro, Mass.
Heitz, Karl, Inc., New York, N.Y.
Luft Instrs., Inc., Lincoln, Mass.
National Sonics, Farmingdale, N.Y.

Nuclear Resch. Corp., Southampton, Pa.
NUSonics, Inc., Paramus, N.J.
Photomation, Inc., Mountain View, Calif.
Princo Instrs., Southampton, Pa.
RIL Elctrns., Inc., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Scientronics, Barrington, N.J.
Spatial Data Systems, Inc., Goleta, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.

Controls, Dimension

Int'l. Electro-Magnetics, Palatine, Ill. Vol 1•313
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autotron, Inc., Danville, Ill.
Columbia Resch. Labs., Woodlyn, Pa.
Data Technology Inc., Watertown, Mass.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Electron-Machine Corp., Umatilla, Fla.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Inc., Lincoln, Mass.
Midland Standard Inc., Elgin, Ill.
Minnetech Labs, Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Scientific Technology, Mountain View, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Tempo Instrument, Inc., Plainview, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Veeder-Root, Hartford, Conn.
Worner Elctrn. Devices, Rankin, Ill.

Controls, Door Opening & Closing (Industrial)

A.R.F. Products, Inc., Boulder, Colo.
Innovation Industries Inc., Roswell, N.M.
Instrumentation Tech. Corp., Northbridge, Cal.
Micro Switch, Freeport, Ill.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Scientific Technology, Mountain View, Cal.

Controls, Environmental Test Equipment

Unholtz-Dickie Corp., Hamden, Conn. Vol 1•530
American Instr. Co., Silver Spring, Md.
Artisan Elctrns. Corp., Parsippany, N.J.
Bafco, Inc., Warminster, Pa.
Bell & Howell Co., Pasadena, Calif.
Blue M Engrg. Co., Blue Island, Ill.
Chadwick-Helmuth Co., Inc., Monrovia, Calif.
Control Technology Co., L.I.C., N.Y.
Delta Design, San Diego, Cal
Elctrn. Control Co., Dresher, Pa.
Erdco Engrg. Corp., Addison, Ill.
Foxboro Co., Foxboro, Mass.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Hotpack Corp., Phila., Pa.
Jade Corp., Huntingdon Valley, Pa.
Lab-Line Instrs., Inc., Melrose Park, Ill.
L.A.B. Corp., Skaneateles, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Luft Instrs., Inc., Lincoln, Mass.
NES, Inc., Itasca, Ill.
OAL Assocs., Inc., Westbury, N.Y.
Oven Industries, Inc., Mechanicsburg, Pa.
Precision Timer Co., Westbrook, Conn.
Research, Inc., Minneapolis, Minn.
Sealectro Corp., Mamaroneck, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tech Serv., Inc., Fogelsville, Pa.
Tenney Engrg., Inc., Union, N.J.
Torr Labs., Los Angeles, Cal.
United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.
Warren G-V Communications, Livingston, N.J.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Whittaker Corp., Los Angeles, Cal.

Controls, Fluid Conductivity

Applied Control Co., Fairfield, N.J.
Bailey Meter Co., Wickliffe, Ohio
Beckman Instrs., Cedar Grove, N.J.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Corp., No. Wales, Pa.
Mag-Con, Inc., New Brighton, Minn.
NUSonics, Inc., Paramus, N.J.
Robertshaw Controls Co., Richmond, Va.
Scientronics, Barrington, N.J.
Tempo Instrument, Inc., Plainview, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Controls, Fluid Flow

Square D Co., Park Ridge, Ill.. Vol 2•367
Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371,377
Anderson, W.E., Inc., Kansas City, Mo.
Autocon Inds., Inc., Minneapolis, Minn.
Bailey Meter Co., Wickliffe, Ohio
Bell & Howell Co., Pasadena, Calif.
Bendix Corp., N. Hollywood, Calif.
Bendix Corp., Davenport, Iowa
Brooks Instr. Div., Hatfield, Pa.
Computer Instrs., Hempstead, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Dietz, Henry G. Co., Inc., Long Island City, N.Y.
Durant Digital Instrs., Watertown, Wisc.
Erdco Engrg. Corp., Addison, Ill.
Fenwal Elctrns., Framingham, Mass.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Gems Sensors Div., Farmington, Conn.
General Valve Corp., E. Hanover, N.J.
Harwil Co., Santa Monica, Calif.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Johnson Corp., Three Rivers, Mich.
Kidde, Walter & Co., Belleville, N.J.
Lear Siegler, Inc., Elyria, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Inc., Lincoln, Mass.
Matheson Gas Products, East Rutherford, N.J.
Midland Standard Inc., Elgin, Ill.
Precision Dynamics Corp., Burbank, Cal.
Robertshaw Controls Co., Richmond, Va.
Rosemount Inc., Minneapolis, Minn.
Seco Elctrns. Corp., Hopkins, Minn.
Skinner Elec. Valve Div., New Britain, Conn.
Taylor Instr. Process Control Div., Rochester, N.Y.
Trans-Sonics, Inc., Lexington, Mass.
Tylan Corp., Torrance, Calif.
United Elec. Controls Co., Watertown, Mass.
Veeder-Root, Hartford, Conn.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Whittaker Corp., Los Angeles, Cal.

Controls, Frequency

Active Control Instrumentation, E. Northport, NY..... Vol 2•326,327
Autronics Corp., Pasadena, Calif. Vol 2•333
Accutronics, Geneva, Ill.
Allis, Louis Div., Milwaukee, Wisc.
American Elctrns., Inc., Fullerton, Cal.
American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
Amtron Inc., Midlothian, Ill.
Anadex Instrs., Inc., Van Nuys, Calif.
Avtron Mfg., Inc., Cleveland, Ohio
Bramco Controls, Piqua, Ohio
CML-Macarr, Inc., Edison, N.J.
Control Technology Co., L.I.C., N.Y.
Davidson Elctrn. Dev. Co., Erie, Pa.
Douglas Randall Div., Pawcatuck, Conn.
Dynapar Corp., Gurnee, Ill.
Electro Corp., Sarasota, Fla.
Electronic Research Co., Shawnee Mission, Kan.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
Geo Space Sys., Tampa, Fla.
Guardian California, Culver City, Cal.
Hartman Electrical Mfg., Mansfield, Ohio
Hi-G, Windsor Locks, Conn.
Leeds & Northrup Corp., No. Wales, Pa.
Logiconcepts Inc., Los Alamitos, Cal.
Logitek, Inc., Farmingdale, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Midland Standard Inc., Elgin, Ill.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
Philamon, Inc., Westbury, N.Y.
Riverbank Labs., Geneva, Ill.
Scientific Technology, Mountain View, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Controls, Gas

Air Prods. & Chems., Inc., Allentown, Pa.
Bailey Meter Co., Wickliffe, Ohio
Bristol Div, Waterbury, Conn
Devco Engrg., W. Caldwell, N.J.
Fenwal Elctrns., Framingham, Mass.
Honeywell, Ft. Washington, Pa.
Lektra Labs., Inc., College Point, N.Y.
Matheson Gas Products, East Rutherford, N.J.
Singer Co., Philadelphia, Pa.
Teledyne Geotech, Dallas, Tex.
Triac Elctrn. Sys., Forest Hills, N. Y.
Tylan Corp., Torrance, Calif.
United Elec. Controls Co., Watertown, Mass.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Controls, Hardware, Shafts & Accessories—See Shafts; Dials;etc.

Controls, Humidity

American Instr. Co., Silver Spring, Md.
Applied Control Co., Fairfield, N.J.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Blue M Engrg. Co., Blue Island, Ill.
Bristol Div, Waterbury, Conn
Climatronics Corp., Hauppauge, N.Y.
Davidson Elctrn. Dev. Co., Erie, Pa.
Foxboro Co., Foxboro, Mass.
Harrel, Inc., E. Norwalk, Conn.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Hotpack Corp., Phila., Pa.
Lab-Line Instrs., Inc., Melrose Park, Ill.
Lear Siegler, Inc., Elyria, Ohio
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.

Controls, Ignitron Firing

Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371,373
Advanced Kinetics, Costa Mesa, Calif.
Autronics Corp., Pasadena, Calif.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Essex Int'l., Logansport, Ind.
Ledex, Inc., Dayton, Ohio
Precision Timer Co., Westbrook, Conn.
Research, Inc., Minneapolis, Minn.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.

Controls, Joystick

Bowmar Instr. Corp., Ft. Wayne, Ind. Vol 2•334

Controls, Lamp Dimming, Flashing

Autronics Corp., Pasadena, Calif. Vol 2• 333
Accurate Elctrns. Corp., Elyria, Ohio
Bell Industries, Compton, Cal.
Cross Electronics Inc., Warrendale, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Hunt Electronics Co., Dallas, Tex.
IEC Electronics Corp., E. Rochester, N.Y.
Ledex, Inc., Dayton, Ohio
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
Precision Dynamics Corp., Burbank, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.
W-F Products, Inc., Denver, Co.
W.V. Industries Inc., Franklin Lakes, N.J.
Warren G-V Communications, Livingston, N.J.

Controls, Level, Dry Material

Amtron Inc., Midlothian, Ill.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Automation Devices, Inc., Fairview, Pa.
Autotron, Inc., Danville, Ill.
Control Technology Co., L.I.C., N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Delavan Electronics, Scottsdale, Ariz.
Dietz, Henry G. Co., Inc., Long Island City, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Innovation Industries Inc., Roswell, N.M.
Mag-Con, Inc., New Brighton, Minn.
Micro Switch, Freeport, Ill.
National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Princo Instrs., Southampton, Pa.
RIL Elctrns., Inc., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Scientific Technology, Mountain View, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
Taylor Instr. Process Control Div., Rochester, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transducer Controls Corp., Covina, Calif.
Triac Elctrn. Sys., Forest Hills, N. Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.

Controls, Level, Liquid

Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•377
Air-O-Tronics Prods., Morrisville, N.Y.
Ametek/Instrs. & Controls, Feasterville, Pa.
Amtron Inc., Midlothian, Ill.
Autocon Inds., Inc., Minneapolis, Minn.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autotron, Inc., Danville, Ill.
Bailey Meter Co., Wickliffe, Ohio
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., Davenport, Iowa
Bristol Div, Waterbury, Conn
Brooks Instr. Div., Hatfield, Pa.
Coil Co. of Amer., Northvale, N.J.
Cole-Parmer Instr. Co., Chicago, Ill.
Computer Instrs., Hempstead, N.Y.
Conrac Corp., Fairfield, N.J.
Consolidated Controls Corp., Bethel, Conn.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Cutler-Hammer, Milwaukee, Wisc.
Delavan Electronics, Scottsdale, Ariz.
Dietz, Henry G. Co., Inc., Long Island City, N.Y.
Farmer Elec. Prods. Co., Inc., Natick, Mass.
Foxboro Co., Foxboro, Mass.
Furnas Elec. Co., Batavia, Ill.
Gagne Assocs., Inc., Binghamton, N.Y.
Gems Sensors Div., Farmington, Conn.
Guardian Elec. Mfg. Co., Chicago, Ill.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Ind'l. Control Co., Farmingdale, N.Y.
Innovation Industries Inc., Roswell, N.M.
Johnson Corp., Three Rivers, Mich.
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Leeds & Northrup Corp., No. Wales, Pa.
Luft Instrs., Inc., Lincoln, Mass.
Mag-Con, Inc., New Brighton, Minn.

Master Elctrn. Controls, Santa Monica, Cal.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Oxford Instr. Corp., Annapolis, Md.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Power Instrs., Skokie, Ill.
Princo Instrs., Southampton, Pa.
RIL Elctrns., Inc., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Scientific Technology, Mountain View, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Square D Co., Park Ridge, Ill.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Thermometrics, Inc., Edison, N.J.
Torr Labs., Los Angeles, Cal.
Trans-Sonics, Inc., Lexington, Mass.
Transducer Controls Corp., Covina, Calif.
Ultrasonic Corp., Pipestone, Minn.
United Elec. Controls Co., Watertown, Mass.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.
Zi-Tech Div., Palo Alto, Cal.

Controls, Machine Tool

Measurement Sys., Inc., Norwalk, Conn. Vol 2•356
Square D Co., Park Ridge, Ill.. Vol 2•367
Allen-Bradley Co., Milwaukee, Wisc.
Allen-Bradley, Highland Hgts., Ohio
Allis-Chalmers, Milwaukee, Wisc.
Amtron Inc., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Arrow-Hart, Inc., Hartford, Conn.
Astrosystems, Inc., Lake Success, N.Y.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Automation Devices, Inc., Fairview, Pa.
Baldwin Elctrns., Little Rock, Ark.
Bendix Corp., Detroit, Mich.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Cincinnati Milacron, Lebanon, Ohio
Coil Co. of Amer., Northvale, N.J.
Computer Conversions Corp., East Northport, N.Y.
Conrac Corp., Westminster, Cal.
Control Technology Co., L.I.C., N.Y.
Controls Div., Elizabeth, N.J.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Data Technology Inc., Watertown, Mass.
Datascan, Inc., Clifton, N.J.
Datex Div., Duarte, Cal.
Davidson Elctrn. Dev. Co., Erie, Pa.
De Soto Elec. Prods., De Soto, Mo.
Delco Elctrns. Div., Kokomo, Ind.
Devco Engrg., W. Caldwell, N.J.
Digital Equip. Corp., Maynard, Mass.
Durant Digital Instrs., Watertown, Wisc.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Electro Corp., Sarasota, Fla.
Farrand Controls, Inc., Valhalla, N.Y.
Fincor Div., York, Pa.
Flight Sys., Inc., Mechanicsburg, Pa.
Furnas Elec. Co., Batavia, Ill.
Guardian California, Culver City, Cal.
Hoagland Instr., Dayton, N.J.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Landis & Gyr, Inc., Elmsford, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Major Data Corp., Costa Mesa, Cal.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
Midwest Controls Co., Lincoln, Neb.
Minnetech Labs, Minneapolis, Minn.
NES, Inc., Itasca, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Parametrics, Inc., Orange, Conn.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Precision Timer Co., Westbrook, Conn.
Proto Matic Co., Cincinnati,, Ohio
Raymond Controls Corp., Middletown, Conn.
Robicon Corp., Pittsburgh, Pa.
Scientific Technology, Mountain View, Cal.
Seco Elctrns. Corp., Hopkins, Minn.
Struthers-Dunn, Inc., Pitman, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
Summit Engrg. Corp., Bozeman, Mont.
Superior Elec., Bristol, Conn.
Tapeswitch Corp. Amer., Farmingdale, N.Y.
Taylor-Winfield Corp., Warren, Ohio
Tektronix, Inc., Beaverton, Ore.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
Torque Systems, Waltham, Mass.
Transducer Controls Corp., Covina, Calif.
Triac Elctrn. Sys., Forest Hills, N. Y.
W.V. Industries Inc., Franklin Lakes, N.J.
Westamp, Inc., Santa Monica, Cal.
Westinghouse Elec., Buffalo, N. Y.
Westinghouse Elec. Corp., Ind'l. Systems Div., Pittsburgh, Pa.
Yaskawa Elec. America, Inc., Oak Brook, Ill.

Controls, Moisture—See Controls, Humidity

Controls, Motor Speed

Autronics Corp., Pasadena, Calif. Vol 2•333
Bodine Elec. Co., Chicago, Ill. Vol 2•634
Carter Motor Co., Chicago, Ill. Vol 2•635
Ind'l. Control Co., Farmingdale, N.Y. Vol 2•989
Measurement Sys., Inc., Norwalk, Conn. Vol 2•356
Servo-Tek Prods. Co., Hawthorne, N.J. Vol 2•661
Torque Systems, Waltham, Mass. Vol 2•991
Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371,373,376
Advance Instr. Corp., Belmar, N. J.
Allen-Bradley Co., Milwaukee, Wisc.
Allis-Chalmers, Milwaukee, Wisc.
Allis, Louis Div., Milwaukee, Wisc.
American Elctrns., Inc., Fullerton, Cal.
AMF Electical Prods., Alexandria, Va.
Amtron Inc., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Arnold Magnetics, Culver City, Cal.
Autocon Inds., Inc., Minneapolis, Minn.
Avtron Mfg., Inc., Cleveland, Ohio
B & B Motor & Control, New York, NY
Basler Elec. Co., Highland, Ill.
Beckman Instrs., Helipot Div., Fullerton, Cal.
BECO, Inc., Salem, Va.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Carson Mfg. Co., Indianapolis, Ind.
Cherry Electrical Prods., Waukegan, Ill
CML-Macarr, Inc., Edison, N.J.
Cole-Parmer Instr. Co., Chicago, Ill.
Computer Devices of Calif., Santa Fe Springs, Cal.
Control Technology Co., L.I.C., N.Y.
Cross Electronics Inc., Warrendale, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Datron Systems, Chatsworth, Cal.
Davidson Elctrn. Dev. Co., Erie, Pa.
De Soto Elec. Prods., De Soto, Mo.
Dynapar Corp., Gurnee, Ill.
ECC Corp., Euless, Tex.
Electro Corp., Sarasota, Fla.
Electro-Craft Corp, Hopkins, Minn
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Electro-Pacific, Inc., Goleta, Calif.
Electrol Co., Inc., York, Pa.
Elctrn. Control Co., Dresher, Pa.
Fincor Div., York, Pa.
Firing Circuits, Norwalk, Conn.
Foxboro Co., Foxboro, Mass.
Furnas Elec. Co., Batavia, Ill.
Gems Sensors Div., Farmington, Conn.
General Devices, Inc., Princeton, N.J.
Glentek, Inc., Santa Monica, Calif.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Halmar Elctrns., Inc., Columbus, Ohio
Hamlin, Inc., Lake Mills, Wisc.
Honeywell, Ft. Washington, Pa.
Hope Elctrns., Clifton, N.J.
Hunt Electronics Co., Dallas, Tex.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
IEC Electronics Corp., E. Rochester, N.Y.
Innovatek Enterprise, Millerton, N.Y.
Inservco, Inc., La Grange, Ohio
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International Rectifier, El Segundo, Cal.
Jones Motrola Corp., Stamford, Conn.
Kratos, Pasadena, Cal
Landis & Gyr, Inc., Elmsford, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
LFE Corp., Waltham,, Mass.
Linemaster Switch Corp., Woodstock, Conn.
Luft Instrs., Inc., Lincoln, Mass.
LVC Inds. Inc., Flushing, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Master Elctrn. Controls, Santa Monica, Cal.
Meltronics Inc., Leeds, Ala.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
MKC Elctrns. Corp., Kansas City, Kans.
Ohmite Mfg. Co., Skokie, Ill.
Opad Elec. Co., Inc., New York, N.Y.
Parametrics, Inc., Orange, Conn.
PECO Corp., Milpitas, Cal.
Power Control Corp., Pittsburgh, Pa.
Power Technology, Inc., Little Rock, Ark.
Precision Dynamics Corp., Burbank, Cal.
Quadrastat Controls Corp., Glendale, Cal.
Ratelco, Inc., Seattle, Wash.
Reliance Elec. Co., Cleveland, Ohio
Research, Inc., Minneapolis, Minn.
Robicon Corp., Pittsburgh, Pa.
Sawyer Inds., Arcadia, Cal.
Schaevitz Engrg., Pennsauken, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Seco Elctrns. Corp., Hopkins, Minn.
Sensor Corp., Scottsdale, Pa.
Sequential Information Systems, Elmsford, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Speed Detectors, Bedford, Ohio
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Bettendorf, Iowa
Summit Engrg. Corp., Bozeman, Mont.
Superior Elec., Bristol, Conn.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
Transducer Controls Corp., Covina, Calif.
Transicoil, Inc., Worcester, Pa.
Unitron Inc., Garland, Tex.
Vectrol, Inc., Rockville, Md.
Voltex Co., Inc., Farmingdale, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Westamp, Inc., Santa Monica, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Westinghouse Elec., Buffalo, N. Y.
Westinghouse Elec. Corp., Ind'l. Systems Div., Pittsburgh, Pa.

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Accutronics, Geneva, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Electronic Research Co., Shawnee Mission, Kan.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
J-B-T Instrs., Inc., New Haven, Conn.
Meloy Laboratories Inc., Springfield, Va.
Philamon, Inc., Westbury, N.Y.
Precision Dynamics Corp., Burbank, Cal.
Sensor Corp., Scottsdale, Pa.
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Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autotron, Inc., Danville, Ill.
Controlcraft Corp., West Chicago, Ill.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Hughey & Phillips, Inc., Burbank, Cal.
IEC Electronics Corp., E. Rochester, N.Y.
Innovation Industries Inc., Roswell, N.M.
International Rectifier, El Segundo, Cal.
Kates Scientific Instrs., Inc., Watertown, Mass.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Luft Instrs., Inc., Lincoln, Mass.
Master Elctrn. Controls, Santa Monica, Cal.
NES, Inc., Itasca, Ill.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Precision Dynamics Corp., Burbank, Cal.
Ripley Co., Inc., Middletown, Conn.
Scientific Technology, Mountain View, Cal.
Sensor Technology, Chatsworth, Cal.
Sigma Instrs., Inc., Braintree, Mass.
Skan-A-Matic Corp., Elbridge, N. Y.
Spectronics, Inc., Richardson, Tex.
Tri-Tronics Co., Oak Brook, Ill.
Triac Elctrn. Sys., Forest Hills, N. Y.
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ABA Industries, Inc., Pinellas Pk., Fla.
Aeroflex Labs., Plainview, N.Y.
Allen-Bradley, Highland Hgts., Ohio
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American Time Products, Woodside, N.Y.
Ametek/Instrs. & Controls, Feasterville, Pa.
Applied Control Co., Fairfield, N.J.
Astrosystems, Inc., Lake Success, N.Y.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Avtron Mfg., Inc., Cleveland, Ohio
Bailey Meter Co., Wickliffe, Ohio
Baldwin Elctrns., Little Rock, Ark.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bendix Corp., N. Hollywood, Calif.
Bendix Corp., Detroit, Mich.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Div, Waterbury, Conn
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C & A Products, Inc., Woodside, N. Y.
Cherry Electrical Prods., Waukegan, Ill
Columbia Resch. Labs., Woodlyn, Pa.
Computer Conversions Corp., East Northport, N.Y.
Computer Devices of Calif., Santa Fe Springs, Cal.
Computer Instrs., Hempstead, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Data Technology Inc., Watertown, Mass.
Datex Div., Duarte, Cal.
Datron Systems, Chatsworth, Cal.
Delco Elctrns. Div., Kokomo, Ind.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Electro Corp., Sarasota, Fla.
Electro-Craft Corp, Hopkins, Minn
Electrol Co., Inc., York, Pa.
Farrand Controls, Inc., Valhalla, N.Y.
Fiber Photics, Inc., Santa Cruz, Cal.
Fincor Div., York, Pa.

Foxboro Co., Foxboro, Mass.
Gap Instr. Corp., Hauppauge, N.Y.
Gems Sensors Div., Farmington, Conn.
General Scanning, Watertown, Mass.
Geo Space Sys., Tampa, Fla.
Glentek, Inc., Santa Monica, Calif.
HEI, Inc., Chaska, Minn.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
IEC Electronics Corp., E. Rochester, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Int'l. Electro-Magnetics, Palatine, Ill.
Jordan Controls, Milwaukee, Wisc.
Lear Siegler, Inc., Santa Monica, Calif.
Ledex, Inc., Dayton, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Inc., Lincoln, Mass.
LVC Inds. Inc., Flushing, N.Y.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
Minnetech Labs, Minneapolis, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
National Sonics, Farmingdale, N.Y.
Orbit Instr. Corp., Syosset, N.Y.
Parametrics, Inc., Orange, Conn.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Precision Mechanisms Corp., Westbury, N.Y.
Proto Matic Co., Cincinnati,, Ohio
Quadrastat Controls Corp., Glendale, Cal.
Robicon Corp., Pittsburgh, Pa.
Schaevitz Engrg., Pennsauken, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Technology, Mountain View, Cal.
Sealectro Corp., Mamaroneck, N.Y.
Seco Elctrns. Corp., Hopkins, Minn.
Sensor Corp., Scottsdale, Pa.
Sequential Information Systems, Elmsford, N.Y.
Singer Co., Glendale, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
Speed Detectors, Bedford, Ohio
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Taylor Instr. Process Control Div., Rochester, N.Y.
Taylor-Winfield Corp., Warren, Ohio
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
3M Co., St. Paul, Minn.
Transducer Controls Corp., Covina, Calif.
Transicoil, Inc., Worcester, Pa.
Veeder-Root, Hartford, Conn.
Vernitech, Deer Pk., N.Y.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.
Westamp, Inc., Santa Monica, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.
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Allen-Bradley Co., Milwaukee, Wisc.
Ametek/Instrs. & Controls, Feasterville, Pa.
Autocon Inds., Inc., Minneapolis, Minn.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bell & Howell Co., Pasadena, Calif.
Bendix Corp., Davenport, Iowa
Bristol Div, Waterbury, Conn
Columbus Elec. Mfg. Co., Columbus, Ohio
Computer Instrs., Hempstead, N.Y.
Conrac Corp., Duarte, Cal.
Consolidated Controls Corp., Bethel, Conn.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Control Technology Co., L.I.C., N.Y.
Cook Elec. Co., Morton Grove, Ill.
Cutler-Hammer, Milwaukee, Wisc.
Dietz, Henry G. Co., Inc., Long Island City, N.Y.
Dynamic Controls Corp., S. Windsor, Conn.
Foxboro Co., Foxboro, Mass.
Furnas Elec. Co., Batavia, Ill.
Gagne Assocs., Inc., Binghamton, N.Y.
Gems Sensors Div., Farmington, Conn.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Kidde, Walter & Co., Belleville, N.J.
Lear Siegler, Inc., Elyria, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Lion Precision Corp, Newton, Mass.
Luft Instrs., Inc., Lincoln, Mass.
Matheson Gas Products, East Rutherford, N.J.
MKS Instrs., Inc., Burlington, Mass.
Precision Dynamics Corp., Burbank, Cal.
Robertshaw Controls Co., Richmond, Va.
Rosemount Inc., Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Seco Elctrns. Corp., Hopkins, Minn.
Sensotec, Inc., Columbus, Ohio
Singer Co., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Texas Instruments, Inc., Houston, Tex.
Transducer Controls Corp., Covina, Calif.
United Elec. Controls Co., Watertown, Mass.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Worner Elctrn. Devices, Rankin, Ill.

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Allis, Louis Div., Milwaukee, Wisc.
Alnor Instr. Co., Chicago, Ill.
Ametek/Instrs. & Controls, Feasterville, Pa.
Amtron Inc., Midlothian, Ill.
Applied Control Co., Fairfield, N.J.
Avtron Mfg., Inc., Cleveland, Ohio
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bendix Corp., N. Hollywood, Calif.
Blue M Engrg. Co., Blue Island, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Div, Waterbury, Conn
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cole-Parmer Instr. Co., Chicago, Ill.
Control Technology Co., L.I.C., N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cox & Co., Inc., New York, N.Y.
Cross Electronics Inc., Warrendale, Pa.
Durant Digital Instrs., Watertown, Wisc.
Dynapar Corp., Gurnee, Ill.
Electrol Co., Inc., York, Pa.
Elctrn. Control Co., Dresher, Pa.
Foxboro Co., Foxboro, Mass.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Guardian California, Culver City, Cal.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
Ind'l. Control Co., Farmingdale, N.Y.
Int'l. Instrs., Orange, Conn.
Jordan Controls, Milwaukee, Wisc.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Matheson Gas Products, East Rutherford, N.J.
Measurement Sys., Inc., Norwalk, Conn.
MKC Elctrns. Corp., Kansas City, Kans.
NES, Inc., Itasca, Ill.
Oven Industries, Inc., Mechanicsburg, Pa.
Power Control Corp., Pittsburgh, Pa.
Research, Inc., Minneapolis, Minn.
Robertshaw Controls Co., Richmond, Va.
Robicon Corp., Pittsburgh, Pa.
Schaevitz Engrg., Pennsauken, N.J.
Seco Elctrns. Corp., Hopkins, Minn.
Solid State Elctrns. Corp., Sepulveda, Cal.
Summit Engrg. Corp., Bozeman, Mont.
Taylor Instr. Process Control Div., Rochester, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
3M Co., St. Paul, Minn.
Transducer Controls Corp., Covina, Calif.
Triac Elctrn. Sys., Forest Hills, N. Y.
Vectrol, Inc., Rockville, Md.
Veeder-Root, Hartford, Conn.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

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Automatic Timing & Controls, Inc., King of Prussia, Pa.
Automation Services Div., Windsor, N. Y.
Autotron, Inc., Danville, Ill.
Coil Co. of Amer., Northvale, N.J.
Cole Instrument Corp., Costa Mesa, Cal.
Controlcraft Corp., West Chicago, Ill.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Delavan Electronics, Scottsdale, Ariz.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Electro Corp., Sarasota, Fla.
Electrol Co., Inc., York, Pa.
Farmer Elec. Prods. Co., Inc., Natick, Mass.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
HEI, Inc., Chaska, Minn.
Honeywell, Minneapolis, Minn.
IEC Electronics Corp., E. Rochester, N.Y.
Licon Div., Chicago, Ill.
Lion Precision Corp, Newton, Mass.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Precision Dynamics Corp., Burbank, Cal.
Reed Switch Dev. Co., Greenwich, Conn.
Robertshaw Controls Co., Richmond, Va.
Schaevitz Engrg., Pennsauken, N.J.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Skan-A-Matic Corp., Elbridge, N. Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Square D Co., Park Ridge, Ill.
Texas Instruments, Attleboro, Mass.
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AMF Electical Prods., Alexandria, Va.
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A.R.F. Products, Inc., Boulder, Colo.
Arrow-Hart, Inc., Hartford, Conn.
Astrosystems, Inc., Lake Success, N.Y.
Autocon Inds., Inc., Minneapolis, Minn.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bramco Controls, Piqua, Ohio
Carson Mfg. Co., Indianapolis, Ind.
Cole Instrument Corp., Costa Mesa, Cal.
Cole-Parmer Instr. Co., Chicago, Ill.
Control Technology Co., L.I.C., N.Y.
Dale Elctrns., Inc., Yankton, S.D.
Dataprobe, Inc., So. Hackensack, N.J.
Datron Systems, Chatsworth, Cal.
Dukane Corp., St. Charles, Ill.
Electrol Co., Inc., York, Pa.
Foxboro Co., Foxboro, Mass.
Furnas Elec. Co., Batavia, Ill.
General Elec. Company, Providence, R.I.
Geo Space Sys., Tampa, Fla.
Hathaway Instruments, Inc., Denver, Colo.
Heitz, Karl, Inc., New York, N.Y.
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Innovatek Enterprise, Millerton, N.Y.
Landis & Gyr, Inc., Elmsford, N.Y.
Ledex, Inc., Dayton, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Luft Instrs., Inc., Lincoln, Mass.
Micro Switch, Freeport, Ill.
Midland Standard Inc., Elgin, Ill.
NES, Inc., Itasca, Ill.
Oak Inds. Inc., Crystal Lake, Ill.
Precision Dynamics Corp., Burbank, Cal.
Quadrastat Controls Corp., Glendale, Cal.
RCA Corp., Camden, N.J.
Robertshaw Controls Co., Richmond, Va.
Scientific Technology, Mountain View, Cal.
Seco Elctrns. Corp., Hopkins, Minn.
Solid State Elctrns. Corp., Sepulveda, Cal.
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Superior Elec., Bristol, Conn.
Texas Instruments, Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
Triac Elctrn. Sys., Forest Hills, N. Y.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

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Innovation Industries Inc., Roswell, N.M.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Micro Switch, Freeport, Ill.
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AMF Electical Prods., Alexandria, Va.
Applied Control Co., Fairfield, N.J.
B & B Motor & Control, New York, NY
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Basler Elec. Co., Highland, Ill.
Blue M Engrg. Co., Blue Island, Ill.
Bristol Div, Waterbury, Conn
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Caig Labs., Inc., Westbury, N.Y.
Cal-Power Corp., El Segundo, Calif.
Carson Mfg. Co., Indianapolis, Ind.
Coil Co. of Amer., Northvale, N.J.
Constant Voltage Co., Chicago, Ill.
Cox & Co., Inc., New York, N.Y.

Cross Electronics Inc., Warrendale, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Datron Systems, Chatsworth, Cal.
De Soto Elec. Prods., De Soto, Mo.
Despatch Oven Co., Minneapolis, Minn.
Digitron Corp., Norristown, Pa.
Dynamic Controls Corp., S. Windsor, Conn.
Electro-Devices, Inc., Paterson, N.J.
Electro-Pacific, Inc., Goleta, Calif.
Electrol Co., Inc., York, Pa.
Elctrn. Control Co., Dresher, Pa.
Fincor Div., York, Pa.
Firing Circuits, Norwalk, Conn.
Flight Sys., Inc., Mechanicsburg, Pa.
General Instr. Corp., Semiconductor Comps. Div., Hicksville, N.Y.
Glentek, Inc., Santa Monica, Calif.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
GRM Corp., Medford, N.J.
Halmar Elctrns., Inc., Columbus, Ohio
Honeywell, Ft. Washington, Pa.
Hotpack Corp., Phila., Pa.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Int'l. Instrs., Orange, Conn.
International Rectifier, El Segundo, Cal.
Jordan Controls, Milwaukee, Wisc.
LFE Corp., Waltham,, Mass.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Master Elctrn. Controls, Santa Monica, Cal.
Midland Standard Inc., Elgin, Ill.
Motorola Semiconductor Prods., Phoenix, Ariz.
Ohmite Mfg. Co., Skokie, Ill.
Parametrics, Inc., Orange, Conn.
Power Control Corp., Pittsburgh, Pa.
Reliance Elec. Co., Cleveland, Ohio
Research, Inc., Minneapolis, Minn.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Robicon Corp., Pittsburgh, Pa.
Rosemount Inc., Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Seco Elctrns. Corp., Hopkins, Minn.
Sensor Corp., Scottsdale, Pa.
Signalite, Neptune, N.J.
Texas Instruments, Dallas, Tex.
Texas Instruments, Attleboro, Mass.
Vectrol, Inc., Rockville, Md.
Veeder-Root, Hartford, Conn.
Voltex Co., Inc., Farmingdale, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
WER Industrial, Grand Island, N.Y.
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Cross Electronics Inc., Warrendale, Pa.
Diversified Elctrns., Evansville, Ind
Dynamic Controls Corp., S. Windsor, Conn.
Dynapar Corp., Gurnee, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
Luft Instrs., Inc., Lincoln, Mass.
Pioneer/Instrumentation, Cleveland, Ohio
Power Control Corp., Pittsburgh, Pa.
Solid State Elctrns. Corp., Sepulveda, Cal.
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Warren G-V Communications, Livingston, N.J.

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Arnold Magnetics, Culver City, Cal.
Bafco, Inc., Warminster, Pa.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., N. Hollywood, Calif.
Bodine Elec. Co., Chicago, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C & A Products, Inc., Woodside, N. Y.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Datron Systems, Chatsworth, Cal.
Digiac Corp., Plainview, N.Y.
Dynapar Corp., Gurnee, Ill.
Electro-Craft Corp, Hopkins, Minn
Hills-McCanna Co., Carpentersville, Ill.
Honeywell, Ft. Washington, Pa.
Innovatek Enterprise, Millerton, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Meltronics Inc., Leeds, Ala.
Micro Switch, Freeport, Ill.
Robicon Corp., Pittsburgh, Pa.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Technology, Mountain View, Cal.
Sequential Information Systems, Elmsford, N.Y.
Singer Co., Little Falls, N.J,
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transicoil, Inc., Worcester, Pa.
Vernitech, Deer Pk., N.Y.
Vibra-Metrics, Inc., E. Haven, Conn.
Westamp, Inc., Santa Monica, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zonic Tech. Labs., Cincinnati, Ohio

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American Elctrns., Inc., Fullerton, Cal.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
B & B Motor & Control, New York, NY
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Clifton Precision, Clifton Hgts., Pa.
Computer Devices of Calif., Santa Fe Springs, Cal.
Conrac Corp., Fairfield, N.J.
Control Data Corp., Minneapolis, Minn.
Datron Systems, Chatsworth, Cal.
Dynapar Corp., Gurnee, Ill.
Furnas Elec. Co., Batavia, Ill.
Gap Instr. Corp., Hauppauge, N.Y.
Glentek, Inc., Santa Monica, Calif.
Harowe Servo Controls, W. Chester, Pa.
Honeywell, Ft. Washington, Pa.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
IMC Magnetics Corp., Westbury, N.Y.
IMC Magnetics Corp., Rochester, N.H.
IMC Magnetics Corp., Maywood, Cal.
Ledex, Inc., Dayton, Ohio
Measurement Sys., Inc., Norwalk, Conn.
North American Philips Controls Corp., Cheshire, Conn.
Precision Dynamics Corp., Burbank, Cal.
Precision Timer Co., Westbrook, Conn.
Proto Matic Co., Cincinnati,, Ohio
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Sealectro Corp., Mamaroneck, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Singer Co., Little Falls, N.J.
Summit Engrg. Corp., Bozeman, Mont.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Texas Instruments, Attleboro, Mass.
Theta Instr. Corp., Fairfield, N.J.
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Ametek/Instrs. & Controls, Feasterville, Pa.
AMF Electical Prods., Alexandria, Va.
Andersen Labs. Inc., Bloomfield, Conn.
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ARI Inds., Inc., Franklin Pk., Ill.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Barnes Engrg. Co., Stamford, Conn.
BECO, Inc., Salem, Va.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Bell & Howell Co., Pasadena, Calif.
Bell Industries, Compton, Cal.
Blue M Engrg. Co., Blue Island, Ill.
Bristol Div, Waterbury, Conn
Burling Instr. Co., Chatham, N.J.
Caig Labs., Inc., Westbury, N.Y.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Cambridge Thermionic, Cambridge, Mass
Chatham Controls Corp., Chatham, N.J.
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Cole-Parmer Instr. Co., Chicago, Ill.
Columbus Elec. Mfg. Co., Columbus, Ohio
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Consolidated Ohmic Devices, Carle Pl., N.Y.
Control Technology Co., L.I.C., N.Y.
Cross Electronics Inc., Warrendale, Pa.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Davidson Elctrn. Dev. Co., Erie, Pa.
Devco Engrg., W. Caldwell, N.J.
Dohrmann Div., Mountain View, Cal.
Dynamic Controls Corp., S. Windsor, Conn.
Eagle Signal, Davenport, Iowa
Eastern Industries, Hamden, Conn.
Edison, Instr. Div., W. Orange, N.J.
Elcom Sys., Deer Pk., N.Y.
Electro-Pacific, Inc., Goleta, Calif.
Electrol Co., Inc., York, Pa.
Elctrn. Control Co., Dresher, Pa.
Electronic Research Co., Shawnee Mission, Kan.
Elmwood Sensors, Inc., Cranston, R.I.
Essex International, Mansfield, Ohio
Fenwal, Inc., Ashland, Mass.
Fisher Sci. Co., Pittsburgh, Pa.
Forma Scientific, Marietta, Ohio
Foxboro Co., Foxboro, Mass.
General Electric, Shelbyville, Ind.
General Elec., W. Lynn, Mass.
Glentek, Inc., Santa Monica, Calif.
Guardian California, Culver City, Cal.
Guildline Instrs., Inc., Larchmont, N.Y.
H-B Instr. Co., Phila., Pa.
Hamlin, Inc., Lake Mills, Wisc.
Hexacon Elec. Co., Roselle Park, N.J.
Hoagland Instr., Dayton, N.J.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Hope Elctrns., Clifton, N.J.
Hunt Electronics Co., Dallas, Tex.
Hy-Cal Engrg., Santa Fe Springs, Cal.
IEC Electronics Corp., E. Rochester, N.Y.
Int'l. Instrs., Orange, Conn.
Jade Corp., Huntingdon Valley, Pa.
James Elctrns., Inc., Chicago, Ill.
Keystone Carbon Co., St. Marys, Pa.
Kidde, Walter & Co., Belleville, N.J.
Kistler Instr. Co., Redmond, Wash.
Lab-Line Instrs., Inc., Melrose Park, Ill.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Luft Instrs., Inc., Lincoln, Mass.
Mag-Con, Inc., New Brighton, Minn.
Master Elctrn. Controls, Santa Monica, Cal.
Matheson Gas Products, East Rutherford, N.J.
Matrix Corp., Beech Grove, Ind.
Midland Standard Inc., Elgin, Ill.
Mikron Instr. Co., Ridgewood, N.J.
MKC Elctrns. Corp., Kansas City, Kans.
NES, Inc., Itasca, Ill.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Nuclear Sys., Garland, Tex.
OAL Assocs., Inc., Westbury, N.Y.
Oxford Instr. Corp., Annapolis, Md.
P.E.T., Inc., Pittsburgh, Pa.
Pioneer/Instrumentation, Cleveland, Ohio
Precision Dynamics Corp., Burbank, Cal.
Precision Sci. Co., Chicago, Ill.
Princeton Applied Resch. Corp., Princeton, N.J.
Princo Instrs., Southampton, Pa.
Procedyne Corp., New Brunswick, N.J.
Proto Matic Co., Cincinnati,, Ohio
Raytek, Inc., Mountain View, Cal.
RDF Corp., Hudson, N.H.
Relco Prods., Denver, Colo.
Research, Inc., Minneapolis, Minn.
RIL Elctrns., Inc., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Robicon Corp., Pittsburgh, Pa.
Rosemount Inc., Minneapolis, Minn.
Rosemount Nashville Inc., Lavergne, Tenn.
Recorder Systems Div., E. Greenwich, R.I.
Scientronics, Barrington, N.J.
Sigma Instrs., Inc., Braintree, Mass.
Signet Scientific Co., Burbank, Cal.
Simpson Elec. Co., Chicago, Ill.
Singer Co., Philadelphia, Pa.
Singer Co., Schiller Park, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Syracuse Elctrns. Corp., Syracuse, N.Y.
Syscon Int'l., Inc., So. Bend, Ind.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tempil Div., So. Plainfield, N.J.
Tempo Instrument, Inc., Plainview, N.Y.
Temptronix Inc., Newton, Mass.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Thermal Sys., Los Angeles, Cal.
Thermo Elec. Co., Inc., Saddle Brook, N.J.
Thermometrics, Inc., Edison, N.J.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Trans-Met Engrg., La Habra, Cal.
Transducer Controls Corp., Covina, Calif.
Tylan Corp., Torrance, Calif.
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Varian Assocs., Vacuum Div., Palo Alto, Cal.
Vectrol, Inc., Rockville, Md.
Victory Engrg. Corp., Springfield, N.J.
VirTis Co., Gardiner, N.Y.
Voltex Co., Inc., Farmingdale, N.Y.
Warren G-V Communications, Livingston, N.J.
Watlow Elec. Mfg. Co., St. Louis, Mo.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

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Del Electronics Corp., Mt. Vernon, N.Y.
Firing Circuits, Norwalk, Conn.
Hope Elctrns., Clifton, N.J.
Precision Dynamics Corp., Burbank, Cal.
Taylor-Winfield Corp., Warren, Ohio
Triac Elctrn. Sys., Forest Hills, N. Y.
Vectrol, Inc., Rockville, Md.

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Allis, Louis Div., Milwaukee, Wisc.

Ametek/Instrs. & Controls, Feasterville, Pa.
B & B Motor & Control, New York, NY
Bodine Elec. Co., Chicago, Ill.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Control Technology Co., L.I.C., N.Y.
Cross Electronics Inc., Warrendale, Pa.
Electrol Co., Inc., York, Pa.
Fincor Div., York, Pa.
General Time Corp., Thomaston, Conn.
Himmelstein, S. & Co., Elk Grove Village, Ill.
Honeywell, Ft. Washington, Pa.
Ledex, Inc., Dayton, Ohio
McFadden Elctrns. Co., South Gate, Calif.
Minnetech Labs, Minneapolis, Minn.
Robicon Corp., Pittsburgh, Pa.
Sensotec, Inc., Columbus, Ohio
Sigma Instrs., Inc., Braintree, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Vibrac Corp., Chelmsford, Mass.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zonic Tech. Labs., Cincinnati, Ohio

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Airflyte Elctrns. Co., Bayonne, N.J.
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Amtron Inc., Midlothian, Ill.
Anadex Instrs., Inc., Van Nuys, Calif.
Analogic, Wakefield, Mass.
Astrosystems, Inc., Lake Success, N.Y.
Austin Elctrns., Roselle, N.J.
Automated Meas., Oakland, Calif.
Baganoff Assocs., Inc., St. Louis, Mo.
Baldwin Elctrns., Little Rock, Ark.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Bell & Howell Co., Pasadena, Calif.
Biomation Corp., Cupertino, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Div, Waterbury, Conn
C & A Products, Inc., Woodside, N. Y.
Computer Prods., Ft. Lauderdale, Fla.
Conrac Corp., Fairfield, N.J.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Data General Corp. (E), Southboro, Ma.
Data Technology, Santa Ana, Cal.
Datametrics Inc., Wilmington, Mass.
Datascan, Inc., Clifton, N.J.
Datum, Inc., Anaheim, Calif.
Digiac Corp., Plainview, N.Y.
Digilin, Inc., Glendale, Cal.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamic Measurements Corp., Winchester, Ma.
E-H Resch. Labs., Inc., Oakland, Cal.
Electro-Numerics, Santa Clara, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Epsco, Inc., Westwood, Mass.
Fairchild Space & Defense Sys., Syosset, N.Y.
Fifth Dimension, Princeton, N.J.
Foxboro Co., Foxboro, Mass.
Junction Modules, Inc., Irvine, Cal.
Gap Instr. Corp., Hauppauge, N.Y.
General Devices, Inc., Princeton, N.J.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
Honeywell Information Systems, Waltham, Mass.
IEC Electronics Corp., E. Rochester, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Innovatek Enterprise, Millerton, N.Y.
Intech, Santa Clara, Cal.
Lear Siegler, Inc., Santa Monica, Calif.
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Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Measurement Sys., Inc., Norwalk, Conn.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Micro Instr. Co., Hawthorne, Cal.
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Monitor Labs, Inc., San Diego, Cal.
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MPC Prods. Corp., Chicago, Ill.
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Nicolet Instr. Corp., Madison, Wisc.
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North Atlantic Inds., Plainview, N.Y.
Northern Precision Labs., Inc., Fairfield, N.J.
Novatronics, Inc., Pompano Beach, Fla.
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Packard Instrument Co., Inc., Downers Grove, Ill.
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Precision Monolithics Inc., Santa Clara, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Measurements, Wilmette, Ill.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Signal Analysis Oper., Hauppauge, N.Y.
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Sprague Elec. Co., No. Adams, Mass.
SSR Instrs. Co., Santa Monica, Cal.
Struthers-Dunn, Inc., Bettendorf, Iowa
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Teledyne Philbrick, Dedham, Mass.
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Tohoku Metal Inds., Ltd., Tokyo, Japan
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Conrac Corp., Fairfield, N.J.
Control Technology Co., L.I.C., N.Y.
Datum, Inc., Anaheim, Calif.
Digilin, Inc., Glendale, Cal.
Digital Equip. Corp., Maynard, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro-Numerics, Santa Clara, Cal.
Foxboro Co., Foxboro, Mass.
Junction Modules, Inc., Irvine, Cal.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hybrid Sys. Corp., Burlington, Mass.
Lear Siegler, Grand Rapids, Mich.
Matrix Corp., Beech Grove, Ind.
Measurement Sys., Inc., Norwalk, Conn.
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Airflyte Elctrns. Co., Bayonne, N.J.
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Bowmar Instr. Corp., Ft. Wayne, Ind.
CGS Units, Inc., Rochester, N.Y.
Computer Conversions Corp., East Northport, N.Y.
Conrac Corp., Fairfield, N.J.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Data Technology Inc., Watertown, Mass.
Datametrics Inc., Wilmington, Mass.
Datascan, Inc., Clifton, N.J.
Datum, Inc., Anaheim, Calif.
Digital Equip. Corp., Maynard, Mass.
Digitran Co., Pasadena, Cal.
Digitron Corp., Norristown, Pa.
Dynamic Measurements Corp., Winchester, Ma.
General Microwave Corp., Farmingdale, N.Y.
Geo Space Sys., Tampa, Fla.
Honeywell Information Systems, Waltham, Mass.
Instrumentation Tech. Corp., Northbridge, Cal.
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Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Matrix Systems Corp., Chatsworth, Calif.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Midland Standard Inc., Elgin, Ill.
Monitor Systems, Ft. Washington, Pa
NES, Inc., Itasca, Ill.
Norden Div., Norwalk, Conn.
Phoenix Data Inc., Phoenix, Ariz.
Pinlites, Fairfield, N.J.
Precision Dynamics Corp., Burbank, Cal.
Republic Advanced System Technology Group, Chatsworth, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Co., Little Falls, N.J.
Struthers-Dunn, Inc., Pitman, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
TEC, Inc., Tucson, Ariz.
Tech Serv., Inc., Fogelsville, Pa.
Texas Instruments, Dallas, Tex.
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3M Co., St. Paul, Minn.
Veeder-Root, Hartford, Conn.
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Wyle Computer Prods., Inc., El Segundo, Calif.
Xerox Data Sys., El Segundo, Cal

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Datum, Inc., Anaheim, Calif.
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Frequency Engrg. Labs., Farmingdale, N.J.
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Burr-Brown Resch. Corp., Tucson, Ariz.
Conrac Div., Covina, Calif.
Data Disc, Inc., Sunnyvale, Cal.
Datum, Inc., Anaheim, Calif.
Del Electronics Corp., Mt. Vernon, N.Y.
Digital Equip. Corp., Maynard, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamic Measurements Corp., Winchester, Ma.
ILC Data Device Corp., Hicksville, N.Y.
Information Displays, Inc., Mt. Kisco, N.Y.
Integrated Systems, Inc., Norcross, Ga.
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Melcor Elctrns. Corp., Farmingdale, N.Y.
Monitor Systems, Ft. Washington, Pa
Natel Engrg. Co., Canoga Pk., Cal.
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Pacific Meas., Inc., Palo Alto, Calif.
Powercube Corp, Waltham, Mass.
Precision Dynamics Corp., Burbank, Cal.
Princeton Elctrn. Prods., New Brunswick, N.J.
Sierra Sys., Mountain View, Cal.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Technipower Inc., Ridgefield, Conn.
Tecnetics, Inc., Boulder, Colo.
Tektronix, Inc., Beaverton, Ore.
Venus Scientific, Farmingdale, N.Y.

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Amtron Inc., Midlothian, Ill.
Anadex Instrs., Inc., Van Nuys, Calif.
Analogic, Wakefield, Mass.

Astrosystems, Inc., Lake Success, N.Y.
Austin Elctrns., Roselle, N.J.
Berkeley Nucleonics Corp., Berkeley, Calif.
C & A Products, Inc., Woodside, N. Y.
Components Corp., Denville, N.J.
Computer Conversions Corp., East Northport, N.Y.
Computer Prods., Ft. Lauderdale, Fla.
Conrac Corp., Fairfield, N.J.
Control Technology Co., L.I.C., N.Y.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Data General Corp. (E), Southboro, Ma.
Data Technology, Santa Ana, Cal.
Datametrics Inc., Wilmington, Mass.
Datex Div., Duarte, Cal.
Datum, Inc., Anaheim, Calif.
Digiac Corp., Plainview, N.Y.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Dynamic Measurements Corp., Winchester, Ma.
Dynapar Corp., Gurnee, Ill.
E-H Resch. Labs., Inc., Oakland, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Fairchild Space & Defense Sys., Syosset, N.Y.
Fifth Dimension, Princeton, N.J.
Foxboro Co., Foxboro, Mass.
Junction Modules, Inc., Irvine, Cal.
Gap Instr. Corp., Hauppauge, N.Y.
General Data Inds. Inc. Inc., Wilton, Conn.
General Devices, Inc., Princeton, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Geo Space Sys., Tampa, Fla.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
Honeywell Information Systems, Waltham, Mass.
HyComp Inc., Maynard, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Information Displays, Inc., Mt. Kisco, N.Y.
Intech, Santa Clara, Cal.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Kepco, Inc., Flushing, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Lear Siegler, Grand Rapids, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Micro Networks, Worcester, Mass.
Monitor Labs, Inc., San Diego, Cal.
Monitor Systems, Ft. Washington, Pa
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
MPC Prods. Corp., Chicago, Ill.
NES, Inc., Itasca, Ill.
Norden Div., Norwalk, Conn.
North Atlantic Inds., Plainview, N.Y.
Novatronics, Inc., Pompano Beach, Fla.
Perkin-Elmer Corp., Electronic Prods. Dept., Norwalk, Conn.
Phoenix Data Inc., Phoenix, Ariz.
Precision Monolithics Inc., Santa Clara, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Measurements, Wilmette, Ill.
Signal Analysis Oper., Hauppauge, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Singer Co., Little Falls, N.J.
Solid State Elctrns. Corp., Sepulveda, Cal.
Sprague Elec. Co., No. Adams, Mass.
SSR Instrs. Co., Santa Monica, Cal.
Struthers-Dunn, Inc., Pitman, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
Superior Elec., Bristol, Conn.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Systron Donner Trygon Elctrns. Sub., Westbury, N.Y.
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Teledyne Philbrick, Dedham, Mass.
3M Co., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Irvine, Cal.
Varian Data Machines, Palo Alto, Cal.
Vernitech, Deer Pk., N.Y.
Weston Instruments, Inc., Newark, N.J.
Wyle Computer Prods., Inc., El Segundo, Calif.
Xerox Data Sys., El Segundo, Cal
Zeltex, Inc., Concord, Calif.

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A. D. Data Sys., Inc., Rochester, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Data Graphics, San Antonio, Tex.
Datametrics Inc., Wilmington, Mass.
Datum, Inc., Anaheim, Calif.
Demex, Inc., Kansas City, Mo.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Dytro Corp., Hicksville, N.Y.
Eldorado Electrodata, Concord, Cal.
Epsco, Inc., Westwood, Mass.
Instrumentation Tech. Corp., Northbridge, Cal.
Matrix Corp., Beech Grove, Ind.
Monitor Labs, Inc., San Diego, Cal.
NES, Inc., Itasca, Ill.
Struthers-Dunn, Inc., Bettendorf, Iowa
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Control Sciences, Inc., Granada Hills, Cal.
Control Technology Co., L.I.C., N.Y.
Datametrics Inc., Wilmington, Mass.
Fairchild Space & Defense Sys., Syosset, N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
Hybrid Sys. Corp., Burlington, Mass.
Lear Siegler, Grand Rapids, Mich.
Natel Engrg. Co., Canoga Pk., Cal.
NES, Inc., Itasca, Ill.
Perkin-Elmer Corp., Electronic Prods. Dept., Norwalk, Conn.
Republic Advanced System Technology Group, Chatsworth, Calif.
Singer Co., Little Falls, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
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Control Technology Co., L.I.C., N.Y.
Digital Equip. Corp., Maynard, Mass.
Dytro Corp., Hicksville, N.Y.
Epsco, Inc., Westwood, Mass.
Gap Instr. Corp., Hauppauge, N.Y.
HyComp Inc., Maynard, Mass.
Hybrid Sys. Corp., Burlington, Mass.
Lear Siegler, Grand Rapids, Mich.
Natel Engrg. Co., Canoga Pk., Cal.
NES, Inc., Itasca, Ill.
Perkin-Elmer Corp., Electronic Prods. Dept., Norwalk, Conn.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Republic Advanced System Technology Group, Chatsworth, Calif.
Singer Co., Little Falls, N.J.
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General Data Inds. Inc. Inc., Wilton, Conn.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Instrumentation Tech. Corp., Northbridge, Cal.
Novatronics, Inc., Pompano Beach, Fla.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
T-F Electronics, Inc., Austin, Tex.

Converters, Frequency, Test

Advanced Energy Conversion, Belmont, Cal.
Aerospace Avionics, Inc., Bohemia, N.Y.
Astrosystems, Inc., Lake Success, N.Y.
Basler Elec. Co., Highland, Ill.
Behlman Div., California Instrs., San Diego, Cal
Behlman Engrg. Corp., Santa Barbara, Cal.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
CML-Macarr, Inc., Edison, N.J.
Elcom Sys., Deer Pk., N.Y.
Elgar Corp., San Diego, Cal.
Elin Div., San Diego, Cal.
Georator Corporation, Manassas, Va.
Meloy Laboratories Inc., Springfield, Va.
Nova Electric Mfg. Co., Nutley, N.J.
Novatronics, Inc., Pompano Beach, Fla.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

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Allis, Louis Div., Milwaukee, Wisc.
Almond Instrs. Co., Covina, Cal
American Elctrns., Inc., Fullerton, Cal.
American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
AMP Capitron Div./AMP Incorporated, Elizabethtown, Pa.
Amp Inc., Harrisburg, Pa.
Anadex Instrs., Inc., Van Nuys, Calif.
Analogic, Wakefield, Mass.
Astrosystems, Inc., Lake Success, N.Y.
ATR Elctrns., Inc., St. Paul, Minn.
Autronics Corp., Pasadena, Calif.
Avtel Corp., Covina, Cal.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Basler Elec. Co., Highland, Ill.
Bicron Elctrns. Co., Canaan, Conn.
C & A Products, Inc., Woodside, N. Y.
Cal-Power Corp., El Segundo, Calif.
Christie Elec., Los Angeles, Cal.
CML-Macarr, Inc., Edison, N.J.
Computer Conversions Corp., East Northport, N.Y.
Constant Voltage Co., Chicago, Ill.
Control Technology Co., L.I.C., N.Y.
Del Electronics Corp., Mt. Vernon, N.Y.
Digital Equip. Corp., Maynard, Mass.
Electric Indicator Co., Inc., Norwalk, Conn.
Electro Corp., Sarasota, Fla.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Freed Transformer Co., Bklyn., N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
Georator Corporation, Manassas, Va.
Glentronics, Div. Sawyer Inds., Glendora, Cal.
Hybrid Sys. Corp., Burlington, Mass.
Interelectronics Corp., Congers, N.Y.
International Rectifier, El Segundo, Cal.
Kato Engrg. Co., Mankato, Minn.
Kratos, Pasadena, Cal
Lorch Elctrns. Corp., Englewood, N.J.
Matrix Corp., Beech Grove, Ind.
Natel Engrg. Co., Canoga Pk., Cal.
North Atlantic Inds., Plainview, N.Y.
Novatronics, Inc., Pompano Beach, Fla.
Oeco Corp., Portland, Ore.
Pioneer Magnetics, Santa Monica, Cal.
Powercube Corp, Waltham, Mass.
POWERTEC INC., Chatsworth, Cal.
PPM, Inc., Bedford, Ohio
Price & Rutzebeck, Hayward, Calif.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Sawyer Inds., Arcadia, Cal.
Scientific Columbus, Columbus, Ohio
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Sensor Corp., Scottsdale, Pa.
Singer - Tele-Signal, Woodbury, N.Y.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Teledyne Philbrick, Dedham, Mass.
Telmar, Inc., Columbus, Ohio
Terado Corp., St. Paul, Minn.
Transmagnetics Inc., Farmingdale, N. Y.
Unitron Inc., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
Vibrac Corp., Chelmsford, Mass.
Vibration Instrs. Co., Anaheim, Cal.
Vidar Corp., Mountain View, Cal.
Watkins Johnson Co., Palo Alto, Cal.

Converters, Graphic To Digital

Data Graphics, San Antonio, Tex.
Information Displays, Inc., Mt. Kisco, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Measurement Sys., Inc., Norwalk, Conn.
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Anaren Microwave, Inc., Syracuse, N.Y.
Anzac Elctrns., Waltham, Mass.
Astro-Metrix, Burbank, Cal.
Avtel Corp., Covina, Cal.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cal-Power Corp., El Segundo, Calif.
CML-Macarr, Inc., Edison, N.J.
Elcom Sys., Deer Pk., N.Y.
Georator Corporation, Manassas, Va.
Holt Instr. Labs., Oconto, Wisc.
HRB-Singer, Inc., State College, Pa.
Interelectronics Corp., Congers, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Kato Engrg. Co., Mankato, Minn.
Lorch Elctrns. Corp., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
Miteq Inc., Hauppauge, N.Y.
Mobil Elctrns., Inc., Anderson, Ind.
OPtimax Inc., Colmar, Pa.
Powercube Corp, Waltham, Mass.

R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Signal Analysis Oper., Hauppauge, N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Unitron Inc., Garland, Tex.
Vari-L Co., Inc., Denver, Colo.
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Allis, Louis Div., Milwaukee, Wisc.
American Time Products, Woodside, N.Y.
Anzac Elctrns., Waltham, Mass.
Astro-Metrix, Burbank, Cal.
Avtel Corp., Covina, Cal.
Behlman Div., California Instrs., San Diego, Cal
Behlman Engrg. Corp., Santa Barbara, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cal-Power Corp., El Segundo, Calif.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
CML-Macarr, Inc., Edison, N.J.
Del Electronics Corp., Mt. Vernon, N.Y.
Elcom Sys., Deer Pk., N.Y.
Elgar Corp., San Diego, Cal.
Elin Div., San Diego, Cal.
Georator Corporation, Manassas, Va.
Guardian California, Culver City, Cal.
Interelectronics Corp., Congers, N.Y.
Kato Engrg. Co., Mankato, Minn.
Lorch Elctrns. Corp., Englewood, N.J.
Meloy Laboratories Inc., Springfield, Va.
Microphase Corp., Cos Cob, Conn.
Mobil Elctrns., Inc., Anderson, Ind.
Natel Engrg. Co., Canoga Pk., Cal.
Oeco Corp., Portland, Ore.
Polyphase Instr. Co., Bridgeport, Pa.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Riverbank Labs., Geneva, Ill.
Solid State Elctrns. Corp., Sepulveda, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Vari-L Co., Inc., Denver, Colo.
Watkins Johnson Co., Palo Alto, Cal.
Zaring Inds., Inc., Westfield, Ind.

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Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Anaren Microwave, Inc., Syracuse, N.Y.
Collins Radio Co., Dallas, Tex.
Elcom Sys., Deer Pk., N.Y.
Electrac, Inc., Anaheim, Calif.
Environmental Communications Inc., Santa Ana, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Greenray Inds., Inc., Mechanicsburg, Pa.
Lorch Elctrns. Corp., Englewood, N.J.
Micro-Tel Corp., Baltimore, Md.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
OPtimax Inc., Colmar, Pa.
Premier Microwave, Port Chester, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rodelco, Deer Park, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Communications, Garland, Tex.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
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Electrac, Inc., Anaheim, Calif.
General Magnetics, Bloomfield, N.J.
Georator Corporation, Manassas, Va.
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Ind'l. Control Co., Farmingdale, N.Y.
Kato Engrg. Co., Mankato, Minn.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
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AMF Electical Prods., Alexandria, Va.
AMP Capitron Div./AMP Incorporated, Elizabethtown, Pa.
Amp Inc., Harrisburg, Pa.
ATR Elctrns., Inc., St. Paul, Minn.
Basler Elec. Co., Highland, Ill.
Behlman Div., California Instrs., San Diego, Cal
B.H. Inds., Los Angeles, Cal.
Biometrics Instrument Corp., Garland, Tex.
Cal-Power Corp., El Segundo, Calif.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
Christie Elec., Los Angeles, Cal.
Components Corp., Denville, N.J.
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Control Technology Co., L.I.C., N.Y.
Cycle-Dyne, Inc., Jamaica, N.Y.
Elasco-Div. Buchbinder Corp., Bloomfield, Conn.
Electro-Pacific, Inc., Goleta, Calif.
Elgar Corp., San Diego, Cal.
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Microtran Co. Inc., Valley Stream, N.Y.
Mid-Eastern Inds., Scotch Plains, N.J.
NH Research, Inc., Santa Ana, Calif.
North Electric Co., Galion, Ohio
North Hills Elctrns., Inc., Glen Cove, N.Y.
Novatronics, Inc., Pompano Beach, Fla.
Oeco Corp., Portland, Ore.
Power Control Corp., Pittsburgh, Pa.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Riverbank Labs., Geneva, Ill.
Robicon Corp., Pittsburgh, Pa.
Solidstate Controls, Inc., Columbus, Ohio
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
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Todd Products Corp., Farmingdale, N.Y.
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Bristol Div, Waterbury, Conn
C & A Products, Inc., Woodside, N. Y.
Computer Conversions Corp., East Northport, N.Y.
Control Technology Co., L.I.C., N.Y.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynapar Corp., Gurnee, Ill.
E-H Resch. Labs., Inc., Oakland, Cal.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
General Devices, Inc., Princeton, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Lear Siegler, Grand Rapids, Mich.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Matrix Corp., Beech Grove, Ind.
Micro Instr. Co., Hawthorne, Cal.
MPC Prods. Corp., Chicago, Ill.
NES, Inc., Itasca, Ill.
North Hills Elctrns., Inc., Glen Cove, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
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United Prods. Co., New Hyde Pk., N.Y.

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Magnetics, Div. Spang Inds., Butler, Pa.
Tohoku Metal Inds., Ltd., Tokyo, Japan
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Magnetics, Div. Spang Inds., Butler, Pa.
United Prods. Co., New Hyde Pk., N.Y.

Cores, Magnetic, Powdered Iron, Pot/Cup

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Cortec, Newport Beach, Cal.
Permacor, Oak Lawn, Ill.
Pyroferric - N. Y., Inc., Bronx, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
United Prods. Co., New Hyde Pk., N.Y.

Cores, Magnetic, Powdered Iron, Slug

Arnold Engineering Co., Marengo, Ill.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Cortec, Newport Beach, Cal.
Kwikset Powdered Metal Prods., Anaheim, Cal.
Permacor, Oak Lawn, Ill.
Pyroferric - N. Y., Inc., Bronx, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
United Prods. Co., New Hyde Pk., N.Y.
Workman Elctrn. Prods., Inc., Sarasota, Fla.
TDK Elctrns. Corp., Long Island City, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Trans-Tech, Gaithersburg, Md.
United Mineral & Chem. Corp., New York, N.Y.
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United Prods. Co., New Hyde Pk., N.Y.

Cores, Magnetic, Powdered Permalloy, Toroid

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Cores, Magnetic, Silicon, "C"

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United Prods. Co., New Hyde Pk., N.Y.
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Baldwin Elctrns., Little Rock, Ark.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Burroughs Corp., Plainfield, N.J.
CGS Units, Inc., Rochester, N.Y.
Computer Conversions Corp., East Northport, N.Y.
Controlcraft Corp., West Chicago, Ill.
Data Graphics, San Antonio, Tex.
Data Technology Inc., Watertown, Mass.
Davidson Elctrn. Dev. Co., Erie, Pa.
Digital Equip. Corp., Maynard, Mass.
Digitron Corp., Norristown, Pa.
Durant Digital Instrs., Watertown, Wisc.
Dynapar Corp., Gurnee, Ill.
Eldorado Electrodata, Concord, Cal.
ENM Co., Chicago, Ill.
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Geo Space Sys., Tampa, Fla.
Haydon Switch & Instr., Waterbury, Conn.
Hi-G, Windsor Locks, Conn.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Info-Lite Corp., Corona, N.Y.
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Logiconcepts Inc., Los Alamitos, Cal.
Machine Components Corp., Plainview, N.Y.
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Monitor Labs, Inc., San Diego, Cal.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
North American Philips Controls Corp., Cheshire, Conn.
Parametrics, Inc., Orange, Conn.
Planet Instr., Gardena, Cal.
Precision Dynamics Corp., Burbank, Cal.
Presin Co., Inc., Shelton, Conn.
Redington Counters, Inc., Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Renco Corp., Goleta, Cal.
Signetics. Corp., Sunnyvale, Calif.
Solid State Systems, Inc., Columbia, Mo.
Speed Detectors, Bedford, Ohio
Struthers-Dunn, Inc., Bettendorf, Iowa
Summit Engrg. Corp., Bozeman, Mont.
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Theta Instr. Corp., Fairfield, N.J.
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WER Industrial, Grand Island, N.Y.

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Avtron Mfg., Inc., Cleveland, Ohio
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Presin Co., Inc., Shelton, Conn.
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Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Veeder-Root, Hartford, Conn.

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Data Technology Inc., Watertown, Mass.
Durant Digital Instrs., Watertown, Wisc.
Dynapar Corp., Gurnee, Ill.
Eldorado Electrodata, Concord, Cal.
ESE, Inglewood, Cal.
Keltron Corp., Waltham, Mass.
Planet Instr., Gardena, Cal.
Precision Dynamics Corp., Burbank, Cal.
Signetics. Corp., Sunnyvale, Calif.
Struthers-Dunn, Inc., Bettendorf, Iowa
Systron-Donner Concord Instr. Div., Concord, Cal.
Theta Instr. Corp., Fairfield, N.J.
Thiem Industries, Inc., Torrance, Cal.
3M Co., St. Paul, Minn.
Triac Elctrn. Sys., Forest Hills, N. Y.
Veeder-Root, Hartford, Conn.

Counters, Electro-Magnetic

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Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Chrono-log Corp., Broomall, Pa.
Cramer Division, Old Saybrook, Conn.
Durant Digital Instrs., Watertown, Wisc.
Dytro Corp., Hicksville, N.Y.
Electric Tachometer Corp., Philadelphia, Pa.
ENM Co., Chicago, Ill.
ITT General Controls, Glendale, Cal.
Norden Div., Norwalk, Conn.
North American Philips Controls Corp., Cheshire, Conn.
Orbit Instr. Corp., Syosset, N.Y.
Practical Automation, Inc., Shelton, Conn.
Precision Timer Co., Westbrook, Conn.
Presin Co., Inc., Shelton, Conn.
Redington Counters, Inc., Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Stock Drive Prods., New Hyde Pk., N.Y.
Thiem Industries, Inc., Torrance, Cal.
Triac Elctrn. Sys., Forest Hills, N. Y.
Whittaker Corp., Los Angeles, Cal.

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Hickok Elect. Instr., Cleveland, Ohio
Lion Precision Corp, Newton, Mass.
Simpson Elec. Co., Chicago, Ill.
Tektronix, Inc., Beaverton, Ore.
Tenor Co., Inc., New Berlin, Wisc.
Triac Elctrn. Sys., Forest Hills, N. Y.
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Advanced Energy Conversion, Belmont, Cal.
American Elctrn. Labs., Inc., Lansdale, Pa.
Anadex Instrs., Inc., Van Nuys, Calif.
Astro Comm. Lab., Gaithersburg, Md.
Ballantine Laboratories, Inc., Boonton,, N. J.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Calico Div., San Diego, Cal.
Controlcraft Corp., West Chicago, Ill.
Dana Labs., Inc., Irvine, Calif.
Dynapar Corp., Gurnee, Ill.
EIP, Inc., Santa Clara, Cal.
Eldorado Electrodata, Concord, Cal.
Electro-Numerics, Santa Clara, Cal.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Harshaw Chem. Co., Cleveland, Ohio
Heath Co., Benton Harbor, Mich.
Hecon Corp., New Shrewsbury, N.J.
IEC Electronics Corp., E. Rochester, N.Y.
Integrated Systems, Inc., Norcross, Ga.
Kay Elemetrics, Pine Brook, N.J.
Keltron Corp., Waltham, Mass.
Landis & Gyr, Inc., Elmsford, N.Y.
Micro-Tel Corp., Baltimore, Md.
Midland Standard Inc., Elgin, Ill.
Milletron, Inc., Pittsburgh, Pa.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
Newport Labs., Inc., Santa Ana, Cal.
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Plessey Enviromental Sys., San Diego, Cal.
Practical Automation, Inc., Shelton, Conn.
Railway Comm., Raytown, Mo.
Regency Elctrns., Inc., Indianapolis, Ind.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Speed Detectors, Bedford, Ohio
Struthers-Dunn, Inc., Bettendorf, Iowa
Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
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Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
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Anadex Instrs., Inc., Van Nuys, Calif.
Ballantine Laboratories, Inc., Boonton,, N. J.
Controlcraft Corp., West Chicago, Ill.
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Electronic Research Co., Shawnee Mission, Kan.
Fork Standards, W. Chicago, Ill.
Landis & Gyr, Inc., Elmsford, N.Y.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
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NES, Inc., Itasca, Ill.
Newport Labs., Inc., Santa Ana, Cal.
Signetics. Corp., Sunnyvale, Calif.
Systron-Donner Concord Instr. Div., Concord, Cal.
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Allied Elctrns., Chicago, Ill.
Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Barker & Williamson, Inc., Bristol, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Chicago Dynamic Inds., Chicago, Ill.
Cramer Division, Old Saybrook, Conn.
Eagle Signal, Davenport, Iowa
Electric Tachometer Corp., Philadelphia, Pa.
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ITT General Controls, Glendale, Cal.
Johnson E. F. Co., Waseca, Minn.
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Landis & Gyr, Inc., Elmsford, N.Y.
Machine Components Corp., Plainview, N.Y.

North American Philips Controls Corp., Cheshire, Conn.
Orbit Instr. Corp., Syosset, N.Y.
PIC Design Division, Ridgefield,, Conn.
Planet Instr., Gardena, Cal.
Precision Timer Co., Westbrook, Conn.
Presin Co., Inc., Shelton, Conn.
Redington Counters, Inc., Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Triac Elctrn. Sys., Forest Hills, N. Y.
Veeder-Root, Hartford, Conn.
Whittaker Corp., Los Angeles, Cal.

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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Bailey Instrs., Inc., Saddle Brook, N.J.
Clean Room Prods., Farmingdale, N.Y.
Components Corp., Denville, N.J.
Durant Digital Instrs., Watertown, Wisc.
Electronic Research Co., Shawnee Mission, Kan.
General Scanning, Watertown, Mass.
Landis & Gyr, Inc., Elmsford, N.Y.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Milletron, Inc., Pittsburgh, Pa.
NES, Inc., Itasca, Ill.
Nuclear Resch. Corp., Southampton, Pa.
Princeton Elctrn. Prods., New Brunswick, N.J.
Rank Precision Inds., Des Plaines, Ill.
SSR Instrs. Co., Santa Monica, Cal.
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Meloy Laboratories Inc., Springfield, Va.
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MKC Elctrns. Corp., Kansas City, Kans.
NES, Inc., Itasca, Ill.
Nuclear Resch. Corp., Southampton, Pa.
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Scientific Technology, Mountain View, Cal.
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Spectronics, Inc., Richardson, Tex.
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Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Burroughs Corp., Plainfield, N.J.
Chrono-log Corp., Broomall, Pa.
Controlcraft Corp., West Chicago, Ill.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Data Graphics, San Antonio, Tex.
Data Technology Inc., Watertown, Mass.
Di/An Controls, Inc., Boston, Mass.
Disc Instruments, Inc., Costa Mesa, Ca.
Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Eldorado Electrodata, Concord, Cal.
ENM Co., Chicago, Ill.
ESE, Inglewood, Cal.
Farmer Elec. Prods. Co., Inc., Natick, Mass.
Fork Standards, W. Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Harrel, Inc., E. Norwalk, Conn.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Info-Lite Corp., Corona, N.Y.
Itek Corp. Meas. Sys. Div., Newton, Mass.
ITT General Controls, Glendale, Cal.
Keltron Corp., Waltham, Mass.
Midland Standard Inc., Elgin, Ill.
Milletron, Inc., Pittsburgh, Pa.
MKC Elctrns. Corp., Kansas City, Kans.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
NES, Inc., Itasca, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Nuclear Meas. Corp., Indianapolis, Ind.
Packard Instrument Co., Inc., Downers Grove, Ill.
PECO Corp., Milpitas, Cal.
Precision Timer Co., Westbrook, Conn.
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Redington Counters, Inc., Windsor, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
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Thiem Industries, Inc., Torrance, Cal.
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Anadex Instrs., Inc., Van Nuys, Calif.
Antex Inds., Inc., Palo Alto, Cal.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Chicago Dynamic Inds., Chicago, Ill.
Chicago Switch, Chicago, Ill.
Controlcraft Corp., West Chicago, Ill.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cramer Division, Old Saybrook, Conn.
Curtis Instrs., Inc., Mt. Kisco, N.Y.
Data Technology Inc., Watertown, Mass.
Del Electronics Corp., Mt. Vernon, N.Y.
Digilin, Inc., Glendale, Cal.
Digital Equip. Corp., Maynard, Mass.
Disc Instruments, Inc., Costa Mesa, Ca.
Durant Digital Instrs., Watertown, Wisc.
Dynapar Corp., Gurnee, Ill.
Eagle Signal, Davenport, Iowa
Eldorado Electrodata, Concord, Cal.
Electro-Numerics, Santa Clara, Cal.
Electronic Research Co., Shawnee Mission, Kan.
ENM Co., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Harshaw Chem. Co., Cleveland, Ohio
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IEC Electronics Corp., E. Rochester, N.Y.
Info-Lite Corp., Corona, N.Y.
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Joslyn Elctrn. Sys., Goleta, Cal.
Keltron Corp., Waltham, Mass.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Milletron, Inc., Pittsburgh, Pa.
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North American Philips Controls Corp., Cheshire, Conn.
Nuclear Data, Palatine, Ill.
Nuclear Meas. Corp., Indianapolis, Ind.
Nuclear Resch. Corp., Southampton, Pa.
Packard Instrument Co., Inc., Downers Grove, Ill.
Practical Automation, Inc., Shelton, Conn.
Precision Timer Co., Westbrook, Conn.
Presin Co., Inc., Shelton, Conn.
Quan-Tech, Whippany, N.J.
Redington Counters, Inc., Windsor, Conn.
Sensor Corp., Scottsdale, Pa.
Signetics Corp., Sunnyvale, Calif.
Simpson Elec. Co., Chicago, Ill.
Square D Co., Park Ridge, Ill.
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Struthers-Dunn, Inc., Pitman, N.J.
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Tenor Co., Inc., New Berlin, Wisc.
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Wilmar Elctrns. Inc., Torrance, Cal.

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Christie Elec., Los Angeles, Cal.
E-H Resch. Labs., Inc., Oakland, Cal.
Electronic Dev. Corp., Boston, Mass.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Foxboro Co., Foxboro, Mass.
General Resistance, Inc., Mt. Vernon, N.Y.
Glentronics, Div. Sawyer Inds., Glendora, Cal.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
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Keithley Instrs., Inc., Cleveland, Ohio
Kepco, Inc., Flushing, N.Y.
McKee-Pedersen Instrs., Danville, Calif.
Power Designs, Westbury, N.Y.
Raytheon Co., Quincy, Mass.
Sawyer Inds., Arcadia, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
Todd Products Corp., Farmingdale, N.Y.
Trio Labs, Inc., Plainview, N.Y.
Voltex Co., Inc., Farmingdale, N.Y.
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Communications Technology Corp., Los Angeles, Cal.
General Hardware Mfg. Co., New York, N.Y.
Greenlee Tool Co., Rockford, Ill.
Jonard Inds. Corp., Bronx, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Mann, Henry Inc., Feasterville, Pa.
Smith, Herman H., Inc., Bklyn., N.Y.
Techni-Tool, Inc., Philadelphia, Pa.

Cutters, Wire, Automatic—See Wire Measuring & Cutting Machines

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Control Technology Co., L.I.C., N.Y.
Eastern Air Devices, Inc., Dover, N.H.
Honeywell, Ft. Washington, Pa.
Ind'l. Control Co., Farmingdale, N.Y.
Singer Co., Little Falls, N.J.
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Vernitech, Deer Pk., N.Y.

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A.R.F. Products, Inc., Boulder, Colo.
Astrosystems, Inc., Lake Success, N.Y.
Austin Elctrns., Roselle, N.J.
Autocon Inds., Inc., Minneapolis, Minn.
Automation Dynamics, Northvale, N.J.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Baganoff Assocs., Inc., St. Louis, Mo.
Bailey Meter Co., Wickliffe, Ohio
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bell & Howell Co., Pasadena, Calif.
Bendix Corp., N. Hollywood, Calif.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Biocom, Inc., Culver City, Cal.
Biomation Corp., Cupertino, Calif.
Bowmar/ALI, Inc., Acton, Mass.
Bristol Div, Waterbury, Conn
Burr-Brown Resch. Corp., Tucson, Ariz.
C & A Products, Inc., Woodside, N. Y.
Cardion Elctrns., Woodbury, N.Y.
Chronetics, Inc., Mt. Vernon, N.Y.
Climatronics Corp., Hauppauge, N.Y.
Computer Automation, Inc., Irvine, Cal.
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D.A.T.A. Inc., Orange, N.J.
Data-Control Systems, Danbury, Conn.
Data Graphics, San Antonio, Tex.
Data Specialties Inc., Highland Park, Ill.
Datacom, Inc., Ft. Walton Bch., Fla.
Datametrics Inc., Wilmington, Mass.

Datron Systems, Chatsworth, Cal.
Davidson Elctrn. Dev. Co., Erie, Pa.
Delco Elctrns. Div., Kokomo, Ind.
Design Automation, Inc., Lexington, Mass.
Digital Equip. Corp., Maynard, Mass.
Doric Sci. Corp., San Diego, Calif.
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Dynamic Measurements Corp., Winchester, Ma.
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E-Systems Inc., Dallas, Tex.
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Fairchild Space & Defense Sys., Syosset, N.Y.
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General Devices, Inc., Princeton, N.J.
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Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Harrel, Inc., E. Norwalk, Conn.
Harshaw Chem. Co., Cleveland, Ohio
Hawkeye Instrus., Inc., Marion, Iowa
Honeywell, Ft. Washington, Pa.
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Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Hybrid Sys. Corp., Burlington, Mass.
Information Transfer, Inc., Holcomb, N.Y.
Instrumentation Tech. Corp., Northbridge, Cal.
Integrated Systems, Inc., Norcross, Ga.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
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Lear Siegler, Inc., Santa Monica, Calif.
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Lecroy Resch. Sys. Corp., West Nyack, N.Y.
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Mann, David W. Co., Burlington, Mass.
Matrix Corp., Beech Grove, Ind.
Melpar, Falls Church, Va.
Metra Instruments, Inc., Mt. View, Cal.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Midland Standard Inc., Elgin, Ill.
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Monitor Systems, Ft. Washington, Pa
Nicolet Instr. Corp., Madison, Wisc.
Nuclear Data, Palatine, Ill.
Petty Geophysical Engrg., San Antonio, Tex.
Phoenix Data Inc., Phoenix, Ariz.
Princeton Applied Resch. Corp., Princeton, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Republic Advanced System Technology Group, Chatsworth, Calif.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Schaevitz Engrg., Pennsauken, N.J.
Schneider Instr. Co., Cincinnati, Ohio
Scientific-Atlanta, Inc., Atlanta, Ga.
Signal Analysis Oper., Hauppauge, N.Y.
Spatial Data Systems, Inc., Goleta, Cal.
Systems Instrs. Resch., Inc., Atlanta, Ga.
Systron Donner Computer Systems Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
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United Sys. Corp., Dayton, Ohio
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Victor Comptometer Corp., Chicago, Ill.
Vidar Corp., Mountain View, Cal.
Video Research Corp., Gaithersburg, Md.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Westronics, Inc., Ft. Worth, Tex.
Xerox Data Sys., El Segundo, Cal
Zeltex, Inc., Concord, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

Data Compressors, Digital

Analogic, Wakefield, Mass.
Biomation Corp., Cupertino, Calif.
Datacom, Inc., Ft. Walton Bch., Fla.
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Biomation Corp., Cupertino, Calif.
Burroughs Corp., Pasadena, Cal.
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Clary Corp., San Gabriel, Calif.
Control Equip. Corp., Lowell, Mass.
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Data Recording Sys., Sunnyvale, Cal.
Data Specialties Inc., Highland Park, Ill.
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Victor Comptometer Corp., Chicago, Ill.
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Rohde & Schwarz Sls., Passaic, N.J.
Sprague Elec. Co., No. Adams, Mass.
Stevens Prods., Inc., E. Orange, N.J.
Wiltron Co., Palo Alto, Calif.

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Elctrn. Concepts, Inc., Eatontown, N.J.
Stevens Prods., Inc., E. Orange, N.J.

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Magnetic Elctrns., Van Nuys, Cal.
Microtran Co. Inc., Valley Stream, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Stevens Prods., Inc., E. Orange, N.J.

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Dale Elctrns., Inc., Columbus, Neb.
Digitran Co., Pasadena, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fogg System Co., Denver, Col.
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RCA Elctrns. Comps., Harrison, N.J.
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American Time Products, Woodside, N.Y.
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Cardion Elctrns., Woodbury, N.Y.
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Murata Corp. of America, Elmsford, N.Y.
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RFL Inds., Comms. Div., Boonton, N.J.
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Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Signetics. Corp., Sunnyvale, Calif.
3M Co., St. Paul, Minn.
Voiceprint Laboratories Corp., Somerville, N. J.

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Norden Div., Norwalk, Conn.
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Signetics. Corp., Sunnyvale, Calif.
Struthers-Dunn, Inc., Pitman, N.J.
Struthers-Dunn, Inc., Bettendorf, Iowa
Tasker Systems, Chatsworth, Cal.
Theta Instr. Corp., Fairfield, N.J.
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Video Research Corp., Gaithersburg, Md.

Decommutators, Telemetering

Arnoux Corp., Santa Barbara, Cal
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Data-Control Systems, Danbury, Conn.
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Lear Siegler, Inc., Santa Monica, Calif.
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Lear Siegler, Inc., Elyria, Ohio
Pall Trinity Micro Corp., Cortland, N.Y.
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Kappa Networks, Inc., Carteret, N.J.
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Data Delay Devices, Clifton, N.J.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Millen, James Mfg., Malden, Mass.
Phelps Dodge Comm., North Haven, Conn.
Precision Tube, No. Wales, Pa.
RCL Elctrns., Inc., Irvington, N.J.
Stanford Applied Engrg., Santa Clara, Cal.
Tektronix, Inc., Beaverton, Ore.
Teledyne Mec., Palo Alto, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Victor Wire & Cable, L.A., Cal.

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PCA Elctrns., Inc., Sepulveda, Calif.
Pulse Engrg., Inc., San Diego, Cal.
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Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
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Edison Elctrns. Div., Manchester, N.H.
Kappa Networks, Inc., Carteret, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
PCA Elctrns., Inc., Sepulveda, Calif.
Pulse Engrg., Inc., San Diego, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Stanford Applied Engrg., Santa Clara, Cal.
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Corning Glass Works, Raleigh, N.C.
Damon Corp., Westwood, Mass.
Esco Products, Oak Ridge, NJ
Microsonics, Inc., Weymouth, Mass.
Teledyne Mec., Palo Alto, Cal.
Television Microtime, Inc., Bloomfield, Conn.
Valpey Corp., Holliston, Mass.

Delay Lines, Liquid

Control Elctrns. Co., Inc., Farmingdale, N.Y.
Microsonics, Inc., Weymouth, Mass.

Delay Lines, Lumped-Constant (Electrically Variable)

Andersen Labs. Inc., Bloomfield, Conn. Vol 3•983
Bel Fuse, Inc., Jersey City, N.J. Vol 3•986,988,989
Columbia Components, Hempstead, N.Y. ..... Vol 3•1221
Computer Devices, Commack, N.Y. Vol 3•994
Computer Instrs., Hempstead, N.Y. Vol 3•1221
Data Delay Devices, Clifton, N.J. Vol 3•997,998
ESC Elctrns. Corp., Palisades Pk., N.J. Vol 3•999
Kappa Networks, Inc., Carteret, N.J. Vol 3•1000
RCL Elctrns., Inc., Irvington, N.J. Vol 3•1003
Allen Avionics, Mineola, N.Y.
Artronic Instr. Co., Silver Spring, Md.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Dietz Design, Inc., Belton, Mo.
Edison Elctrns. Div., Manchester, N.H.
PCA Elctrns., Inc., Sepulveda, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
TDK Elctrns. Corp., Long Island City, N.Y.
Television Microtime, Inc., Bloomfield, Conn.
Varian Assocs., Palo Alto, Cal.

Delay Lines, Lumped-Constant (Fixed)

Allen Avionics, Mineola, N.Y. Vol 3•978,979,981
Andersen Labs. Inc., Bloomfield, Conn. Vol 3•982,983
Artronic Instr. Co., Silver Spring, Md. Vol 3•984
Bel Fuse, Inc., Jersey City, N.J. Vol 3•986,987,990,991
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y. ..... Vol 2•554
Columbia Components, Hempstead, N.Y. ..... Vol 3•1221
Computer Devices, Commack, N.Y. Vol 3•995
Computer Instrs., Hempstead, N.Y. Vol 3•1221
Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Data Delay Devices, Clifton, N.J. Vol 3•996,997
ESC Elctrns. Corp., Palisades Pk., N.J. Vol 3•999
Kappa Networks, Inc., Carteret, N.J. Vol 3•1000,1001
RCL Elctrns., Inc., Irvington, N.J. Vol 3•1002
Torotel, Inc., Grandview, Mo. .. Vol 2•453
Arcidy Assocs., Manchester, N. H.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Chesterfield Prods. Inc., Saddle Brook, N. J.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Dietz Design, Inc., Belton, Mo.
Edison Elctrns. Div., Manchester, N.H.
El-Rad Mfg. Co., Chicago, Ill.
Engineered Components Co., Gardena, Cal.
Hisonic, Inc., Olathe, Kans.
Millen, James Mfg., Malden, Mass.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
PCA Elctrns., Inc., Sepulveda, Calif.
Pulse Engrg., Inc., San Diego, Cal.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Shallco, Inc., Smithfield, N.C.
Sprague Elec. Co., No. Adams, Mass.
Stanford Applied Engrg., Santa Clara, Cal.
TDK Elctrns. Corp., Long Island City, N.Y.
Television Microtime, Inc., Bloomfield, Conn.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Varian Assocs., Palo Alto, Cal.

Delay Lines, Lumped-Constant (Mechanically Variable)

Allen Avionics, Mineola, N.Y. Vol 3•979,981
Andersen Labs. Inc., Bloomfield, Conn. Vol 3•983
Artronic Instr. Co., Silver Spring, Md. Vol 3•984
Columbia Components, Hempstead, N.Y. ..... Vol 3•1221
Computer Devices, Commack, N.Y. Vol 3•994
Computer Instrs., Hempstead, N.Y. Vol 3•1221
Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Data Delay Devices, Clifton, N.J. Vol 3•996,997
ESC Elctrns. Corp., Palisades Pk., N.J. Vol 3•999
RCL Elctrns., Inc., Irvington, N.J. Vol 3•1002
Arcidy Assocs., Manchester, N. H.
Bel Fuse, Inc., Jersey City, N.J.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Edison Elctrns. Div., Manchester, N.H.
Kappa Networks, Inc., Carteret, N.J.
PCA Elctrns., Inc., Sepulveda, Calif.
Shallco, Inc., Smithfield, N.C.
Television Microtime, Inc., Bloomfield, Conn.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Wiltron Co., Palo Alto, Calif.

Delay Lines, Magnetostrictive

Computer Devices, Commack, N.Y. Vol 3•993,994
Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Data Delay Devices, Clifton, N.J. Vol 3•998
Andersen Labs. Inc., Bloomfield, Conn.
Baganoff Assocs., Inc., St. Louis, Mo.
Microsonics, Inc., Weymouth, Mass.
RCL Elctrns., Inc., Irvington, N.J.
TDK Elctrns. Corp., Long Island City, N.Y.

Delay Lines, Miniature & Subminiature-Also See Specific Types Of Delay Lines

Allen Avionics, Mineola, N.Y. Vol 3•978-981
Artronic Instr. Co., Silver Spring, Md. Vol 3•984
Bel Fuse, Inc., Jersey City, N.J. Vol 3•986-991
Columbia Components, Hempstead, N.Y. ..... Vol 3•1221
Computer Devices, Commack, N.Y. Vol 3 •994,995
Computer Instrs., Hempstead, N.Y. Vol 3 •1221

Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Damon Corp., Westwood, Mass. Vol 4•389*
Data Delay Devices, Clifton, N.J. Vol 3•996,997
ESC Elctrns. Corp., Palisades Pk., N.J. Vol 3•999
Kappa Networks, Inc., Carteret, N.J. Vol 3•1000,1001
RCL Elctrns., Inc., Irvington, N.J. Vol 3•1002,1003
Uniform Tubes, Collegeville, Pa. Vol 3•1415
Arcidy Assocs., Manchester, N. H.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Edison Elctrns. Div., Manchester, N.H.
El-Rad Mfg. Co., Chicago, Ill.
Engineered Components Co., Gardena, Cal.
Hisonic, Inc., Olathe, Kans.
Microsonics, Inc., Weymouth, Mass.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
PCA Elctrns., Inc., Sepulveda, Calif.
Phelps Dodge Comm., North Haven, Conn.
Precision Tube, No. Wales, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Shallco, Inc., Smithfield, N.C.
Sprague Elec. Co., No. Adams, Mass.
Stanford Applied Engrg., Santa Clara, Cal.
TDK Elctrns. Corp., Long Island City, N.Y.
Teledyne Mec., Palo Alto, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Delay Lines, Solid Blank

Bliley Electric, Erie, Pa. ..... Vol 3•985
Amersil, Inc., Hillside, N.J.
Andersen Labs. Inc., Bloomfield, Conn.
Bel Fuse, Inc., Jersey City, N.J.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Corning Glass Works, Raleigh, N.C.
Damon Corp., Westwood, Mass.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Microsonics, Inc., Weymouth, Mass.
Valpey Corp., Holliston, Mass.

Delay Lines, Strip

Bel Fuse, Inc., Jersey City, N.J. Vol 3•986
Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Andersen Labs. Inc., Bloomfield, Conn.
Bliley Electric, Erie, Pa.
ESC Elctrns. Corp., Palisades Pk., N.J.
Microsonics, Inc., Weymouth, Mass.
Pulse Engrg., Inc., San Diego, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Solitron/Microwave, Port Salerno, Fla.

Delay Lines, Trimmer

Andersen Labs. Inc., Bloomfield, Conn. Vol 3•983
Bel Fuse, Inc., Jersey City, N.J. Vol 3•986,989
Columbia Components, Hempstead, N.Y. ..... Vol 3•1221
Computer Devices, Commack, N.Y. Vol 3•994
Computer Instrs., Hempstead, N.Y. Vol 3•1221
Data Delay Devices, Clifton, N.J. Vol 3•996,998
Kappa Networks, Inc., Carteret, N.J. Vol 3•1000
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Engineered Components Co., Gardena, Cal.
ESC Elctrns. Corp., Palisades Pk., N.J.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Delay Lines, Ultrasonic

Bliley Electric, Erie, Pa. ..... Vol 3•985
Control Elctrns. Co., Inc., Farmingdale, N.Y. ..... Vol 3•992
Andersen Labs. Inc., Bloomfield, Conn.
Corning Glass Works, Raleigh, N.C.
Microsonics, Inc., Weymouth, Mass.
TDK Elctrns. Corp., Long Island City, N.Y.
Thomson-CSF Electron Tubes, N.Y., N.Y.

Delay Lines, Waveguide

Aircom, Inc., Union, N.H.
Andersen Labs. Inc., Bloomfield, Conn.
Datalight Inc., Bloomfield, Conn.
Maury Microwave Corp., Cucamonga, Calif.
Premier Microwave, Port Chester, N.Y.
Standard Wire & Cable, Los Angeles, Cal.
TRG Prods., E. Boston, Mass.
Uniform Tubes, Collegeville, Pa.

Delay Lines, Wire

Andersen Labs. Inc., Bloomfield, Conn. Vol 3•982
Allen Avionics, Mineola, N.Y.
Bel Fuse, Inc., Jersey City, N.J.
Computer Devices, Commack, N.Y.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Hamilton Technology, Inc., Lancaster, Pa.
Microsonics, Inc., Weymouth, Mass.
Victor Wire & Cable, L.A., Cal.

Delays, Time (Excluding Delay Lines, Timers, Delay & Relays-Time Delay)

General Time Corp., Thomaston, Conn. Vol 2•344
Adams & Westlake, Elkhart, Ind.
Allen Avionics, Mineola, N.Y.
Artisan Elctrns. Corp., Parsippany, N.J.
Artronic Instr. Co., Silver Spring, Md.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autronics Corp., Pasadena, Calif.
Bristol Saybrook Co., Old Saybrook, Conn.
Bulova Watch Co., Flushing, N.Y.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Diversified Elctrns., Evansville, Ind
Eagle Signal, Davenport, Iowa
Electro-Module, Inc., Pomona, Cal.
Gems Sensors Div., Farmington, Conn.
Gibbs Mfg. & Resch., Janesville, Wisc.
Guardian California, Culver City, Cal.
Hi-G, Windsor Locks, Conn.
Hoagland Instr., Dayton, N.J.
Intermatic, Spring Grove, Ill.
Jay-El Prods., Gardena, Calif.
North American Philips Controls Corp., Cheshire, Conn.
PECO Corp., Milpitas, Cal.
Precision Timer Co., Westbrook, Conn.
Princeton Elctrn. Prods., New Brunswick, N.J.
Sealectro Corp., Mamaroneck, N.Y.
Sensor Corp., Scottsdale, Pa.
TRW Instrs., El Segundo, Cal.
Warren G-V Communications, Livingston, N.J.
Worner Elctrn. Devices, Rankin, Ill.
Zenith Controls Inc., Chicago, Ill.

Demagnetizers

RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Advanced Kinetics, Costa Mesa, Calif.
Ampex Corp., Redwood City, Calif.
Barnes & Reinecke, Inc., Chicago, Ill.
Coil Co. of Amer., Northvale, N.J.
Eastern Delta Corp., Fair Lawn, N.J.
GC Electronics, Rockford, Ill.
Ideal Industries, Inc., Sycamore, Ill.
LDJ Electronics, Troy, Mich.
Mag-Con, Inc., New Brighton, Minn.
Magnaflux Corp., Chicago, Ill.
Mann, Henry Inc., Feasterville, Pa.
Microtran Co. Inc., Valley Stream, N.Y.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
Schonstedt Instr. Co., Reston, Va.
Shigoto Inds., Ltd., New York, N.Y.
Stancor, Chicago, Ill.
Stearns Magnetics Inc., Cudahy, Wisc.
Techni-Tool, Inc., Philadelphia, Pa.
Thomas & Skinner, Inc., Indianapolis, Ind.

Demodulators

Control Technology Co., L.I.C., N.Y. Vol 2•986
Natel Engrg. Co., Canoga Pk., Cal. Vol 1•360
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Transmagnetics Inc., Farmingdale, N. Y. Vol 1•379
Ametek/Instrs. & Controls, Feasterville, Pa.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Biocom, Inc., Culver City, Cal.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C & A Products, Inc., Woodside, N. Y.
Cermetek, Inc., Mountain View, Cal.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Clarke - Hess, New York, N.Y.
Collins Radio Co., Dallas, Tex.
Comdel, Inc., Beverly, Mass.
Computer Conversions Corp., East Northport, N.Y.
Control Sciences, Inc., Granada Hills, Cal.
Data-Control Systems, Danbury, Conn.
Dynair Elctrns. Inc., San Diego, Calif.
Electrac, Inc., Anaheim, Calif.
Environmental Communications Inc., Santa Ana, Cal.
Feedback, Inc., Berkeley Hghts., N.J.
General Magnetics, Bloomfield, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Glentek, Inc., Santa Monica, Calif.
Ind'l. Control Co., Farmingdale, N.Y.
Ithaco, Inc., Ithaca, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Lorch Elctrns. Corp., Englewood, N.J.
Microtran Co. Inc., Valley Stream, N.Y.
Monitor Systems, Ft. Washington, Pa
Norsal Industries, Inc., Brentwood, N.Y.
North Atlantic Inds., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Radiation Devices Co., Baltimore, Md.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Signetics. Corp., Sunnyvale, Calif.
Singer Co., Little Falls, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Statek Corp., Orange, Cal.
Theta Instr. Corp., Fairfield, N.J.
Validyne Engrg. Corp., Northridge, Cal.
Vari-L Co., Inc., Denver, Colo.
Vega Precision Labs., Vienna, Va.
Video Research Corp., Gaithersburg, Md.
Watkins Johnson Co., Palo Alto, Cal.

Demodulators, Magnetic

General Magnetics, Bloomfield, N.J. Vol 2•340
Transmagnetics Inc., Farmingdale, N. Y. Vol 1•379
American Aerospace Controls Inc., Farmingdale, N.Y.
Computer Conversions Corp., East Northport, N.Y.

Densitometers, Electronic

Beckman Instrs., (AISSD), Fullerton, Cal.
Chemical Etching Equip. & Supply, Alexandria, Va.
Cosar Corp., Garland, Texas
Gaertner Scientific Corp., Chicago, Ill.
Gamma Sci., San Diego, Cal.
Sargent Welch Sci. Co., Skokie, Ill.
Spatial Data Systems, Inc., Goleta, Cal.

Deposition Equipment, Vacuum & Accessories-Also See Evaporation Equipment, Electron Beam

CCA Elctrns. Corp., Gloucester, N.J.
Ceramaseal, Inc., New Lebanon Center, N.Y.
Edwards High Vacuum, Grand Island, N.Y.
GTE Sylvania Inc., Danvers, Mass.
High Vacuum Equip. Corp., Hingham, Mass.
Inficon Inc., E. Syracuse, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Proto Matic Co., Cincinnati,, Ohio
Sloan Technology Corp., Santa Barbara, Calif.
T-M Vacuum Prods., Riverton, N.J.
Thin Film Services, Gile, Wisc.
Torr Labs., Los Angeles, Cal.
Uthe Technology Int'l., Sunnyvale, Cal.
Vactronic Lab. Equip., Inc., E. Northport, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Dessicants

Union Carbide, San Diego, Cal.
United Mineral & Chem. Corp., New York, N.Y.

Desiccators—See Dehumidifiers

Desoldering Tools & Equipment—See Soldering Accessories; Soldering Equip.; Soldering Guns; etc.

Detectors, A-F—See Detectors, Frequency

Detectors, Cable & Pipe—See Locators, Metal

Detectors, Coaxial

Aertech Inds., Sunnyvale, Calif.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Bird Elctrn., Cleveland, Ohio
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
CES Elctrns., Brooklyn, N.Y.
Engelmann Microwave, Montville, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
Radio Resch. Co., Rockaway, N.J.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co., Phoenix, Ariz.
Wiltron Co., Palo Alto, Calif.

Detectors, Corona—See Testers, Corona

Detectors, Crystal

R L C Elctrns., Inc., Mt. Kisco, N.Y. Vol 2•620
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal. ..... Vol 1•507
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal. ..... Vol 1•507
Aertech Inds., Sunnyvale, Calif.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Americon Microwave Inds., Inc., Waltham, Mass.
Electro/Data, Inc., Garland, Tex.
Frequency Elctrns., New Hyde Pk., N.Y.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
Linden Labs., Inc., State College, Pa.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
Packard Instrument Co., Inc., Downers Grove, Ill.
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
Soltec Corp., No. Hollywood, Cal.

Systron-Donner Microwave Div., Van Nuys, Cal.
Waveline, Inc., W. Caldwell, N.J.
Wiltron Co., Palo Alto, Calif.

Detectors, Electrostatic—See Meters, Volt, Electrostatic

Detectors, F-M—See Detectors, Frequency

Detectors, Flaw & Defect-Also See Locators, Open-Short

GRM Corp., Medford, N.J. ..... Vol 1•319
American Gas & Chemicals, New York, N.Y.
Automation Inds., Danbury, Conn.
Barnes Engrg. Co., Stamford, Conn.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Black Light Corp. Amer., San Gabriel, Cal.
Branson Instruments Co., Stamford, Conn.
Chemical Etching Equip. & Supply, Alexandria, Va.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Fiber Photics, Inc., Santa Cruz, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
Magnaflux Corp., Chicago, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Peschel Instrs., Cape Coral, Fla.
Photobell Co., Inc., New York, N.Y.
Princeton Elctrn. Prods., New Brunswick, N.J.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Sotcher Measurement, Cupertino, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Ultra-Violet Prods., Inc., San Gabriel, Cal.

Detectors, Frequency

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Acromag, Inc., Wixom, Mich.
Anadex Instrs., Inc., Van Nuys, Calif.
Autronics Corp., Pasadena, Calif.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Bramco Controls, Piqua, Ohio
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Data-Control Systems, Danbury, Conn.
Douglas Randall Div., Pawcatuck, Conn.
Elcom Sys., Deer Pk., N.Y.
Electro-Module, Inc., Pomona, Cal.
Engelmann Microwave, Montville, N.J.
Environmental Communications Inc., Santa Ana, Cal.
Frequency Elctrns., New Hyde Pk., N.Y.
General Microwave Corp., Farmingdale, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Guardian California, Culver City, Cal.
HI-G, Windsor Locks, Conn.
ITT Mackay Marine, Elizabeth, N.J.
Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Kratos, Pasadena, Cal
Lithic Systems, Inc., Cupertino, Cal.
Logitek, Inc., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
OMNI Spectra, Farmington, Mich.
PRD Elctrns., Inc., Westbury, N.Y.
Proto Matic Co., Cincinnati,, Ohio
RHG Elctrns. Lab., Deer Park, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
T-F Electronics, Inc., Austin, Tex.
Techsonics, El Prado, N.M.
Telonic Inds., Inc., Laguna Beach, Calif.
Tempo Instrument, Inc., Plainview, N.Y.
Texscan Corp., Indianapolis, Ind.
Watkins Johnson Co., Palo Alto, Cal.
Wavetek Indiana, Inc., Beech Grove, Ind.
Wiltron Co., Palo Alto, Calif.

Detectors, Gas Leak

Gulton Inds., Newport Bch., Cal. Vol 3•683
Air Prods. & Chems., Inc., Allentown, Pa.
American Gas & Chemicals, New York, N.Y.
Amperex Electronic Corp., Hicksville, N.Y.
Bacharach Instr. Co., Pittsburgh, Pa.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Datametrics Inc., Wilmington, Mass.
Devco Engrg., W. Caldwell, N.J.
Dukane Corp., St. Charles, Ill.
Erdco Engrg. Corp., Addison, Ill.
General Elec., W. Lynn, Mass.
General Monitors, Inc., Costa Mesa, Calif.
Gow-Mac Instr. Co., Madison, N.J.
Honeywell, Ft. Washington, Pa.
Ind'l. Test Equip., Clifton, NJ
Inficon Inc., E. Syracuse, N.Y.
Lion Precision Corp, Newton, Mass.
Matheson Gas Products, East Rutherford, N.J.
MKS Instrs., Inc., Burlington, Mass.
Shannon Luminous Mat'ls., Hollywood, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Techni-Tool, Inc., Philadelphia, Pa.
Techsonics, El Prado, N.M.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Union Carbide, Linde Div., New York, N. Y.
Vacumetrics Inc., Waltham, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Detectors, Impedance—See Meters, Impedance

Detectors, Infrared

Advanced Kinetics, Costa Mesa, Calif.
Amperex Elctronic Corp., Slatersville, R.I.
Automation Devices, Inc., Fairview, Pa.
Barnes Engrg. Co., Stamford, Conn.
Bendix Corp., Sturbridge, Mass.
Cetron Elctrn. Corp., Geneva, Ill.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dolan-Jenner Inds., Inc., Melrose, Mass.
EG & G, Inc., Salem, Mass.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
Gamma Sci., San Diego, Cal.
General Electrodynamics Corp., Garland, Tex.
General Microwave Corp., Farmingdale, N.Y.
Hamamatsu Corp. (E), Middlesex, N. J.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Harshaw Chem. Co., Cleveland, Ohio
HEI, Inc., Chaska, Minn.
Honeywell, Minneapolis, Minn.
Honeywell, Mpls., Minn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Judson Resch. & Mfg. Co., Conshohocken, Pa.
Laser Sys. Corp., Ann Arbor, Mich.
Mikron Instr. Co., Ridgewood, N.J.
Molectron Corp., Sunnyvale, Cal.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Ohio Semitronics, Columbus, Ohio
Omega Engrg., Inc., Stamford, Conn.
Optical Communications, Inc., Orlando, Fla.
Photobell Co., Inc., New York, N.Y.
Plessey Semiconductors, Farmingdale, N.Y.
Radiation Devices Co., Baltimore, Md.
Rank Precision Inds., Des Plaines, Ill.
Raytek, Inc., Mountain View, Cal.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Santa Barbara Resch. Ctr., Goleta, Calif.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Sensor Technology, Chatsworth, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
Special Microwave Devices Oper., Waltham, Mass.
Spectronics, Inc., Richardson, Tex.
Thermometrics, Inc., Edison, N.J.
United Detector Technology Inc., Santa Monica, Cal.
Victory Engrg. Corp., Springfield, N.J.

Detectors, Light Intensity—See Meters, Light, Nonphotographic

Detectors, Magnetic

Advanced Kinetics, Costa Mesa, Calif.
American Aerospace Controls Inc., Farmingdale, N.Y.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Controlcraft Corp., West Chicago, Ill.
Electro-Mechanics Co., Austin, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Int'l. Electro-Magnetics, Palatine, Ill.
Mag-Con, Inc., New Brighton, Minn.
Magnaflux Corp., Chicago, Ill.
Ohio Semitronics, Columbus, Ohio
PECO Corp., Milpitas, Cal.
Rank Precision Inds., Des Plaines, Ill.
RFL Inds., Instr. Div., Boonton, N.J.
Schonstedt Instr. Co., Reston, Va.
Sensor Corp., Scottsdale, Pa.
Sprague Elec. Co., No. Adams, Mass.
Stearns Magnetics Inc., Cudahy, Wisc.
O. S. Walker Co., Worcester, Mass.

Detectors, Metal—See Locators, Metal

Detectors, Microwave

Electro/Data, Inc., Garland, Tex. Vol 1•547
Texscan Corp., Indianapolis, Ind. Vol 1•514
Aertech Inds., Sunnyvale, Calif.
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Alford Mfg. Co., Winchester, Mass.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Electronic Corp., Hicksville, N.Y.
CES Elctrns., Brooklyn, N.Y.
Cir-Q-Tel, Kensington, Md.
Collins Radio Co., Dallas, Tex.
Engelmann Microwave, Montville, N.J.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Melpar, Falls Church, Va.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
Parametric Inds., Inc., Winchester, Mass.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
RCA Elctrns. Comps., Harrison, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
Texas Instruments, Dallas, Tex.
TRG Prods., E. Boston, Mass.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Detectors, Null—See Indicators, Null

Detectors, Phase-Sensitive

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Vari-L Co., Inc., Denver, Colo. Vol 2•623-626,628
Associated Resch., Chicago, Ill.
Autronics Corp., Pasadena, Calif.
C & A Products, Inc., Woodside, N. Y.
Climatronics Corp., Hauppauge, N.Y.
Control Technology Co., L.I.C., N.Y.
Datron Systems, Chatsworth, Cal.
Diversified Elctrns., Evansville, Ind
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamic Controls Corp., S. Windsor, Conn.
Dytronics Co., Columbus, Ohio
Elcom Sys., Deer Pk., N.Y.
Electrac, Inc., Anaheim, Calif.
Electro-Module, Inc., Pomona, Cal.
Engelmann Microwave, Montville, N.J.
General Magnetics, Bloomfield, N.J.
Guardian California, Culver City, Cal.
HI-G, Windsor Locks, Conn.
Hybrid Sys. Corp., Burlington, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
Ithaco, Inc., Ithaca, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Logitek, Inc., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Mini-Circuits Lab., Brooklyn, N.Y.
Natel Engrg. Co., Canoga Pk., Cal.
Norsal Industries, Inc., Brentwood, N.Y.
North Atlantic Inds., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nuclear Meas. Corp., Indianapolis, Ind.
Opad Elec. Co., Inc., New York, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Radio Resch. Co., Rockaway, N.J.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Signetics. Corp., Sunnyvale, Calif.
Theta Instr. Corp., Fairfield, N.J.
Triac Elctrn. Sys., Forest Hills, N. Y.
Trio Labs, Inc., Plainview, N.Y.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Varian Assocs., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Detectors, Photovoltaic —See Cells, Photovoltaic

Detectors,R-F—See Detectors, Frequency

Detectors, Radiation

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183

Detectors, Standing Wave

Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Aircom, Inc., Union, N.H.
Alford Mfg. Co., Winchester, Mass.
Anzac Elctrns., Waltham, Mass.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
CCA Elctrns. Corp., Gloucester, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Johnson E. F. Co., Waseca, Minn.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
Rank Precision Inds., Des Plaines, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
TRG Prods., E. Boston, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Detectors, Ultraviolet

Clairex Elctrns., Mt. Vernon, N.Y. Vol 2•673
Amperex Elctronic Corp., Slatersville, R.I.
Bendix Corp., Sturbridge, Mass.
Black Light Corp. Amer., San Gabriel, Cal.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Edison, Instr. Div., W. Orange, N.J.
Gamma Sci., San Diego, Cal.
Hamamatsu Corp. (E), Middlesex, N. J.
Honeywell, Ft. Washington, Pa.
Sensor Technology, Chatsworth, Cal.
Shannon Luminous Mat'ls., Hollywood, Cal.
Soltec Corp., No. Hollywood, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
United Detector Technology Inc., Santa Monica, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Detectors, Vacuum

Amperex Elctronic Corp., Slatersville, R.I.
Bendix Corp., Sturbridge, Mass.
Datametrics Inc., Wilmington, Mass.
Edwards High Vacuum, Grand Island, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
United Elec. Controls Co., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Detectors,Vibration—See Transducers, Vibration

Detectors, Video

Aertech Inds., Sunnyvale, Calif.
American Elctrn. Labs., Inc., Lansdale, Pa.
Electro/Data, Inc., Garland, Tex.
Hamamatsu Corp. (E), Middlesex, N. J.
Microphase Corp., Cos Cob, Conn.
Waveline, Inc., W. Caldwell, N.J.
Wide Band Engrg. Co., Phoenix, Ariz.

Detectors, Voltage

ADC Prods., Minneapolis, Minn.
Airpax Elctrns., Inc., Cambridge, Md.
Applied Control Co., Fairfield, N.J.
Autronics Corp., Pasadena, Calif.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
C & A Products, Inc., Woodside, N. Y.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Diversified Elctrns., Evansville, Ind
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Module, Inc., Pomona, Cal.
Electro Sci. Inds., Portland, Ore.
General Magnetics, Bloomfield, N.J.
Guardian California, Culver City, Cal.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hi-G, Windsor Locks, Conn.
Ideal Industries, Inc., Sycamore, Ill.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Test Equip., Clifton, NJ
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Logitek, Inc., Farmingdale, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Micro Instr. Co., Hawthorne, Cal.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Parametric Inds., Inc., Winchester, Mass.
PECO Corp., Milpitas, Cal.
Peschel Instrs., Cape Coral, Fla.
Pioneer/Instrumentation, Cleveland, Ohio
Ross Engrg. Corp., Campbell, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Texscan Corp., Indianapolis, Ind.
Triac Elctrn. Sys., Forest Hills, N. Y.
Warren G-V Communications, Livingston, N.J.
Zeltex, Inc., Concord, Calif.

Detectors, Waveguide Arc

Varian Assocs., Palo Alto, Cal.

Dial Locks—See Locks, Dial & Shaft

Dials, Instrument, Metal, Plastic, etc.

Beckman Instrs., Helipot Div., Fullerton, Cal. ..... Vol 3•1212
Datak Corp., Passaic, N.J. ..... Vol 2•479
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•824
Theta Instr. Corp., Fairfield, N.J. Vol 1•377
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Alco Elctrn. Prods., North Andover, Mass.
Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Apahouser Corp. of N.E., Boston, Mass.
Birnbach Co., Inc., Freeport, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Central Plastics Dists., Chicago, Ill.
Davies, Harry Molding Co., Chicago, Ill.
Dura Plastics N.Y., Inc., Westport, Conn.
Electronic Hardware Corp., Jamaica, N.Y.
Hermes Plastics, Inc., New York, N.Y.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Matheson Gas Products, East Rutherford, N.J.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Millen, James Mfg., Malden, Mass.
NOBEX Div., Burlingame, Cal.
Norelcom Inds., Inc., Farmingdale, N.Y.
Panelgraphic Corp., Caldwell, N.J.
Perfect Gear & Instr. Corp., Northridge, Calif.
Photo Chemical Prods. Cal., Santa Monica, Cal.
PIC Design Division, Ridgefield,, Conn.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Precision Timer Co., Westbrook, Conn.
Radial Controls Div. Nicely Corp., Indianapolis, Ind.
Raytheon Co., Quincy, Mass.
Simpson Elec. Co., Chicago, Ill.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Tech-Etch, Inc., Hingham, Mass.
3M Co., St. Paul, Minn.
Vemaline Prods. Co., Wyckoff, N.J.
Waldom Elctrns., Inc., Chicago, Ill.
Weston Instruments, Inc., Newark, N.J.

Dials, Telephone-Type

Bramco Controls, Piqua, Ohio
GTE Automatic Elec., Northlake, Ill.
ITT Telecommunications, Corinth, Miss.
Ledex, Inc., Dayton, Ohio
Shigoto Inds., Ltd., New York, N.Y.

Dials, Turns-Counting

Amphenol Controls Oper. of Connector Div., Broadview, Ill. ..... Vol 2•462,463
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. ..... Vol 2•462,463
Beckman Instrs., Helipot Div., Fullerton, Cal. ..... Vol 3•1212
Bourns, Inc., Trimpot Prods. Div., Riverside, Cal. ..... Vol 3•1200
Clarostat Mfg. Co., Inc., Dover, N.H. Vol 3•1219
Duncan Elctrns., Costa Mesa, Cal. Vol 3•1224
Harrel, Inc., E. Norwalk, Conn. Vol 2•1163
Millen, James Mfg., Malden, Mass. Vol 2•520
Spectrol Elctrns., City of Industry, Cal. Vol 3•1228,1229
TRW/IRC Potentiometers, St. Petersburg, Fla. ..... Vol 3•1233
Beckman Instrs., Helipot Div., Fullerton, Cal.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Johnson E. F. Co., Waseca, Minn.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Waters Mfg., Inc., Wayland, Mass.

Dielectric Coolants—See Coolants, Circuit & Component

Dielectric Heating Equipment

Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
Advanced Energy Conversion, Belmont, Cal.
Cycle-Dyne, Inc., Jamaica, N.Y.
Taylor-Winfield Corp., Warren, Ohio
3M Co., St. Paul, Minn.

Dielectrics—See Films; Insulation Materials

Differentials, Mechanical—See Gears & Gear Mechanisms

Digital Comparators—See Comparators, Digital

Digital Tape Recorders—See Data Recorders, Computer

Digital Voltmeters—See Meters, Volt, Digital

Digitizers, Pencil Follower (Inc. Coordinate & Graphic)

California Computer Prods., Anaheim, Cal
Data Specialties Inc., Highland Park, Ill.
Data Technology Inc., Watertown, Mass.
MFE Corporation, Salem, N.H.
Norden Div., Norwalk, Conn.
Spatial Data Systems, Inc., Goleta, Cal.
Superior Elec., Bristol, Conn.
Universal Drafting Mach., Bedford Hgts., Ohio

Diode Arrays

Beckman Instrs., Helipot Div., Fullerton, Cal. ..... Vol 2•589
Centralab Semiconductor, El Monte, Cal. ..... Vol 2•670
International Rectifier, El Segundo, Cal. Vol 2•906
Mini-Systems, Inc, North Attleboro, Mass. ..... Vol 3•1147
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal. ..... Vol 2•522
Nat'l. Semiconductors, Plattsburgh, N.Y. Vol 2•674
Optron, Inc., Carrollton, Tex. Vol 2•678,921,922
Semtech Corp., Newbury Pk., Cal. Vol 2•933-935
Solid State Devices, Inc., La Mirada, Cal. ..... Vol 2•941
Wagner Elec. Corp., Livingston, N.J. Vol 2•952-954
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Electronic Corp., Hicksville, N.Y.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
Eastern Delta Corp., Fair Lawn, N.J.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Hamamatsu Corp. (E), Middlesex, N. J.
HEI, Inc., Chaska, Minn.
ITT Semiconductors, W. Palm Beach, Fla.
Micro Components Corp., Cranston, R.I.
Microsemiconductor Corp., Culver City, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
RCA Solid State Div., Somerville, N. J.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.
United Detector Technology Inc., Santa Monica, Cal.

Diode Testers—See Testers, Diode

Diodes, Avalanche

M & H Electronics, Long Branch, N.J. Vol 2•908-915
TRW Semiconductors, Lawndale, Cal. Vol 2•950
Wagner Elec. Corp., Livingston, N.J. Vol 2•955,956
Alpha Instr. Inc., Woburn, Mass.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
AFI Industries Inc., Long Branch, N. J.
FMC Corp., Homer City, Pa.
General Semiconductor Inds., Tempe, Ariz.
GHZ Devices, Inc., So. Chelmsford, Mass.
KMC Semiconductor Corp., Long Valley, N.J.
KSC Semiconductor Corp., Chelmsford, Mass.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Power Components, Inc., Woodland Hills, Cal.
RCA Solid State Div., Somerville, N. J.
Sarkes Tarzian, Inc., Bloomington, Ind.
Semicon Inc., Burlington, Mass.
Semtech Corp., Newbury Pk., Cal.
Sensitron Semiconductor, Deer Pk., N.Y.
Solid State Devices, Inc., La Mirada, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Varo Semiconductor, Inc., Garland, Tex.

Diodes, Backward

Aertech Inds., Sunnyvale, Calif.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Centralab Semiconductor, El Monte, Cal.
Computer Diode, Fair Lawn, N.J.
KMC Semiconductor Corp., Long Valley, N.J.
Microphase Corp., Cos Cob, Conn.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Sarkes Tarzian, Inc., Bloomington, Ind.
Solid State Devices, Inc., La Mirada, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Electroluminescent (Radiating)

Electro-Nuclear Labs., Inc., Menlo Park, Calif.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
Motorola Semiconductor Prods., Phoenix, Ariz.
OPCOA, Inc., Edison, N.J.
Sensor Technology, Chatsworth, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Gallium Arsenide

Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
Dialight Corp., Brooklyn, N.Y.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
GHZ Devices, Inc., So. Chelmsford, Mass.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Spectronics, Inc., Richardson, Tex.
Sperry Elctrn. Tube, Gainesville, Fla.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.

Diodes, Germanium

RCA Solid State Div., Somerville, N. J. Vol 4*436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4*436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4*436*
Aertech Inds., Sunnyvale, Calif.
Amperex Elctrn., Slatersville, R.I.
Calvert Elctrns., Inc., New York, N.Y.
Cordover, Carl & Co., Mineola, N.Y.
CSR Industries Inc., E. Farmingdale, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
International Diode Corp., Jersey City, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Semiconductors, W. Palm Beach, Fla.
Kemtron Electron Prods., Inc., Newburyport, Mass.
KMC Semiconductor Corp., Long Valley, N.J.
Microphase Corp., Cos Cob, Conn.
Nucleonic Prods., Canoga Pk, Cal.
Parametric Inds., Inc., Winchester, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Solid State Devices, Inc., La Mirada, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

Diodes, Gunn

Amperex Elctronic Corp., Slatersville, R.I. Vol 2*1183
Plessey Semiconductors, Farmingdale, N.Y. Vol 2*604
Alpha Instr. Inc., Woburn, Mass.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
GHZ Devices, Inc., So. Chelmsford, Mass.
Litton Inds., San Carlos, Calif.
Microwave Assocs., Inc., Burlington, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.

Diodes, High-Voltage (1,000 Volts & Over)

General Instr. Corp., Semiconductor Comps. Div., Hicksville, N.Y. Vol 2*902,903
International Rectifier, El Segundo, Cal. Vol 2*906
RCA Solid State Div., Somerville, N. J. Vol 4*436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4*436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4*436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4*436*
Rectifier Comps. Corp., Union, N.J. Vol 2*925; Vol 4*527*
Semtech Corp., Newbury Pk., Cal. Vol 2*926-937
Sensitron Semiconductor, Deer Pk., N.Y. Vol 2*938,939
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
Dickson Elctrns. Corp., Scottsdale, Ariz
Edal Inds., Inc., E. Haven, Conn.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
AFI Industries Inc., Long Branch, N. J.
FMC Corp., Homer City, Pa.
M & H Electronics, Long Branch, N.J.
Microsemiconductor Corp., Culver City, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Sarkes Tarzian, Inc., Bloomington, Ind.
Semicon Inc., Burlington, Mass.
Solid State Devices, Inc., La Mirada, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Unitrode Corp., Watertown, Mass.
Varo Semiconductor, Inc., Garland, Tex.
Victoreen Instr., Cleveland, Ohio
Westinghouse Elec., Youngwood, Pa.

Diodes, Hot Carrier

Aertech Inds., Sunnyvale, Calif.
Calvert Elctrns., Inc., New York, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
International Diode Corp., Jersey City, N.J.
International Rectifier, El Segundo, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Nucleonic Prods., Canoga Pk, Cal.
Parametric Inds., Inc., Winchester, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Light-Emitting (LED)

Centralab Semiconductor, El Monte, Cal. Vol 2*670,671
Dialight Corp., Brooklyn, N.Y. Vol 2*483
Genisco Technology Corp., Eldema Div., Compton, Cal. Vol 2*495
Lamps, Inc., Torrance, Cal. Vol 2*517
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal. Vol 2*522
Optron, Inc., Carrollton, Tex. Vol 2*678,921,922
Plessey Semiconductors, Farmingdale, N.Y. Vol 2*604
SCS Corporation-Microsystems, Ft. Lauderdale, Fla. Vol 2*605
Shigoto Inds., Ltd., New York, N.Y. Vol 2*676
Sloan Co., Sun Valley, Cal. Vol 2*530
Spectronics, Inc., Richardson, Tex. Vol 2*677
Antex Inds., Inc., Palo Alto, Cal.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Calvert Elctrns., Inc., New York, N.Y.
Chicago Miniature Lamp Works, Chicago, Ill.
Data Display Products, Los Angeles, Cal.
Drake Mfg., Harwood Hgts., Ill.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
General Illumination, Inc., St. Paul, Minn.
HEI, Inc., Chaska, Minn.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
Licon Div., Chicago, Ill.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
OPCOA, Inc., Edison, N.J.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
RCA Elctrns. Comps., Harrison, N.J.
Skan-A-Matic Corp., Elbridge, N. Y.
TEC, Inc., Tucson, Ariz.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Limiting

Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Calvert Elctrns., Inc., New York, N.Y.
Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
GHZ Devices, Inc., So. Chelmsford, Mass.
Int'l. Elctrns., Melville, N.Y.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Power Components, Inc., Woodland Hills, Cal.
Schauer Mfg. Corp., Cincinnati, Ohio
Siliconix, Inc., Santa Clara, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

Diodes, Matched Pairs

Centralab Semiconductor, El Monte, Cal. Vol 2*670,671
Semtech Corp., Newbury Pk., Cal. Vol 2*933-935
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Elctrn., Slatersville, R.I.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
Dickson Elctrns. Corp., Scottsdale, Ariz
Edal Inds., Inc., E. Haven, Conn.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Semiconductor Inds., Tempe, Ariz.
International Diode Corp., Jersey City, N.J.
International Rectifier, El Segundo, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Kemtron Electron Prods., Inc., Newburyport, Mass.
Microphase Corp., Cos Cob, Conn.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Nucleonic Prods., Canoga Pk, Cal.
Parametric Inds., Inc., Winchester, Mass.
Power Components, Inc., Woodland Hills, Cal.
Semicon Inc., Burlington, Mass.
Solid State Devices, Inc., La Mirada, Cal.
Sperry Elctrn. Tube, Gainesville, Fla.
Summit Engrg. Corp., Bozeman, Mont.
Teledyne Crystalonics, Cambridge, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
TRG Prods., E. Boston, Mass.

Diodes, Matched Quads

Semtech Corp., Newbury Pk., Cal. Vol 2*933,934
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Elctrn., Slatersville, R.I.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
International Diode Corp., Jersey City, N.J.
International Rectifier, El Segundo, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Kemtron Electron Prods., Inc., Newburyport, Mass.
Microphase Corp., Cos Cob, Conn.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Parametric Inds., Inc., Winchester, Mass.
Power Components, Inc., Woodland Hills, Cal.
Semicon Inc., Burlington, Mass.
Solid State Devices, Inc., La Mirada, Cal.
Summit Engrg. Corp., Bozeman, Mont.
Teledyne Crystalonics, Cambridge, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
United Detector Technology Inc., Santa Monica, Cal.

Diodes, Microwave Detector

Amperex Elctronic Corp., Slatersville, R.I. Vol 2*1182,1183
Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Kemtron Electron Prods., Inc., Newburyport, Mass.
KMC Semiconductor Corp., Long Valley, N.J.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Special Microwave Devices Oper., Waltham, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Microwave Mixer

Amperex Elctronic Corp., Slatersville, R.I. Vol 2*1182,1183
Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Kemtron Electron Prods., Inc., Newburyport, Mass.
KMC Semiconductor Corp., Long Valley, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Sarkes Tarzian, Inc., Bloomington, Ind.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.

Diodes, Noise

Solitron Devices, San Diego, Cal. Vol 2*943
Solitron Devices, Inc., Riviera Bch., Fla. Vol 2*943
Solitron Devices, Inc., Tappan, N.Y. Vol 2*943
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Alpha Instr. Inc., Woburn, Mass.
Calvert Elctrns., Inc., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
Computer Diode, Fair Lawn, N.J.
General Semiconductor Inds., Tempe, Ariz.
Signalite, Neptune, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.

Diodes, Photoelectric

Centralab Semiconductor, El Monte, Cal. Vol 2*670,671
International Rectifier, El Segundo, Cal. Vol 2*906
Nat'l. Semiconductors, Plattsburgh, N.Y. Vol 2*674
Optron, Inc., Carrollton, Tex. Vol 2*678,920-922
Shigoto Inds., Ltd., New York, N.Y. Vol 2*676
Calvert Elctrns., Inc., New York, N.Y.
Clairex Elctrns., Mt. Vernon, N.Y.
EG & G, Inc., Salem, Mass.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
Hamamatsu Corp. (E), Middlesex, N. J.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
HEI, Inc., Chaska, Minn.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
RCA Elctrns. Comps., Harrison, N.J.
Santa Barbara Resch. Ctr., Goleta, Calif.
Sensor Corp., Scottsdale, Pa.
Sensor Technology, Chatsworth, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
Spectronics, Inc., Richardson, Tex.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
United Detector Technology Inc., Santa Monica, Cal.

Diodes, Pin

Unitrode Corp., Watertown, Mass. Vol 2•621
Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Calvert Elctrns., Inc., New York, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
GHZ Devices, Inc., So. Chelmsford, Mass.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Sensor Technology, Chatsworth, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
TRW Semiconductors, Lawndale, Cal.
United Detector Technology Inc., Santa Monica, Cal.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Diodes, Schottky

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TRW Semiconductors, Lawndale, Cal. Vol 2•950
Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
International Rectifier, El Segundo, Cal.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Thor Elctrns. Corp., Elizabeth, N.J.
TRG Prods., E. Boston, Mass.
United Detector Technology Inc., Santa Monica, Cal.
Varian Assocs., Palo Alto, Cal.

Diodes, Selenium—See Rectifiers, Selenium

Diodes, Silicon

Centralab Semiconductor, El Monte, Cal. ..... Vol 2•670,671,896-898
General Instr. Corp., Semiconductor Comps. Div., Hicksville, N.Y. Vol 2•902,903
International Rectifier, El Segundo, Cal. Vol 2•906
M & H Electronics, Long Branch, N.J. Vol 2•908-915
RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*
Rectifier Comps. Corp., Union, N.J. Vol 2•925; Vol 4•527*
Sanford-Miller Corp., Brooklyn, N.Y. Vol 2•919; Vol 3•1272
Semtech Corp., Newbury Pk., Cal. Vol 2•926-937
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Shigoto Inds., Ltd., New York, N.Y. Vol 2•676
Solid State Devices, Inc., La Mirada, Cal. ..... Vol 2•941
Solitron Devices, San Diego, Cal. Vol 2•943
Solitron Devices, Inc., Riviera Bch., Fla. Vol 2•943
Solitron Devices, Inc., Tappan, N.Y. Vol 2•943
Unitrode Corp., Watertown, Mass. Vol 2•963,964
Varo Semiconductor, Inc., Garland, Tex. Vol 2•972-974
Wagner Elec. Corp., Livingston, N.J. Vol 2•952-956
Westinghouse Elec., Youngwood, Pa. Vol 2•976,977; Vol 4•535-537*
Aertech Inds., Sunnyvale, Calif.
Alpha Components Corp., El Segundo, Cal.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Electronic Corp., Hicksville, N.Y.
Amperex Elctrn., Slatersville, R.I.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Components, Inc., Biddeford, Me.
Computer Diode, Fair Lawn, N.J.
Cordover, Carl & Co., Mineola, N.Y.
CSR Industries Inc., E. Farmingdale, N.Y.
Delco Elctrns. Div., Kokomo, Ind.
Dutrex Inds., Inc., New York, N.Y.
Edal Inds., Inc., E. Haven, Conn.
EG & G, Inc., Salem, Mass.
Elctrn. Devices, Yonkers, N.Y.
Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
AFI Industries Inc., Long Branch, N. J.
FMC Corp., Homer City, Pa.
General Semiconductor Inds., Tempe, Ariz.
GHZ Devices, Inc., So. Chelmsford, Mass.
Hamamatsu Corp. (E), Middlesex, N. J.
International Diode Corp., Jersey City, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Semiconductors, W. Palm Beach, Fla.
Kemtron Electron Prods., Inc., Newburyport, Mass.
Micro Components Corp., Cranston, R.I.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Nucleonic Prods., Canoga Pk, Cal.
Parametric Inds., Inc., Winchester, Mass.
Power Components, Inc., Woodland Hills, Cal.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Sarkes Tarzian, Inc., Bloomington, Ind.
Schauer Mfg. Corp., Cincinnati, Ohio
Semicon Inc., Burlington, Mass.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
TRW Semiconductors, Lawndale, Cal.
United Detector Technology Inc., Santa Monica, Cal.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Diodes, Step Recovery

Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
GHZ Devices, Inc., So. Chelmsford, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Diodes, Surface Barrier

Aertech Inds., Sunnyvale, Calif.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Parametric Inds., Inc., Winchester, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
United Detector Technology Inc., Santa Monica, Cal.

Diodes, Switching

Anaren Microwave, Inc., Syracuse, N.Y. Vol 4•438*
Arra Inc., Bay Shore, N.Y. ..... Vol 2•608
Centralab Semiconductor, El Monte, Cal. ..... Vol 2•896,898
International Rectifier, El Segundo, Cal. Vol 2•906
Semtech Corp., Newbury Pk., Cal. Vol 2• 926-937
Solid State Devices, Inc., La Mirada, Cal. ..... Vol 2•941
Aertech Inds., Sunnyvale, Calif.
Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Elctrn., Slatersville, R.I.
Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Computer Diode, Fair Lawn, N.J.
CSR Industries Inc., E. Farmingdale, N.Y.
Electronic Transistors, Flushing, N.Y.
GHZ Devices, Inc., So. Chelmsford, Mass.
Hutson Industries, Dallas, Tex.
International Diode Corp., Jersey City, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Semiconductors, W. Palm Beach, Fla.
Micro Components Corp., Cranston, R.I.
Microphase Corp., Cos Cob, Conn.
Microsemiconductor Corp., Culver City, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Scientific Technology, Mountain View, Cal.
Sensitron Semiconductor, Deer Pk., N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Diodes, Tunnel

Centralab Semiconductor, El Monte, Cal. ..... Vol 2•897
Aertech Inds., Sunnyvale, Calif.
Calvert Elctrns., Inc., New York, N.Y.
KMC Semiconductor Corp., Long Valley, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Parametric Inds., Inc., Winchester, Mass.
Solid State Devices, Inc., La Mirada, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

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Alpha Instr. Inc., Woburn, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amperex Electronic Corp., Hicksville, N.Y.
Amperex Elctrn., Slatersville, R.I.
Calvert Elctrns., Inc., New York, N.Y.
Centralab Semiconductor, El Monte, Cal.
Computer Diode, Fair Lawn, N.J.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Fansteel Inc., N Chicago, Ill.
GHZ Devices, Inc., So. Chelmsford, Mass.
ITT Electron Tube, Easton, Pa.
ITT Semiconductors, W. Palm Beach, Fla.
KSC Semiconductor Corp., Chelmsford, Mass.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
MSI Electronics, Inc., Woodside, N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Parametric Inds., Inc., Winchester, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Solid State Devices, Inc., La Mirada, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Crystalonics, Cambridge, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Diodes, Video Detector—See Diodes, Microwave Detector

Diodes, Zener & Stabistors (Forward Reference Diodes)

Centralab Semiconductor, El Monte, Cal. ..... Vol 2•896-898
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Wagner Elec. Corp., Livingston, N.J. Vol 2•955,956
Amperex Elctrn., Slatersville, R.I.
Beckman Instrs., Cedar Grove, N.J.
Calvert Elctrns., Inc., New York, N.Y.
Components, Inc., Biddeford, Me.
Computer Diode, Fair Lawn, N.J.
Cordover, Carl & Co., Mineola, N.Y.
CSR Industries Inc., E. Farmingdale, N.Y.
Dickson Elctrns. Corp., Scottsdale, Ariz
Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Semiconductor Inds., Tempe, Ariz.
International Diode Corp., Jersey City, N.J.
ITT Semiconductors, W. Palm Beach, Fla.
Julie Research Lab., New York, N.Y.
KSC Semiconductor Corp., Chelmsford, Mass.
M & H Electronics, Long Branch, N.J.
Mauratron, Inc., Dallas, Tex.
Microsemiconductor Corp., Culver City, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Nucleonic Prods., Canoga Pk, Cal.
Power Components, Inc., Woodland Hills, Cal.
RCA Elctrns. Comps., Harrison, N.J.
Sarkes Tarzian, Inc., Bloomington, Ind.
Schauer Mfg. Corp., Cincinnati, Ohio
Semicon Inc., Burlington, Mass.
Semtech Corp., Newbury Pk., Cal.
Shigoto Inds., Ltd., New York, N.Y.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
TRW Capacitors, Ogallala, Neb.
TRW Semiconductors, Lawndale, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Diplexers—See Multiplexers

Direction Finders

Bendix Corp., Ft. Lauderdale, Fla.
Honeywell, Minneapolis, Minn.
Loral Elctrn. Sys., Bronx, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.

Directional Couplers—See Couplers, Directional

Discharge Systems, Energy

CML-Macarr, Inc., Edison, N.J. Vol 1•645
Advanced Kinetics, Costa Mesa, Calif.
General Lab. Assocs., Norwich, N.Y.
LDJ Electronics, Troy, Mich.
Tobe Deutschmann Labs., Inc., Canton, Mass.
U.S. Scientific Instrs., Watertown, Mass.
Velonex, Santa Clara, Calif.

Discriminators

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Adar Assocs., Cambridge, Mass.
Almond Instrs. Co., Covina, Cal
American Trans-Coil Corp., Richmond Hill, N.Y.
Automated Meas., Oakland, Calif.
Berkeley Nucleonics Corp., Berkeley, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Conic Corp., San Diego, Calif.
Crystal Network Prods. Corp., Erie, Pa.
Damon Corp., Westwood, Mass.
Data-Control Systems, Danbury, Conn.
E-H Resch. Labs., Inc., Oakland, Cal.
Engelmann Microwave, Montville, N.J.
Environmental Communications Inc., Santa Ana, Cal.
ESC Elctrns. Corp., Palisades Pk., N.J.
Freed Transformer Co., Bklyn., N.Y.
Frequency Elctrns., New Hyde Pk., N.Y.
Hughes Aircraft Co., Communication Prods. Dept., Microelectronic Prods. Div., Newport Bch., Cal.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
McCoy Elctrns. Co., Mt. Holly Springs, Pa.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Millen, James Mfg., Malden, Mass.
Nuclear Data, Palatine, Ill.
Physical Elctrn. Labs., Menlo Park, Calif.
Piezo Crystal Co., Carlisle, Pa.
Premier Microwave, Port Chester, N.Y.
RHG Elctrns. Lab., Deer Park, N.Y.
Ryka Scientific, Inc., Sunnyvale, Cal.
Sheroid Crystal Prods., Kansas City, Mo.
SSR Instrs. Co., Santa Monica, Cal.
Teledyne Geotech, Dallas, Tex.
Varian Assocs., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
Vega Precision Labs., Vienna, Va.
Vidar Corp., Mountain View, Cal.

Disc Packs, Magnetic

Digital Equip. Corp., Maynard, Mass.
Elctrn. Memories, Hawthorne, Cal.
Honeywell Information Systems, Waltham, Mass.
3M Co., St. Paul, Minn.
Wang Labs., Inc., Tewksbury, Mass.

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Discs, Optical Encoder—See Coded Discs, Optical

Display Boards—See Boards, Plotting

Display Devices, LED

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Antex Inds., Inc., Palo Alto, Cal.
Electro-Nuclear Labs., Inc., Menlo Park, Calif.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Information Transfer, Inc., Holcomb, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
OPCOA, Inc., Edison, N.J.
Precision Dynamics Corp., Burbank, Cal.
Scientific Technology, Mountain View, Cal.
Shigoto Inds., Ltd., New York, N.Y.
W.V. Industries Inc., Franklin Lakes, N.J.

Display Devices, Liquid Crystal

Ind'l Elctrn. Engrs., Van Nuys, Cal. Vol 2•509
Ragen Precision Inds., Inc., N. Arlington, N.J.
W.V. Industries Inc., Franklin Lakes, N.J.

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Datatron, Inc., Santa Ana, Cal Vol 2•525
Dialight Corp., Brooklyn, N.Y. .. Vol 2•483
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TEC, Inc., Tucson, Ariz. ..... Vol 2•537
Analogic, Wakefield, Mass.
Arvin Sys., Inc., Dayton, Ohio
Autocon Inds., Inc., Minneapolis, Minn.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Dataprobe, Inc., So. Hackensack, N.J.
Devco Engrg., W. Caldwell, N.J.
Fiber Photics, Inc., Santa Cruz, Cal.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Luminator Div., Plano, Tex.
LVC Inds. Inc., Flushing, N.Y.
NES, Inc., Itasca, Ill.
Panelgraphic Corp., Caldwell, N.J.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Precision Dynamics Corp., Burbank, Cal.
Sigma Instrs., Inc., Braintree, Mass.
Singer Co., Little Falls, N.J.
Telmar, Inc., Columbus, Ohio
Vemaline Prods. Co., Wyckoff, N.J.
Zonic Tech. Labs., Cincinnati, Ohio

Displays, Projection Type (CRT; Electromechanical; Film; Light Valve)

Daco Instr. Co., Milford, Conn. Vol 2•478
Ind'l Elctrn. Engrs., Van Nuys, Cal. Vol 2•509
Infodex, Inc., Waterbury, Conn. Vol 1•460
K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan ..... Vol 2•512
TEC, Inc., Tucson, Ariz. ..... Vol 2•537
Allard Instr. Corp., Westbury, NY
Applied Digital Data Systems, Inc., Hauppauge, N.Y.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bowmar Instr. Corp., Ft. Wayne, Ind.
CELCO, Mahwah, N.J.
Conrac Div., Covina, Calif.
CPS, Sunnyvale, Calif.
Data Disc, Inc., Sunnyvale, Cal.
Devco Engrg., W. Caldwell, N.J.
Dialight Corp., Brooklyn, N.Y.
E-Systems Inc., Dallas, Tex.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
Gould Data Systems, Newton Upper Falls, Mass.
Gould, Inc., Cleveland, Ohio
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Minneapolis, Minn.
HRB-Singer, Inc., State College, Pa.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Information Displays, Inc., Mt. Kisco, N.Y.
Kollsman Instr. Co., Syosset, N.Y.
Kratos, Pasadena, Cal
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
Loral Elctrn. Sys., Bronx, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Major Data Corp., Costa Mesa, Cal.
Mast Dev. Co., Davenport, Iowa
McDonnell Douglas Electronics Co., St. Charles, Mo.
Metra Instruments, Inc., Mt. View, Cal.
Monitor Systems, Ft. Washington, Pa
NES, Inc., Itasca, Ill.
Optimation, Inc., Chatsworth, Cal.
Princeton Elctrn. Prods., New Brunswick, N.J.
Raytheon Data Systems Co., Norwood, Mass.
Raytheon Co., Quincy, Mass.
Scientific Communications, Garland, Tex.
Singer Co., Glendale, Cal.
Spatial Data Systems, Inc., Goleta, Cal.
Staver Co., Inc., Bay Shore, N.Y.
Stereotronics Television Co., Sherman Oaks, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Tektronix, Inc., Beaverton, Ore.
Telmar, Inc., Columbus, Ohio
Thomson-CSF Inc., New York, N.Y.
W.V. Industries Inc., Franklin Lakes, N.J.
Westinghouse Elec., Elmira, N.Y.

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Wagner Elec. Corp., Livingston, N.J. Vol 2•539

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Diplexers, Antenna

A.R.F. Products, Inc., Boulder, Colo.
CCA Elctrns. Corp., Gloucester, N.J.
Design Automation, Inc., Lexington, Mass.
Microphase Corp., Cos Cob, Conn.
Mu-Del Elctrns., Silver Spring, Md.
Norsal Industries, Inc., Brentwood, N.Y.
Rantec Div., Calabasas, Calif.
RF Systems, Inc., Cohasset, Mass.

Dissipators, Heat—See Heat Sinks-Also See Transistor & Diode Heat Dissipators

Distortion Analyzers, Indicators—See Analyzers, A-F

Dividers, Analog

Intronics, Inc., Newton, Mass. Vol 2•316
Burr-Brown Resch. Corp., Tucson, Ariz.
Foxboro Co., Foxboro, Mass.
Junction Modules, Inc., Irvine, Cal.
General Magnetics, Bloomfield, N.J.
GPS Corp., Framingham, Mass.
Hybrid Sys. Corp., Burlington, Mass.
Teledyne Philbrick, Dedham, Mass.
Transmagnetics Inc., Farmingdale, N. Y.
Zeltex, Inc., Concord, Calif.

Dividers, Frequency

Digitran Co., Pasadena, Cal. .. Vol 2•1049
Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Plessey Semiconductors, Farmingdale, N.Y. ..... Vol 2•601,602
Accutronics, Geneva, Ill.
Advanced Energy Conversion, Belmont, Cal.
American Time Products, Woodside, N.Y.
Anadex Instrs., Inc., Van Nuys, Calif.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Coast Coil Co., Los Angeles, Calif.
Connor-Winfield Corp., West Chicago, Ill.
Ferwalt, W.H., Inc., Lapwai, Idaho
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
Interstate Elctrns. Corp., Anaheim, Cal.
Kelk, George Ltd., Don Mills, Ont., Canada
Lithic Systems, Inc., Cupertino, Cal.
LVC Inds. Inc., Flushing, N.Y.
Microphase Corp., Cos Cob, Conn.
Milletron, Inc., Pittsburgh, Pa.
NH Research, Inc., Santa Ana, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Solid State Elctrns. Corp., Sepulveda, Cal.
Somerset Radiation Lab., Arlington, Va.
Specific Products, Monrovia, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tempo Instrument, Inc., Plainview, N.Y.
3M Co., St. Paul, Minn.
Vector Industries, Palo Alto, Cal.

Dividers, Magnetic Analog

American Aerospace Controls Inc., Farmingdale, N.Y.
General Magnetics, Bloomfield, N.J.

Dividers, Power (LF, HF, VHF, UHF)

Anaren Microwave, Inc., Syracuse, N.Y. Vol 4•438*
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
Mini-Circuits Lab., Brooklyn, N.Y. Vol 2•617
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 3•1268
Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
Advanced Energy Conversion, Belmont, Cal.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Anzac Elctrns., Waltham, Mass.
Arra Inc., Bay Shore, N.Y.
Coil Craft Inc., Bronxville, N.Y.
Comdel, Inc., Beverly, Mass.
Daico Inds. Inc., Compton, Cal.
Electro Impulse, Inc., Red Bank, N.J.
Engelmann Microwave, Montville, N.J.
General Radio Co., Concord, Mass.
Merrimac Inds., Inc., West Caldwell, N.J.
Microphase Corp., Cos Cob, Conn.
Mu-Del Elctrns., Silver Spring, Md.
Norsal Industries, Inc., Brentwood, N.Y.
Radiation Devices Co., Baltimore, Md.
Radio Resch. Co., Rockaway, N.J.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Technical Research & Mfg. Co., Manchester, N.H.
Trompeter Elctrns., Chatsworth, Cal.
Vari-L Co., Inc., Denver, Colo.
Wide Band Engrg. Co., Phoenix, Ariz.

Dividers, Power, Microwave

Bendix, Franklin, Ind. ..... Vol 2•609
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
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Vari-L Co., Inc., Denver, Colo. Vol 2•622
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Aertech Inds., Sunnyvale, Calif.
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Americon Microwave Inds., Inc., Waltham, Mass.
Amphenol RF Div., Danbury, Conn.
Anzac Elctrns., Waltham, Mass.
Arra Inc., Bay Shore, N.Y.
CES Elctrns., Brooklyn, N.Y.
Collins Radio Co., Dallas, Tex.
Daico Inds. Inc., Compton, Cal.
E & M Laboratories, Inc., Westlake Village, Cal.
Environmental Communications Inc., Santa Ana, Cal.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
HRB-Singer, Inc., State College, Pa.
Maury Microwave Corp., Cucamonga, Calif.
MCL, Inc., La Grange, Ill.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sealectro Corp., Mamaroneck, N.Y.
Solitron/Microwave, Port Salerno, Fla.

Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Trompeter Elctrns., Chatsworth, Cal.
Varian Assocs., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Dividers, Voltage Also See Transformers, Voltage Dividing

Caddock Elctrns., Riverside, Cal. Vol 3•1103
Electro Sci. Inds., Portland, Ore. Vol 1•435
Julie Research Lab., New York, N.Y. Vol 1•467-469
Kilovolt Corp., Hackensack, N.J. Vol 1•757
North Atlantic Inds., Plainview, N.Y. Vol 1•365
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 2•358; Vol 3•1268
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Vishay Resistor Prod. Div., Malvern, Pa. Vol 3•1198
AMP Capitron Div./AMP Incorporated, Elizabethtown, Pa.
Arra Inc., Bay Shore, N.Y.
Astrosystems, Inc., Lake Success, N.Y.
Beckman Instrs., Cedar Grove, N.J.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Centralab Elctrns Div., Milwaukee, Wisc
Coast Coil Co., Los Angeles, Calif.
Collins, G.L. Corp., Long Beach, Calif.
Computer Instrs., Hempstead, N.Y.
Del Electronics Corp., Mt. Vernon, N.Y.
Digitran Co., Pasadena, Cal.
Edison Elctrns. Div., Manchester, N.H.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Radio Co., Concord, Mass.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
LVC Inds. Inc., Flushing, N.Y.
Marstan Resistor, Orange, N.J.
Micro Instr. Co., Hawthorne, Cal.
Microtran Co. Inc., Valley Stream, N.Y.
Oeco Corp., Portland, Ore.
Ohmite Mfg. Co., Skokie, Ill.
Pearson Elctrns., Inc., Palo Alto, Calif.
Pyrofilm Corp., Whippany, N.J.
RFL Inds., Instr. Div., Boonton, N.J.
Shallcross, Selma, N.C.
Vari-L Co., Inc., Denver, Colo.

Dollies & Instrument Carts—See Carts, Instrument & Equipment

Doors, Cabinet, Metal—See Cabinets & Accessories, Metal

Doublers, Frequency—See Multipliers, Frequency

Drafting Machines

Chemical Etching Equip. & Supply, Alexandria, Va.
Dietzgen Corp., Chicago, Ill.
HAPCO, Boulder, Colo.
Information Displays, Inc., Mt. Kisco, N.Y.
Keuffel & Esser Co., Morristown, N.J.
Universal Drafting Mach., Bedford Hgts., Ohio
Xynetics, Inc., Canoga Pk., Cal.

Drafting Symbols, Dry Transfer, Pressure Sensitive, etc.

Datak Corp., Passaic, N.J. ..... Vol 2•479
Bishop Graphics, No. Hollywood, Cal.
Brady, W.H. Co., Milwaukee, Wisc.
Centron Engrg., Torrance, Cal.
Chartpak, Leeds, Mass.
Circuit-Stik, Inc., Torrance, Cal.
HAPCO, Boulder, Colo.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Keuffel & Esser Co., Morristown, N.J.
Russell Inds., Inc., Lynbrook, N.Y.

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Premier Metal Prods. Co., Bronx, N.Y. Vol 3•326-329,334
Scanbe Mfg. Corp., El Monte, Cal. Vol 3•773
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Bud Radio, Willoughby, Ohio
Chassis-Trak, Div., Indianapolis, Ind.
Honeywell, Inc., Wabash, Ind.
Lyon Metal Prod., Inc., Aurora, Ill.
Mupac Corp., Brockton, Mass.
Optima Enclosures, Tucker, Ga.
Stanford Applied Engrg., Inc., Santa Ana, Cal.
Zero Mfg. Co., Burbank, Cal.

Drills & Accessories, Hand & Power

Aremco Prods., Inc., Briarcliff Manor, N.Y.
Chemical Etching Equip. & Supply, Alexandria, Va.
Gardner-Denver Co., Quincy, Ill.
General Hardware Mfg. Co., New York, N.Y.
High Speed Hammer Co., Inc., Rochester, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Mann, Henry Inc., Feasterville, Pa.
Moody Tools, Inc., Providence, R.I.
Petty Geophysical Engrg., San Antonio, Tex.
Price & Rutzebeck, Hayward, Calif.
Standard Pneumatic Motor Co., Reno, Nev.
Techni-Tool, Inc., Philadelphia, Pa.
Vigor Co., New York, N.Y.
Wen Prods., Inc., Chicago, Ill.
X-Acto, Long Island City, N.Y.

Drivers, Chopper

American Time Products, Woodside, N.Y.
Firing Circuits, Norwalk, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Solid State Elctrns. Corp., Sepulveda, Cal.

Drivers, Nut

Channellock, Inc., Meadville, Pa. Vol 3•1235
Megavolt, Inc., New York, N.Y. Vol 1•761
Vaco Prods. Co., Chicago, Ill. Vol 3•1242
Gardner-Denver Co., Quincy, Ill.
General Hardware Mfg. Co., New York, N.Y.
Hunter Tools, El Monte, Calif
Jonard Inds. Corp., Bronx, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Moody Tools, Inc., Providence, R.I.
Porter, H.K., Inc., Somerville, Mass.
Standard Pneumatic Motor Co., Reno, Nev.
Techni-Tool, Inc., Philadelphia, Pa.
Xcelite, Inc., Orchard Park, N.Y.

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Drivers, Switch

American Elctrn. Labs., Inc., Lansdale, Pa.
Arra Inc., Bay Shore, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cole Instrument Corp., Costa Mesa, Cal.
E & M Laboratories, Inc., Westlake Village, Cal.
OPtimax Inc., Colmar, Pa.
Technical Research & Mfg. Co., Manchester, N.H.

Drivers, Tube

Burroughs Corp., Plainfield, N.J.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Keltron Corp., Waltham, Mass.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.

Drivers & Decoders For Readouts

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Burroughs Corp., Plainfield, N.J.
Digital Equip. Corp., Maynard, Mass.
Inter-Market, Inc., Glenview, Ill.
Keltron Corp., Waltham, Mass.
NES, Inc., Itasca, Ill.
Pinlites, Fairfield, N.J.
Precision Dynamics Corp., Burbank, Cal.
Signetics. Corp., Sunnyvale, Calif.
Sperry Information Displays Div., Scottsdale, Ariz.
Theta Instr. Corp., Fairfield, N.J.

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Allis, Louis Div., Milwaukee, Wisc.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Concord Elctrns., New York, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Dale Elctrns., Inc., Yankton, S.D.
Furnas Elec. Co., Batavia, Ill.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Lisk, G.W. Co., Clifton Springs, N.Y.
Machine Components Corp., Plainview, N.Y.
Millen, James Mfg., Malden, Mass.
MPC Prods. Corp., Chicago, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Perfect Gear & Instr. Corp., Northridge, Calif.
PIC Design Division, Ridgefield,, Conn.
Servo-Tek Prods. Co., Hawthorne, N.J.
Sigma Instrs., Inc., Braintree, Mass.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transicoil, Inc., Worcester, Pa.
Vemaline Prods. Co., Wyckoff, N.J.
Waldom Elctrns., Inc., Chicago, Ill.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.

Drums, Computer Memory Also See Memory Systems, Drum

Cognitronics Corp., Stamford, Conn.
Digital Equip. Corp., Maynard, Mass.
Honeywell Information Systems, Waltham, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.

—Dry Boxes -- See Boxes Glove

Dry Transfer Letters & Numbers—See Kits, Marking-Also See Drafting Symbols

Dryers, Air, Heatless

Chemical Etching Equip. & Supply, Alexandria, Va.
Daco Instr. Co., Milford, Conn.
Humphrey, Inc., San Diego, Calif.
Lear Siegler, Inc., Elyria, Ohio
Pall Corp., Glen Cove, N.Y.
Pall Trinity Micro Corp., Cortland, N.Y.
Podgor, Joseph Co., Pennsauken, N.J.
Roberts Air Dryer, Chesterfield, Mo.

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Panduit Corp., Tinley Pk., Ill. .. Vol 3•1408
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Co-Operative Inds., Inc., Chester, N.J.
Cutler-Hammer, Milwaukee, Wisc.
Electrovert, Mt. Vernon, N.Y.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hoffman Engrg. Co., Anoka, Minn.
K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan
Richco Plastic Co., Chicago, Ill.
Square D Co., Park Ridge, Ill.
Taylor Industries Inc., Howell, Mich.
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Bird Elctrn., Cleveland, Ohio Vol 1•396,397
Electro Impulse, Inc., Red Bank, N.J. Vol 1•548,549
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Americon Microwave Inds., Inc., Waltham, Mass.
Arnold Magnetics, Culver City, Cal.
Arra Inc., Bay Shore, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Avtron Mfg., Inc., Cleveland, Ohio
Barth Elctrns., Inc., Cleveland, Ohio
Bendix, Franklin, Ind.
CCA Elctrns. Corp., Gloucester, N.J.
CES Elctrns., Brooklyn, N.Y.
Collins Radio Co., Dallas, Tex.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
E & M Laboratories, Inc., Westlake Village, Cal.
Elcom Sys., Deer Pk., N.Y.
Electronautics, Littleton, Mass.
EMC Technology Inc, Cherry Hill, N.J.
GRM Corp., Medford, N.J.
Heath Co., Benton Harbor, Mich.
Hybrid Technology Corp., Arlington, Tex.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Mobil Elctrns., Inc., Anderson, Ind.
Narda Microwave Corp., Plainview, N.Y.
New-Tronics Corp., Brookpark, Ohio
Norsal Industries, Inc., Brentwood, N.Y.
Ohmite Mfg. Co., Skokie, Ill.
OMNI Spectra, Farmington, Mich.
Premier Microwave, Port Chester, N.Y.
Pyrofilm Corp., Whippany, N.J.
Radiation Devices Co., Baltimore, Md.
Raytheon Co., Waltham, Mass.
RCA Corp., Camden, N.J.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Sealectro Corp., Mamaroneck, N.Y.
Systron-Donner Microwave Div., Van Nuys, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Technical Mat'l., Mamaroneck, N.Y.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
W-F Products, Inc., Denver, Co.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Duplexers, Microwave—See Microwave Duplexers

Duplicators, Magnetic Tape

Ampex Corp., Redwood City, Calif.
Audiotronics, N. Hollywood, Cal.
Crown Int'l., Elkhart, Ind.
NES, Inc., Itasca, Ill.
Telectro Sys. Corp., Corona, N.Y.
Telex Comm. Div., Minneapolis, Minn.
3M Co., St. Paul, Minn.

Duplicators, Paper Tape

Data Specialties Inc., Highland Park, Ill.
NES, Inc., Itasca, Ill.

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Dillon, W.C. & Co., Van Nuys 340, Calif.
Lear Siegler, Inc., Santa Monica, Calif.

Editing Equipment, Tape

Ampex Corp., Redwood City, Calif.
Datatron, Inc., Santa Ana, Cal
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Video Research Corp., Gaithersburg, Md.
W-F Products, Inc., Denver, Co.

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Electrodes, Electroplating—See Electroplating Equipment & Supplies

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Chemical Etching Equip. & Supply, Alexandria, Va.
Hipotronics, Inc., Brewster, N.Y.
Pure Carbon Co., Inc., St. Marys, Pa.

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Electronic Switches (Oscilloscope)

Kay Elemetrics, Pine Brook, N.J. Vol 1•472
Machine Components Corp., Plainview, N.Y.

Electroplating Equipment & Supplies

Advanced Kinetics, Costa Mesa, Calif.
Alpha Metals, Inc., Jersey City, N.J.
Aubin, A.E. Co., Glastonbury, Conn.
Beckman Instrs., Cedar Grove, N.J.
Chemical Etching Equip. & Supply, Alexandria, Va.
Cohn, Sigmund, Mt. Vernon, N.Y.
Fidelity Chem. Prods. Corp., Newark, N.J.
Gates Elctrn. Co., Bronx, N.Y.
Goldsmith Precious Metals Div., Chicago, Ill.
Harshaw Chem. Co., Cleveland, Ohio
Luft Instrs., Inc., Lincoln, Mass.
M & T Chemicals Inc., Rahway, N.J.
NL Inds., Inc., Metal Div., New York, N.Y.
Opad Elec. Co., Inc., New York, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Selectrons, Ltd., New York, N.Y.
Sifco Metachemical, Cleveland, Ohio
Technic, Inc., Providence, R.I.
Triac Elctrn. Sys., Forest Hills, N. Y.
Viking Inds., Inc., Chatsworth, Calif.

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Gates Elctrn. Co., Bronx, N.Y. Vol 1•687
Terado Corp., St. Paul, Minn. Vol 1•906,907
ADC Prods., Minneapolis, Minn.
American Power Systems Corp., Worcester, Mass.
American Time Products, Woodside, N.Y.
Arnold Magnetics, Culver City, Cal.
BECO, Inc., Salem, Va.
Cal-Power Corp., El Segundo, Calif.
Christie Elec., Los Angeles, Cal.
Coil Co. of Amer., Northvale, N.J.
Dynage, Bloomfield, Conn.
Dynascan Corp., Chicago, Ill.
Eastern Delta Corp., Fair Lawn, N.J.
Elasco-Div. Buchbinder Corp., Bloomfield, Conn.
Electronic Resch. Assocs., Moonachie, N.J.
Elgin Elctrns. Inc., Waterford, Pa.
Epsco, Inc., Addison, Ill.
GC Electronics, Rockford, Ill.
Heath Co., Benton Harbor, Mich.
Kepco, Inc., Flushing, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Marathon Battery Co., Houston, Tex.
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Frequency Devices, Inc., Haverhill, Mass.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Kappa Networks, Inc., Carteret, N.J.
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Microtran Co. Inc., Valley Stream, N.Y.
Multimetric Industries, Richmond Hill, N.Y.
NES, Inc., Itasca, Ill.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Polyphase Instr. Co., Bridgeport, Pa.
Radiation Devices Co., Baltimore, Md.
RF Interonics, Bay Shore, N.Y.
San Fernando Elec. Mfg., San Fernando, Cal.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Stanford Applied Engrg., Santa Clara, Cal.
Torotel, Inc., Grandview, Mo.
Torotron, Mt. Vernon, N.Y.
TT Elctrns., Inc., Los Angeles, Cal.

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Murata Mfg. Co. Ltd., Kyoto, Japan
Statek Corp., Orange, Cal.

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American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
A.R.F. Products, Inc., Boulder, Colo.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Cir-Q-Tel, Kensington, Md.
Corcom Inc., Chicago, Ill.
Dietz Design, Inc., Belton, Mo.
E & M Laboratories, Inc., Westlake Village, Cal.
Elcom Sys., Deer Pk., N.Y.
Electro-Mechanics Co., Austin, Tex.
Engelmann Microwave, Montville, N.J.
Erie Technological Prods. (EEM), Erie, Pa.
Filtron Co., Flushing, N.Y.
Frequency Elctrns., New Hyde Pk., N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
ITT Jennings-Monrovia, San Jose, Cal.
Jerrold Electronics Corp., Philadelphia, Pa.
Maury Microwave Corp., Cucamonga, Calif.
McCoy Elctrns. Co., Mt. Holly Springs, Pa.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Physical Elctrn. Labs., Menlo Park, Calif.
Premier Microwave, Port Chester, N.Y.
Radiation Devices Co., Baltimore, Md.
RCA Corp., Camden, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RF Interonics, Bay Shore, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Ryka Scientific, Inc., Sunnyvale, Cal.
Sealectro Corp., Mamaroneck, N.Y.
Teledyne Mec., Palo Alto, Cal.
Teledyne Microwave, Mountain View, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
Texscan Microwave Prods., Indianapolis, Ind.
USCC/Centralab, Elctrns. Div., Burbank, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Wide Band Engrg. Co., Phoenix, Ariz.
Winegard Co., Burlington, Iowa

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American Trans-Coil Corp., Richmond Hill, N.Y.
Applied Research Inc., Port Washington, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cirtech Corp., Leawood, Kans.
Coil Craft Inc., Bronxville, N.Y.
Dynalab Corp., Van Nuys, Cal.
Electrac, Inc., Anaheim, Calif.
ESC Elctrns. Corp., Palisades Pk., N.J.
Fogg System Co., Denver, Col.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Heliotek, Sylmar, Calif.
Kappa Networks, Inc., Carteret, N.J.
Kinetic Tech., Inc., Santa Clara, Cal.
Lorch Elctrns. Corp., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Metavac, Inc., Flushing, N.Y.
Microlab/FXR, Livingston, N.J.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Optics International, Tenafly, N.J.
Optics Technology, Palo Alto, Calif.
Physical Elctrn. Labs., Menlo Park, Calif.
Premier Microwave, Port Chester, N.Y.
RHG Elctrns. Lab., Deer Park, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Ryka Scientific, Inc., Sunnyvale, Cal.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Signal Analysis Oper., Hauppauge, N.Y.
Spectrum Instrs., Inc., New Rochelle, N.Y.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Microwave Prods., Indianapolis, Ind.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vega Precision Labs., Vienna, Va.
Voltex Co., Inc., Farmingdale, N.Y.
Watkins Johnson Co., Palo Alto, Cal.

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ADC Prods., Minneapolis, Minn.
Alford Mfg. Co., Winchester, Mass.
Cir-Q-Tel, Kensington, Md.
Cirtech Corp., Leawood, Kans.
ESC Elctrns. Corp., Palisades Pk., N.J.
Hisonic, Inc., Olathe, Kans.
Multimetric Industries, Richmond Hill, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Polyphase Instr. Co., Bridgeport, Pa.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
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American Elctrn. Labs., Inc., Lansdale, Pa.
Cir-Q-Tel, Kensington, Md.
Cornell-Dubilier Elctrns., Newark, N.J.
E & M Laboratories, Inc., Westlake Village, Cal.
Filtron Co., Flushing, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
GAF Corp., New York, N.Y.
General Microwave Corp., Farmingdale, N.Y.
Greenray Inds., Inc., Mechanicsburg, Pa.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
Premier Microwave, Port Chester, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RF Systems, Inc., Cohasset, Mass.
RHG Elctrns. Lab., Deer Park, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Systron-Donner Microwave Div., Van Nuys, Cal.
Teledyne Microwave, Mountain View, Cal.
UTE Microwave, Asbury Park, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.

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Co-Operative Inds., Inc., Chester, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Narda Microwave Corp., Plainview, N.Y.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
Varian Assocs., Palo Alto, Cal.
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Flash Photolysis Systems & Components

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Drake Mfg., Harwood Hgts., Ill.
Dynamic Controls Corp., S. Windsor, Conn.
EG&G, Inc., Bedford, Mass.
Elco, Willow Grove, Pa.
Electro-Module, Inc., Pomona, Cal.
GTE Sylvania Inc., Danvers, Mass.
Guardian California, Culver City, Cal.
Hoagland Instr., Dayton, N.J.
Hughey & Phillips, Inc., Burbank, Cal.
Innovatek Enterprise, Millerton, N.Y.
Lithic Systems, Inc., Cupertino, Cal.
Magnecraft Elec., Chicago, Ill.
Metric Sys., Ft. Walton Beach, Fla.
North American Philips Controls Corp., Cheshire, Conn.
Oeco Corp., Portland, Ore.
Precision Timer Co., Westbrook, Conn.
Sealectro Corp., Mamaroneck, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Tempo Instrument, Inc., Plainview, N.Y.
U.S. Scientific Instrs., Watertown, Mass.
Wagner Elec. Corp., Livingston, N.J.
Warren G-V Communications, Livingston, N.J.
Wilmar Elctrns. Inc., Torrance, Cal.
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Flashlights & Lanterns

Union Carbide, Consumer Prods., New York, N.Y.
Whittaker Corp., Los Angeles, Cal.

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Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
Black Light Corp. Amer., San Gabriel, Cal.
GAF Corp., New York, N.Y.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
GTE Sylvania, Inc., Towanda, Pa.
Materials for Elctrns., Inc., Jamaica, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
Shannon Luminous Mat'ls., Hollywood, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
United Mineral & Chem. Corp., New York, N.Y.
Voltarc Tubes, Fairfield, Conn.
Westinghouse Elec., Bloomfield, N. J.

Flux, Brazing & Soldering Materials

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Anchor Alloys, Inc., Brooklyn, N.Y.
Bow Solder Products, Newark, N.J.
Chemetron Corp., Chicago, Ill.
Dunton, M.W. Co., Providence, R.I.
Edsyn, Inc., Van Nuys, Cal.
Gardiner Solder Co., Chicago, Ill.
GC Electronics, Rockford, Ill.
Goldsmith Precious Metals Div., Chicago, Ill.
Gte Sylvania Inc., Belmont, Cal.
Handy & Harman, New York, N.Y.
Kester Solder Co, Chicago, Ill.
Lake Chemical Co., Chicago, Ill.
LMB Heeger, Inc., Los Angeles, Calif.
London Chemical Co., Bensenville, Ill.
Multicore Sales Corp., Westbury, N.Y.
NL Inds., Inc., Metal Div., New York, N.Y.
Superior Flux & Mfg., Cleveland, Ohio
Union Carbide, Linde Div., New York, N. Y.
Wall-Lenk Mfg. Co., Kinston, N.C.
Wik-It Elctrns. Corp., Sunnyvale, Cal.

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Foil, Capacitor

Anchor Alloys, Inc., Brooklyn, N.Y.
Fansteel Inc., N Chicago, Ill.
ITT Jennings, Monrovia, Cal.
Paul, F.H. & Stein Bros., New York, N.Y.
Reynolds Metals Co., Richmond, Va.
United Mineral & Chem. Corp., New York, N.Y.

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Bram Metallurgical-Chem. Co., Phila., Pa.
Emerson & Cuming, Inc., Canton, Mass.
GTE Sylvania Inc., Newark, N.J.
Hamilton Technology, Inc., Lancaster, Pa.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Kawecki Berylco Inds., Inc., New York, N.Y.
Magnetic Metals Co., Camden, N.J.
Magnetics, Div. Spang Inds., Butler, Pa.
Millen, James Mfg., Malden, Mass.
Perfection Mica Co., Bensenville, Ill.
Revere Copper and Brass, Incorporated, New York, N.Y.
Russell Inds., Inc., Lynbrook, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan

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Endevco, Pasadena, Calif.
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Alpha Metals, Inc., Jersey City, N.J.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Bead Elctrns., Bridgeport, Conn.
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GTE Sylvania Inc., Warren, Pa.
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Hunter Spring, Hatfield, Pa.
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Falstrom Co., Passaic, N.J.
Formica Metal Prods. Co., Inc., Medford, Mass.
GAF Corp., New York, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
Honeywell, Inc., Wabash, Ind.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Metal Works, Inc., Herman, Mo.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Modpak, Waltham, Mass.
Optima Enclosures, Tucker, Ga.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Titchener, E.H. & Co., Binghamton, N.Y.
Vero Electronics, Inc., Hauppauge, N.Y.
Zero Mfg. Co., Burbank, Cal.

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Fuel Cells

Uniroyal, Inc., New York, N.Y.

Furnaces, Diffusion

Despatch Oven Co., Minneapolis, Minn.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Furnaces, Electric

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Chemical Etching Equip. & Supply, Alexandria, Va.
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Hotpack Corp., Phila., Pa.
L & L Mfg. Co., Twin Oaks, Pa.
Leeds & Northrup Corp., No. Wales, Pa.
OAL Assocs., Inc., Westbury, N.Y.
Procedyne Corp., New Brunswick, N.J.
Taylor-Winfield Corp., Warren, Ohio

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Taylor-Winfield Corp., Warren, Ohio
Watkins Johnson Co., Palo Alto, Cal.
Watkins-Johnson Co., Scotts Valley, Cal.

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Brew Richard D. & Co., Inc., Concord, N.H.
Edwards High Vacuum, Grand Island, N.Y.
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Materials Resch. Corp., Orangeburg, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
T-M Vacuum Prods., Riverton, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

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General Elec. Company, Providence, R.I.
International Rectifier, El Segundo, Cal.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
Mepco/Electra Inc., San Diego, Cal.
Micro Devices Corp., Dayton, Ohio
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Fuses, Failure Indicating

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Master Specialties, Costa Mesa, Cal.
Micro Devices Corp., Dayton, Ohio

Fuses, Thermal

Littelfuse, Inc., Des Plaines, Ill.
Micro Devices Corp., Dayton, Ohio

Fuses, Time Delay

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Economy Fuse Div., Des Plaines, Ill.
General Elec. Company, Providence, R.I.
Micro Devices Corp., Dayton, Ohio
Precision Timer Co., Westbrook, Conn.
Raymond Engrg. Inc., Middletown, Conn.
Teledyne Mec., Palo Alto, Cal.

Galvanometers—See Meters, Galvanometer

Garnet Materials & Parts

Ceramic Magnetics, Inc., Fairfield, N.J.
Countis Inds., San Luis Obispo, Cal.
Crystal Technology, Mountain View, Cal
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Trans-Tech, Gaithersburg, Md.
Union Carbide, San Diego, Cal.

Gases, Inert

Air Prods. & Chems., Inc., Allentown, Pa.
Matheson Gas Products, East Rutherford, N.J.
Union Carbide, Linde Div., New York, N. Y.

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Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
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Microwave Development Labs., Inc., Needham Hgts., Mass.
Parker Seal Co., Culver City, Calif.
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3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.

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Applied Control Co., Fairfield, N.J.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bourns, Inc., Instr. Div., Riverside, Calif.
Computer Instrs., Hempstead, N.Y.
Faria, Thomas G. Corp., Uncasville, Conn.
Gaertner Scientific Corp., Chicago, Ill.
Jonard Inds. Corp., Bronx, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
Lion Precision Corp, Newton, Mass.
Minnetech Labs, Minneapolis, Minn.
Rank Precision Inds., Des Plaines, Ill.
Schaevitz Engrg., Pennsauken, N.J.
Transducer Controls Corp., Covina, Calif.
West Coast Resch. Corp., Los Angeles, Calif.

Gauges, Ionization

Aremco Prods., Inc., Briarcliff Manor, N.Y.
Edwards High Vacuum, Grand Island, N.Y.
Fredericks Co., Huntingdon Valley, Pa.
High Vacuum Equip. Corp., Hingham, Mass.
High Voltage Engrg. Corp., Burlington, Mass.
Nuclear Resch. Corp., Southampton, Pa.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Torr Labs., Los Angeles, Cal.
Vactronic Lab. Equip., Inc., E. Northport, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
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Astrosystems, Inc., Lake Success, N.Y.
Bailey Meter Co., Wickliffe, Ohio
Bell & Howell Co., Pasadena, Calif.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bourns, Inc., Instr. Div., Riverside, Calif.
Bristol Div, Waterbury, Conn
Consolidated Controls Corp., Bethel, Conn.
Datametrics Inc., Wilmington, Mass.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Doric Sci. Corp., San Diego, Calif.
Dynisco, Westwood, Mass.
Edison, Instr. Div., W. Orange, N.J.
Foxboro Co., Foxboro, Mass.
Honeywell, Ft. Washington, Pa.
Jonard Inds. Corp., Bronx, N.Y.
Kistler Instr. Co., Redmond, Wash.
Kollsman Instr. Co., Syosset, N.Y.
Kratos, Pasadena, Cal
Kulite Semiconductor Prod., Ridgefield, N.J.
Lion Precision Corp, Newton, Mass.
Matheson Gas Products, East Rutherford, N.J.
MKS Instrs., Inc., Burlington, Mass.
Owatonna Tool Co., Owatonna, Minn.
Pall Trinity Micro Corp., Cortland, N.Y.
Plessey Enviromental Sys., San Diego, Cal.
Schauer Mfg. Corp., Cincinnati, Ohio
Sensotec, Inc., Columbus, Ohio
SRC Div., Newport Bch., Cal.
Statham Instrs., Inc., Oxnard, Cal.
Texas Instruments, Inc., Houston, Tex.
Thermo Elec. Co., Inc., Saddle Brook, N.J.
Transducer Controls Corp., Covina, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

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Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Bell & Howell Co., Pasadena, Calif.
BLH Elctrns., Inc., Waltham, Mass.
Doric Sci. Corp., San Diego, Calif.
Foxboro Co., Foxboro, Mass.
Hughes Aircraft Co., Space & Comm. Grp., Los Angeles, Cal.
Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
Kulite Semiconductor Prod., Ridgefield, N.J.
Magnaflux Corp., Chicago, Ill.
Micro-Measurements Div., Romulus, Mich.
Statham Instrs., Inc., Oxnard, Cal.
Teledyne Geotech, Dallas, Tex.
Toledo Scale, Toledo, Ohio
West Coast Resch. Corp., Los Angeles, Calif.

Gauges, Tension

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Chatillon John & Sons, Kew Gardens, N.Y.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Doric Sci. Corp., San Diego, Calif.
Hunter Spring, Hatfield, Pa.
Kaman Sciences Corp., Colorado Springs, Colo.
Minnetech Labs, Minneapolis, Minn.
Neuses, P.K., Inc., Arlington Hgts., Ill.
N.Y. Testing Labs., Inc., Westbury, N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Transducer Controls Corp., Covina, Calif.
West Coast Resch. Corp., Los Angeles, Calif.

Gauges, Thickness—See Testers, Thickness (All Types)

Gauges, Vacuum

Bailey Meter Co., Wickliffe, Ohio
Bristol Div, Waterbury, Conn
Cole-Parmer Instr. Co., Chicago, Ill.
Consolidated Controls Corp., Bethel, Conn.
Datametrics Inc., Wilmington, Mass.

Dixson Inc., Meter Div., Grand Junction, Colo.
Edwards High Vacuum, Grand Island, N.Y.
Foxboro Co., Foxboro, Mass.
Fredericks Co., Huntingdon Valley, Pa.
High Vacuum Equip. Corp., Hingham, Mass.
High Voltage Engrg. Corp., Burlington, Mass.
Honeywell, Ft. Washington, Pa.
Lion Precision Corp, Newton, Mass.
Materials Resch. Corp., Orangeburg, N.Y.
Matheson Gas Products, East Rutherford, N.J.
MKS Instrs., Inc., Burlington, Mass.
Nuclear Resch. Corp., Southampton, Pa.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Precision Sci. Co., Chicago, Ill.
RIL Elctrns., Inc., Southampton, Pa.
Schauer Mfg. Corp., Cincinnati, Ohio
Statham Instrs., Inc., Oxnard, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Vacuum Resch. Mfg., San Ramon, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
VirTis Co., Gardiner, N.Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westinghouse Elec., Elmira, N.Y.

Gearheads & Speed Reducers

Bowmar Instr. Corp., Ft. Wayne, Ind. Vol 2•334

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Precision Mechanisms Corp., Westbury, N.Y. ..... Vol 2•990
Bendix, Utica, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
GAF Corp., New York, N.Y.
Gibbs Mfg. & Resch., Janesville, Wisc.
Gibson/Egan Co., Arcadia, Calif.
Gries Reproducer Co., New Rochelle, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Instru-Lec Corp., Mt. Vernon, N.Y.
Invincible Gear Co., Detroit, Mich.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Keller, Hugo P., Inc., New York, N.Y.
Kidde, Walter & Co., Belleville, N.J.
Kwikset Powdered Metal Prods., Anaheim, Cal.
Lear Siegler, Inc., Santa Monica, Calif.
Machine Components Corp., Plainview, N.Y.
Meltronics Inc., Leeds, Ala.
Millen, James Mfg., Malden, Mass.
MPC Prods. Corp., Chicago, Ill.
Orbit Instr. Corp., Syosset, N.Y.
Perfect Gear & Instr. Corp., Northridge, Calif.
PIC Design Division, Ridgefield,, Conn.
Planet Instr., Gardena, Cal.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Transicoil, Inc., Worcester, Pa.
Western Gear Corp., Pasadena, Cal.

Generators, A-M

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Logimetrics, Inc., Greenvale, N.Y. Vol 1•480,481
Ailtech, City of Industry, Cal.
AUL Instrs., Inc., Flushng, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Edison Elctrns. Div., Manchester, N.H.
Exact Elctrns., Inc., Hillsboro, Ore.
General Radio Co., Concord, Mass.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
Interstate Elctrns. Corp., Anaheim, Cal.
Kay Elemetrics, Pine Brook, N.J.
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
MCL, Inc., La Grange, Ill.
Radio Resch. Co., Rockaway, N.J.
RCA Corp., Camden, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Wavetek, San Diego, Cal.
Wiltron Co., Palo Alto, Calif.

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CCA Elctrns. Corp., Gloucester, N.J.
Exact Elctrns., Inc., Hillsboro, Ore.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
Kay Elemetrics, Pine Brook, N.J.
Krohn-Hite, Cambridge, Mass.
Leader Instruments Corp., Long Island City, N.Y.
London Co., Cleveland, Ohio
Polarad Elctrn. Instrs., Lake Success, N.Y.
Radio Resch. Co., Rockaway, N.J.
RCA Corp., Camden, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Texscan Corp., Indianapolis, Ind.
Tucker Electronics Co., Garland, Tex.
Wavetek, San Diego, Cal.
Wavetek Indiana, Inc., Beech Grove, Ind.
Wiltron Co., Palo Alto, Calif.

Generators, Acoustic, High Intensity Noise

CML-Macarr, Inc., Edison, N.J.
Elgenco, Inc., Santa Monica, Cal.

Generators, Audio

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Advanced Energy Conversion, Belmont, Cal.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
Altec Div., Anaheim, Calif.
American Time Products, Woodside, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Barker & Williamson, Inc., Bristol, Pa.
BECO, Inc., Salem, Va.
Behlman Div., California Instrs., San Diego, Cal
Bramco Controls, Piqua, Ohio
Brown Electro-Meas. Corp., Kirkland, Wash.
California Instrs. Co., San Diego, Cal.
Clarke - Hess, New York, N.Y.
CML-Macarr, Inc., Edison, N.J.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Elgenco, Inc., Santa Monica, Cal.
Elin Div., San Diego, Cal.
Exact Elctrns., Inc., Hillsboro, Ore.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
General Radio Co., Concord, Mass.
GRM Corp., Medford, N.J.
Heath Co., Benton Harbor, Mich.
Holt Instr. Labs., Oconto, Wisc.
Hope Elctrns., Clifton, N.J.
Ind'l. Test Equip., Clifton, NJ
Kay Elemetrics, Pine Brook, N.J.
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
Nelson Ross Elctrns., Lake Success, N.Y.
NH Research, Inc., Santa Ana, Calif.
Optimation, Inc., Chatsworth, Cal.
RCA Elctrns. Comps., Harrison, N.J.
Riverbank Labs., Geneva, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Solar Elctrns. Co., Hollywood, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
T-F Electronics, Inc., Austin, Tex.
Tech Serv., Inc., Fogelsville, Pa.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
Unholtz-Dickie Corp., Hamden, Conn.
Wavetek, San Diego, Cal.
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E-H Resch. Labs., Inc., Oakland, Cal.
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Information Displays, Inc., Mt. Kisco, N.Y.
Instrumentation Tech. Corp., Northbridge, Cal.
Monitor Systems, Ft. Washington, Pa
NES, Inc., Itasca, Ill.
Singer - Tele-Signal, Woodbury, N.Y.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
Texas Instruments, Dallas, Tex.
Varian Data Machines, Palo Alto, Cal.

Generators, Digital Delay—

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Astro Comm. Lab., Gaithersburg, Md.
CCA Elctrns. Corp., Gloucester, N.J.
Clarke - Hess, New York, N.Y.
Edison Elctrns. Div., Manchester, N.H.
Exact Elctrns., Inc., Hillsboro, Ore.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
Kay Elemetrics, Pine Brook, N.J.
Krohn-Hite, Cambridge, Mass.
Leader Instruments Corp., Long Island City, N.Y.
Piezo Technology Inc., Orlando, Fla.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Radio Resch. Co., Rockaway, N.J.
Regency Elctrns., Inc., Indianapolis, Ind.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Sound Technology, Cupertino, Cal.
Texscan Corp., Indianapolis, Ind.
Tucker Electronics Co., Garland, Tex.
Video Research Corp., Gaithersburg, Md.
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Wavetek Indiana, Inc., Beech Grove, Ind.
Wiltron Co., Palo Alto, Calif.

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London Co., Cleveland, Ohio .. Vol 1•478
CCA Elctrns. Corp., Gloucester, N.J.
Hickok Elect. Instr., Cleveland, Ohio
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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
A.R.F. Products, Inc., Boulder, Colo.
Bailey Meter Co., Wickliffe, Ohio
BECO, Inc., Salem, Va.
Bicron Elctrns. Co., Canaan, Conn.
Bowmar/ALI, Inc., Acton, Mass.
CELCO, Mahwah, N.J.
Chronetics, Inc., Mt. Vernon, N.Y.
Comaltest, Danbury, Conn.
Computer Diode, Fair Lawn, N.J.
EI Instruments, Derby, Conn.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Esterline Angus Div., Indianapolis, Ind.
Exact Elctrns., Inc., Hillsboro, Ore.
Feedback, Inc., Berkeley Hghts., N.J.
General Computers, Inc., Los Angeles, Calif.
Heath Co., Benton Harbor, Mich.
Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Leader Instruments Corp., Long Island City, N.Y.
Magnetic Elctrns., Van Nuys, Cal.
Monitor Systems, Ft. Washington, Pa
Norden Div., Norwalk, Conn.
Perkin-Elmer Corp., Electronic Prods. Dept., Norwalk, Conn.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Systron Donner Trygon Elctrns. Sub., Westbury, N.Y.
Teledyne Philbrick, Dedham, Mass.
Telonic Inds., Inc., Laguna Beach, Calif.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Texas Instruments, Dallas, Tex.
Transicoil, Inc., Worcester, Pa.
Tucker Electronics Co., Garland, Tex.
Universal Elctrns. Co., Irvine, Cal.

Generators, Hall

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Ohio Semitronics, Columbus, Ohio Vol 2•1179
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Sprague Elec. Co., No. Adams, Mass.

Generators, Harmonic

Varian, Solid State West Division, Palo Alto, Cal. ..... Vol 4•440*
Calvert Elctrns., Inc., New York, N.Y.
CML-Macarr, Inc., Edison, N.J.
Electro/Data, Inc., Garland, Tex.
Ind'l. Test Equip., Clifton, NJ
Ryka Scientific, Inc., Sunnyvale, Cal.
Trak Microwave, Tampa, Fla.

Generators, Impulse

Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.

Generators, Infrared—See Lamps, Infrared

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Advanced Energy Conversion, Belmont, Cal.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
American Elctrns., Inc., Fullerton, Cal.
American Time Products, Woodside, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Behlman Div., California Instrs., San Diego, Cal
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
California Instrs. Co., San Diego, Cal.
CCA Elctrns. Corp., Gloucester, N.J.
CML-Macarr, Inc., Edison, N.J.
Digiac Corp., Plainview, N.Y.
Electric Indicator Co., Inc., Norwalk, Conn.
Elgenco, Inc., Santa Monica, Cal.
Exact Elctrns., Inc., Hillsboro, Ore.
Feedback, Inc., Berkeley Hghts., N.J.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
Georator Corporation, Manassas, Va.
Hope Elctrns., Clifton, N.J.
Interstate Elctrns. Corp., Anaheim, Cal.
Kato Engrg. Co., Mankato, Minn.
Kay Elemetrics, Pine Brook, N.J.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Krohn-Hite, Cambridge, Mass.
Leader Instruments Corp., Long Island City, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Logimetrics, Inc., Greenvale, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
NH Research, Inc., Santa Ana, Calif.
Optimation, Inc., Chatsworth, Cal.
Riverbank Labs., Geneva, Ill.
Rockland Sys. Corp., W. Nyack, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Spectrum Technology, Goleta, Cal.
Systron-Donner Datapulse Div., Culver City, Cal.
T-F Electronics, Inc., Austin, Tex.
Tektronix, Inc., Beaverton, Ore.
Texscan Corp., Indianapolis, Ind.
Wiltron Co., Palo Alto, Calif.

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Ballantine Laboratories, Inc., Boonton,, N. J.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Dynascan Corp., Chicago, Ill.
Electro/Data, Inc., Garland, Tex.
Fork Standards, W. Chicago, Ill.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Jerrold Electronics Corp., Philadelphia, Pa.
Leader Instruments Corp., Long Island City, N.Y.
Meloy Laboratories Inc., Springfield, Va.
Microwave/Sys., Inc., E. Syracuse, N.Y.
PPM, Inc., Bedford, Ohio
RCA Elctrns. Comps., Harrison, N.J.
Regency Elctrns., Inc., Indianapolis, Ind.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Tektronix, Inc., Beaverton, Ore.
Wiltron Co., Palo Alto, Calif.

Generators, Microwave

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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
Aircom, Inc., Union, N.H.
Amperex Electronic Corp., Hicksville, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Cober Elctrns., Inc., Stamford, Conn.
Collins Radio Co., Dallas, Tex.
E-H Resch. Labs., Inc., Oakland, Cal.
Energy Systems, Palo Alto, Cal.
GAF Corp., New York, N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Greenray Inds., Inc., Mechanicsburg, Pa.
Hope Elctrns., Clifton, N.J.
Litton Inds., San Carlos, Calif.
Marconi Instrs., Englewood, N.J.
Micro-Now Instr., Chicago, Ill.
Micro-Tel Corp., Baltimore, Md.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Narda Microwave Corp., Plainview, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Signalite, Neptune, N.J.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Varian, Beverly, Mass.
VTM Microwaves, Inc., Boulder, Colo.
Watkins Johnson Co., Palo Alto, Cal.
Wavetek Indiana, Inc., Beech Grove, Ind.
Wiltron Co., Palo Alto, Calif.

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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Allison Labs., Inc., Austin, Tex.
B & K Instrs., Inc., Cleveland, Ohio
Baganoff Assocs., Inc., St. Louis, Mo.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Berkeley Nucleonics Corp., Berkeley, Calif.
Burr-Brown Resch. Corp., Tucson, Ariz.
Computer Diode, Fair Lawn, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
International Data Sciences, Providence, R.I.
Kay Elemetrics, Pine Brook, N.J.
Microwave Semiconductor Corp., Somerset, N.J.
PRD Elctrns., Inc., Westbury, N.Y.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Signalite, Neptune, N.J.
Systron-Donner Datapulse Div., Culver City, Cal.
Tau-Tron, Inc., Lowell, Mass.
Tech Serv., Inc., Fogelsville, Pa.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Waveline, Inc., W. Caldwell, N.J.

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Chesterfield Prods. Inc., Saddle Brook, N. J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Exact Elctrns., Inc., Hillsboro, Ore.
Feedback, Inc., Berkeley Hghts., N.J.
Georator Corporation, Manassas, Va.
Ind'l. Test Equip., Clifton, NJ
Kato Engrg. Co., Mankato, Minn.
Optimation, Inc., Chatsworth, Cal.
Theta Instr. Corp., Fairfield, N.J.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
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CML-Macarr, Inc., Edison, N.J. Vol 1•644
Georator Corporation, Manassas, Va. Vol 1•691
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AMF Electical Prods., Alexandria, Va.
Bendix, Eatontown, N.J.
California Instrs. Co., San Diego, Cal.
Columbia Elec. Mfg. Co., Cleveland, Ohio
Electro-Pacific, Inc., Goleta, Calif.
General Lab. Assocs., Norwich, N.Y.
Kato Engrg. Co., Mankato, Minn.
NH Research, Inc., Santa Ana, Calif.
ONAN Div., Mpls., Minn.
Systron-Donner Datapulse Div., Culver City, Cal.
Technical Mat'l., Mamaroneck, N.Y.
TRW/Globe Motors, Dayton, Ohio
Varo, Inc., Santa Barbara, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Generators, Pulse

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Tektronix, Inc., Beaverton, Ore. Vol 1•513
Test & Measuring Instrs. Inc., Hicksville, N.Y. ..... Vol 4•424*
Airflyte Elctrns. Co., Bayonne, N.J.
American Time Products, Woodside, N.Y.
Avtron Mfg., Inc., Cleveland, Ohio
Berkeley Nucleonics Corp., Berkeley, Calif.
Bicron Elctrns. Co., Canaan, Conn.
Burr-Brown Resch. Corp., Tucson, Ariz.
CBS Laboratories, Stamford, Conn.
Comaltest, Danbury, Conn.
Data Dynamics Div., Englewood, N.J.
Disc Instruments, Inc., Costa Mesa, Ca.
Dranetz Engrg. Labs., So. Plainfield, N.J.
EI Instruments, Derby, Conn.
Exact Elctrns., Inc., Hillsboro, Ore.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
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Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Mobil Elctrns., Inc., Anderson, Ind.
Optima Enclosures, Tucker, Ga.
Paul, F.H. & Stein Bros., New York, N.Y.
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Useco Div., Van Nuys, Cal.
Vemaline Prods. Co., Wyckoff, N.J.
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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
E-Tronics, Sepulveda, Cal.
Engineering & Elctrn. Devices, Inc., Los Angeles, Calif.
Fansteel Inc., N Chicago, Ill.
GC Electronics, Rockford, Ill.
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Miller, L.C. Co., Monterey Park, Calif.
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Oven Industries, Inc., Mechanicsburg, Pa.
Signet Scientific Co., Burbank, Cal.
Sta-Warm Elec. Co., Ravenna, Ohio
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Watlow Elec. Mfg. Co., St. Louis, Mo.
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Jettron Prods., Hanover, N.J.
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Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
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Bowmar Instr. Corp., Ft. Wayne, Ind.
Clifton Precision, Clifton Hgts., Pa.
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Conrac Corp., Duarte, Cal.
Data Technology Inc., Watertown, Mass.
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Orbit Instr. Corp., Syosset, N.Y.
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Singer Co., Little Falls, N.J.
Speed Detectors, Bedford, Ohio
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Collins Radio Co., Dallas, Tex.
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Cornell-Dubilier Elctrns., Newark, N.J.
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Dranetz Engrg. Labs., So. Plainfield, N.J.
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Republic Advanced System Technology Group, Chatsworth, Calif.
Scientific-Atlanta, Inc., Atlanta, Ga.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
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Clifton Precision, Clifton Hgts., Pa.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Computer Conversions Corp., East Northport, N.Y.
Data Technology Inc., Watertown, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Gap Instr. Corp., Hauppauge, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Humphrey, Inc., San Diego, Calif.
Ind'l. Control Co., Farmingdale, N.Y.
Larson Aero Dev., Concord, Calif.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Grand Rapids, Mich.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Metric Sys., Ft. Walton Beach, Fla.
Natel Engrg. Co., Canoga Pk., Cal.
North Atlantic Inds., Plainview, N.Y.
Northern Precision Labs., Inc., Fairfield, N.J.
Orbit Instr. Corp., Syosset, N.Y.
Republic Advanced System Technology Group, Chatsworth, Calif.
Scientific-Atlanta, Inc., Atlanta, Ga.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transicoil, Inc., Worcester, Pa.
Transmagnetics Inc., Farmingdale, N. Y.
Veeder-Root, Hartford, Conn.
Vernitech, Deer Pk., N.Y.
Waldom Elctrns., Inc., Chicago, Ill.

Indicators, Capacitor Leakage—See Testers, Capacitor

Indicators, Circuit Condition, On, Off etc. (Electro-Mechanical)-Also see Indicators, Instrument

Allard Instr. Corp., Westbury, NY Vol 2•461
Bussmann Mfg. Div., St. Louis, Mo. Vol 2•1008,1011
Daco Instr. Co., Milford, Conn. Vol 2•478
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•491
North American Philips Controls Corp., Cheshire, Conn. ..... Vol 2•357
Wagner Elec. Corp., Livingston, N.J. Vol 2•540,541
Applied Control Co., Fairfield, N.J.
A P Products, Inc., Painesville, Ohio
Artisan Elctrns. Corp., Parsippany, N.J.
Automation Services Div., Windsor, N. Y.
Clare-Pendar Co., Post Falls, Idaho
Control Data Corp., Minneapolis, Minn.
Control Switch, Inc., Folcroft, Pa.
Coto-Coil Co., Inc., Providence, R.I.
Dataprobe, Inc., So. Hackensack, N.J.
Dialight Corp., Brooklyn, N.Y.
Drake Mfg., Harwood Hgts., Ill.
General Illumination, Inc., St. Paul, Minn.
Hickok Elect. Instr., Cleveland, Ohio
Honeywell, Mpls., Minn.
IMC Magnetics Corp., Maywood, Cal.
International Electro Exchange Corp., Eden Prairie, Minn.
Jay-El Prods., Gardena, Calif.
Landis & Gyr, Inc., Elmsford, N.Y.
Molex Inc., Lisle, Ill.
OPCOA, Inc., Edison, N.J.
Penn Keystone Corp., Ansonia, Conn.
Signalite, Neptune, N.J.
Simpson Elec. Co., Chicago, Ill.
Staver Co., Inc., Bay Shore, N.Y.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Unimax Switch Corp., Wallingford, Conn.

Indicators, Computer Type & Data Display—See Lights; Dials-Also See Readouts & Displays

Indicators, Distortion—See Analyzers, A-F

Indicators, Elapsed-Time

Curtis Instrs., Inc., Mt. Kisco, N.Y. Vol 1•418
Freed Transformer Co., Bklyn., N.Y. Vol 1•447
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 1•448
General Time Corp., Thomaston, Conn. Vol 2•345
Geo Space Sys., Tampa, Fla. .. Vol 1•343
J-B-T Instrs., Inc., New Haven, Conn. Vol 2•1083
Kessler-Ellis Prods., Atlantic Highlands, N.J. ..... Vol 2•349
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
North American Philips Controls Corp., Cheshire, Conn. ..... Vol 2•357
Plessey Electro-Products, Los Angeles, Cal. ..... Vol 2•360
Precision Timer Co., Westbrook, Conn. Vol 2•364
Simpson Elec. Co., Chicago, Ill. Vol 1•502
American Time Products, Woodside, N.Y.
Arnoux Corp., Santa Barbara, Cal
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Biddle, James G., Plymouth Meeting, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Saybrook Co., Old Saybrook, Conn.
Bulova Watch Co., Flushing, N.Y.
Cramer Division, Old Saybrook, Conn.
Datatron, Inc., Santa Ana, Cal
Dynapar Corp., Gurnee, Ill.
Dytro Corp., Hicksville, N.Y.
Electric Tachometer Corp., Philadelphia, Pa.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
ENM Co., Chicago, Ill.
Epic, Inc., New York, N.Y.
ESE, Inglewood, Cal.
General Elec., W. Lynn, Mass.
Haydon Switch & Instr., Waterbury, Conn.
Ideal Precision Meter Co., Brooklyn, N. Y.
IEC Electronics Corp., E. Rochester, N.Y.
Jewell Electrical Instrs., Manchester, N.H.
Lab-Line Instrs., Inc., Melrose Park, Ill.
Lear Siegler, Grand Rapids, Mich.
Mallory Timers, Indpls., Ind.
NES, Inc., Itasca, Ill.
Planet Instr., Gardena, Cal.
PPM, Inc., Bedford, Ohio

Raymond Controls Corp., Middletown, Conn.
Singer Co., Little Falls, N.J.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Veeder-Root, Hartford, Conn.

Indicators, Electromechanical
—See Indicators, Circuit Condition, On / Off

Indicators, Frequency—See Meters, Frequency

Indicators, Humidity & Moisture (Electronic)

American Instr. Co., Silver Spring, Md.
Clean Room Prods., Farmingdale, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Doric Sci. Corp., San Diego, Calif.
Forma Scientific, Marietta, Ohio
Honeywell, Ft. Washington, Pa.
Inficon Inc., E. Syracuse, N.Y.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Lab-Line Instrs., Inc., Melrose Park, Ill.
NES, Inc., Itasca, Ill.
Panametrics Inc., Waltham, Mass.

Indicators, Illumination—See Meters, Light (Non Photographic)

Indicators, Instrument, Flag, Pointer, etc.

Allard Instr. Corp., Westbury, NY **Vol 2•461**
Daco Instr. Co., Milford, Conn. Vol 2•478
Abrams Instr., Lansing, Mich.
Ammon Instrs., Inc., Manchester, N.H.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., Ft. Lauderdale, Fla.
Clifton Precision, Clifton Hgts., Pa.
Control Data Corp., Minneapolis, Minn.
Ideal Precision Meter Co., Brooklyn, N. Y.
IMC Magnetics Corp., Westbury, N.Y.
IMC Magnetics Corp., Rochester, N.H.
IMC Magnetics Corp., Maywood, Cal.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Larson Aero Dev., Concord, Calif.
Lear Siegler, Grand Rapids, Mich.
Leeds & Northrup Corp., No. Wales, Pa.
Penn Keystone Corp., Ansonia, Conn.
Robertshaw Controls Co., Richmond, Va.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Transicoil, Inc., Worcester, Pa.

Indicators, Linear Displacement

Ametek/Instrs. & Controls, Feasterville, Pa.
Applied Control Co., Fairfield, N.J.
Astrosystems, Inc., Lake Success, N.Y.
Collins, G.L. Corp., Long Beach, Calif.
Computer Instrs., Hempstead, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Control Technology Co., L.I.C., N.Y.
Davidson Elctrn. Dev. Co., Erie, Pa.
Disc Instruments, Inc., Costa Mesa, Ca.
Doric Sci. Corp., San Diego, Calif.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Electro Corp., Sarasota, Fla.
Gems Sensors Div., Farmington, Conn.
Humphrey, Inc., San Diego, Calif.
Impact-O-Graph Corp., Bedford, Ohio
IMPACT-O-GRAPH Div., Bedford, Ohio
Itek Corp. Meas. Sys. Div., Newton, Mass.
Kaman Sciences Corp., Colorado Springs, Colo.
Larson Aero Dev., Concord, Calif.
Lion Precision Corp, Newton, Mass.
Mann, David W. Co., Burlington, Mass.
Minnetech Labs, Minneapolis, Minn.
Rank Precision Inds., Des Plaines, Ill.
Schaevitz Engrg., Pennsauken, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Technology, Mountain View, Cal.
Speed Detectors, Bedford, Ohio
Taylor Instr. Process Control Div., Rochester, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transducer Controls Corp., Covina, Calif.
Transmagnetics Inc., Farmingdale, N. Y.
Unholtz-Dickie Corp., Hamden, Conn.
United Detector Technology Inc., Santa Monica, Cal.
Veeder-Root, Hartford, Conn.
West Coast Resch. Corp., Los Angeles, Calif.
Westronics, Inc., Ft. Worth, Tex.

Indicators, Liquid Level

Advanced Kinetics, Costa Mesa, Calif.
Ametek/Instrs. & Controls, Feasterville, Pa.
Autocon Inds., Inc., Minneapolis, Minn.
Bailey Meter Co., Wickliffe, Ohio
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., Davenport, Iowa
Bristol Div, Waterbury, Conn
Coil Co. of Amer., Northvale, N.J.
Conrac Corp., Fairfield, N.J.
Consolidated Controls Corp., Bethel, Conn.
Continental Data Sys., Dayton, Ohio
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Delavan Electronics, Scottsdale, Ariz.
Edison, Instr. Div., W. Orange, N.J.
Faria, Thomas G. Corp., Uncasville, Conn.
Fenwal Elctrns., Framingham, Mass.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Gems Sensors Div., Farmington, Conn.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Johnson Corp., Three Rivers, Mich.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Keystone Carbon Co., St. Marys, Pa.
Kratos, Pasadena, Cal
Micro Switch, Freeport, Ill.
National Sonics, Farmingdale, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Oxford Instr. Corp., Annapolis, Md.
Penn Airborne Prods., Southampton, Pa.
P.E.T., Inc., Pittsburgh, Pa.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Robertshaw Controls Co., Richmond, Va.
Scientific Technology, Mountain View, Cal.
Square D Co., Park Ridge, Ill.
Statham Instrs., Inc., Oxnard, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Trans-Sonics, Inc., Lexington, Mass.
Transducer Controls Corp., Covina, Calif.
Triac Elctrn. Sys., Forest Hills, N. Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Weston Instruments, Inc., Newark, N.J.
Westronics, Inc., Ft. Worth, Tex.
Zi-Tech Div., Palo Alto, Cal.

Indicators, Magnetic Field

Perfection Mica Co., Bensenville, Ill. **Vol 2•1189**
Advanced Kinetics, Costa Mesa, Calif.
Automation Inds., Danbury, Conn.
Davidson Elctrn. Dev. Co., Erie, Pa.
Electro-Mechanics Co., Austin, Tex.
High Voltage Engrg. Corp., Burlington, Mass.
LDJ Electronics, Troy, Mich.
Magnaflux Corp., Chicago, Ill.
Ohio Semitronics, Columbus, Ohio
Oxford Instr. Corp., Annapolis, Md.
RFL Inds., Instr. Div., Boonton, N.J.
Thomas & Skinner, Inc., Indianapolis, Ind.
Varian Assocs., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Indicators, Material Thickness
—See Testers, Thickness (All Types)

Indicators, Noise-Figure—See Meters, Noise-Figure

Indicators, Null

Biddle, James G., Plymouth Meeting, Pa. ..... **Vol 1•399**
Brown Electro-Meas. Corp., Kirkland, Wash. ..... **Vol 1•398**
Control Technology Co., L.I.C., N.Y. **Vol 2•987**
Freed Transformer Co., Bklyn., N.Y. **Vol 1•445**
Ammon Instrs., Inc., Manchester, N.H.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bristol Div, Waterbury, Conn
Collins Radio Co., Dallas, Tex.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dytronics Co., Columbus, Ohio
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Electro Sci. Inds., Portland, Ore.
Electronic Dev. Corp., Boston, Mass.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Geo Space Sys., Tampa, Fla.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Control Co., Farmingdale, N.Y.
Jewell Electrical Instrs., Manchester, N.H.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Mini-Circuits Lab., Brooklyn, N.Y.
Modutec, Inc., Norwalk, Conn.
Mura Corp., Jericho, N.Y.
North Atlantic Inds., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Penn Airborne Prods., Southampton, Pa.
Princeton Applied Resch. Corp., Princeton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shallcross, Selma, N.C.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Stock Drive Prods., New Hyde Pk., N.Y.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Theta Instr. Corp., Fairfield, N.J.
Trio Labs, Inc., Plainview, N.Y.
Triplett Corp., Bluffton, Ohio
United Detector Technology Inc., Santa Monica, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Weston Instruments, Inc., Newark, N.J.
Westronics, Inc., Ft. Worth, Tex.
Zi-Tech Div., Palo Alto, Cal.

Indicators, Numeric Readout
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Indicators, Positioning

Astrosystems, Inc., Lake Success, N.Y. **Vol 1•327**
Austron, Inc., Austin, Tex. ..... **Vol 1•391**
Geo Space Sys., Tampa, Fla. .. **Vol 1•550**
Natel Engrg. Co., Canoga Pk., Cal. **Vol 1•361**
Servo-Tek Prods. Co., Hawthorne, N.J. **Vol 2•661**
Vernitech, Deer Pk., N.Y. ..... **Vol 2•543**
Vernitron Control Comps., Torrance, Cal. ..... **Vol 2•992**
Aerospace Knob Co., So. El Monte, Calif.
Ametek/Instrs. & Controls, Feasterville, Pa.
Avtron Mfg., Inc., Cleveland, Ohio
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Barnes Engrg. Co., Stamford, Conn.
Bendix Aerospace-Elctrns., Teterboro, N.J.
C & A Products, Inc., Woodside, N. Y.
Clifton Precision, Clifton Hgts., Pa.
Climatronics Corp., Hauppauge, N.Y.
Computer Conversions Corp., East Northport, N.Y.
Computer Instrs., Hempstead, N.Y.
Control Sciences, Inc., Granada Hills, Cal.
Control Technology Co., L.I.C., N.Y.
Data Technology Inc., Watertown, Mass.
Datron Systems, Chatsworth, Cal.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Edo Western Corp., Salt Lake City, Utah
Electric Tachometer Corp., Philadelphia, Pa.
Electro-Numerics, Santa Clara, Cal.
Electro-Pacific, Inc., Goleta, Calif.
Farrand Controls, Inc., Valhalla, N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
Gems Sensors Div., Farmington, Conn.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Humphrey, Inc., San Diego, Calif.
Icon Corp., Sub of U.S.M. Corp., Cambridge, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Jewell Electrical Instrs., Manchester, N.H.
Kaman Sciences Corp., Colorado Springs, Colo.
Midland Standard Inc., Elgin, Ill.
Minnetech Labs, Minneapolis, Minn.
National Sonics, Farmingdale, N.Y.
NES, Inc., Itasca, Ill.
Norden Div., Norwalk, Conn.
North Atlantic Inds., Plainview, N.Y.
Orbit Instr. Corp., Syosset, N.Y.
Parametrics, Inc., Orange, Conn.
Photobell Co., Inc., New York, N.Y.
Photomation, Inc., Mountain View, Calif.
Schaevitz Engrg., Pennsauken, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Singer Co., Little Falls, N.J.
Skan-A-Matic Corp., Elbridge, N. Y.
Stake Fastener Co., S. El Monte, Calif.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transducer Controls Corp., Covina, Calif.
Transicoil, Inc., Worcester, Pa.
United Detector Technology Inc., Santa Monica, Cal.
Veeder-Root, Hartford, Conn.
West Coast Resch. Corp., Los Angeles, Calif.
Western Indicator Co., So. El Monte, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westronics, Inc., Ft. Worth, Tex.

Indicators, Power Level—See Monitors, Power, R-F

Indicators, Pressure—See Gauges, Pressure

Indicators, Proximity

Advance Instr. Corp., Belmar, N. J.
Ametek/Instrs. & Controls, Feasterville, Pa.
Automation Services Div., Windsor, N. Y.
Collins Radio Co., Dallas, Tex.
Controlcraft Corp., West Chicago, Ill.
Cutler-Hammer, Milwaukee, Wisc.
Delavan Electronics, Scottsdale, Ariz.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Dynamic Data Corp., Columbus, Ohio
Electro Corp., Sarasota, Fla.
Farmer Elec. Prods. Co., Inc., Natick, Mass.
Fiber Photics, Inc., Santa Cruz, Cal.
Kaman Sciences Corp., Colorado Springs, Colo.
Larson Aero Dev., Concord, Calif.
Lion Precision Corp, Newton, Mass.
Photobell Co., Inc., New York, N.Y.
Robertshaw Controls Co., Richmond, Va.
Schaevitz Engrg., Pennsauken, N.J.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Skan-A-Matic Corp., Elbridge, N. Y.
Tapeswitch Corp. Amer., Farmingdale, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.

Indicators, R-F—See Meters, Frequency

Indicators, Rotary Shaft Position—See Encoders, Shaft Position

Indicators, Servo

Control Technology Co., L.I.C., N.Y. Vol 2•987
Ind'l. Control Co., Farmingdale, N.Y. Vol 2•989
ABA Industries, Inc., Pinellas Pk., Fla.
Astrosystems, Inc., Lake Success, N.Y.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp., Davenport, Iowa
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Div, Waterbury, Conn
C & A Products, Inc., Woodside, N. Y.
Clifton Precision, Clifton Hgts., Pa.
Collins Radio Co., Dallas, Tex.
Computer Conversions Corp., East Northport, N.Y.
Control Data Corp., Minneapolis, Minn.
Datron Systems, Chatsworth, Cal.
Electro-Devices, Inc., Paterson, N.J.
Esterline Angus Div., Indianapolis, Ind.
Gap Instr. Corp., Hauppauge, N.Y.
Geo Space Sys., Tampa, Fla.
Henschel Corp., Amesbury, Mass.
Innovatek Enterprise, Millerton, N.Y.
Kollsman Instr. Co., Syosset, N.Y.
Kratos, Pasadena, Cal
Lear Siegler, Inc., Santa Monica, Calif.
MPC Prods. Corp., Chicago, Ill.
Norden Div., Norwalk, Conn.
North Atlantic Inds., Plainview, N.Y.
Northern Precision Labs., Inc., Fairfield, N.J.
Orbit Instr. Corp., Syosset, N.Y.
Penn Airborne Prods., Southampton, Pa.
Precision Mechanisms Corp., Westbury, N.Y.
Singer Co., Little Falls, N.J.
Sterling Instr., New Hyde Pk., NY
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Transicoil, Inc., Worcester, Pa.
Vernitech, Deer Pk., N.Y.
Westronics, Inc., Ft. Worth, Tex.

Indicators, Shorted Turn—See Testers, Coil

Indicators, Sound Level—See Meters, Audio Level

Indicators, Speed

Servo-Tek Prods. Co., Hawthorne, N.J. Vol 2•661
Transmagnetics Inc., Farmingdale, N. Y.

Indicators, Strain (For Use With Strain Gauges)

Applied Control Co., Fairfield, N.J.
Astrosystems, Inc., Lake Success, N.Y.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Bell & Howell Co., Pasadena, Calif.
BLH Elctrns., Inc., Waltham, Mass.
Bristol Div, Waterbury, Conn
Consolidated Controls Corp., Bethel, Conn.
Doric Sci. Corp., San Diego, Calif.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
Gap Instr. Corp., Hauppauge, N.Y.
Gould, Inc., Cleveland, Ohio
Hawkeye Instrus., Inc., Marion, Iowa
Innovatek Enterprise, Millerton, N.Y.
Ithaco, Inc., Ithaca, N.Y.
Matrix Corp., Beech Grove, Ind.
Orbit Instr. Corp., Syosset, N.Y.
PPM, Inc., Bedford, Ohio
Sensotec, Inc., Columbus, Ohio
Statham Instrs., Inc., Oxnard, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Inc., Beaverton, Ore.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Toledo Scale, Toledo, Ohio
Transducer Controls Corp., Covina, Calif.
West Coast Resch. Corp., Los Angeles, Calif.
Westronics, Inc., Ft. Worth, Tex.

Indicators, Surface Roughness

Sloan Technology Corp., Santa Barbara, Calif.

Indicators, Telemetering—See Analyzers, Telemetric Data

Indicators, Temperature—See Meters, Temperature

Indicators, Temperature (Non-Meter Type)

Omega Engrg., Inc., Stamford, Conn. Vol 2•1173
B & F Instrs., Inc., Cornwells Hgts., Pa.
Brady, W.H. Co., Milwaukee, Wisc.
Cox & Co., Inc., New York, N.Y.
Gould, Inc., Cleveland, Ohio
Hy-Cal Engrg., Santa Fe Springs, Cal.
Pacific Transducer Corp., Los Angeles, Calif.
Simpson Elec. Co., Chicago, Ill.
Stow Labs., Inc., Hudson, Mass.

Indicators, Torque

Electro-Numerics, Santa Clara, Cal.
Minnetech Labs, Minneapolis, Minn.
West Coast Resch. Corp., Los Angeles, Calif.

Indicators, Vacuum—See Gauges, Vacuum

Indicators, VSWR—See Meters, Standing Wave Ratio

Inductance Comparators—See Bridges, Inductance

Inductance Standards—See Standards, Inductance

Induction Heating Equipment—See Heaters & Accessories, Induction

Induction Potentiometers—See Resolvers, Synchro

Inductors—See Coils

Inks For Thick Film Microcircuits

Alpha Metals, Inc., Jersey City, N.J.
Electro-Science Labs., Pennsauken, N. J.
Epoxy Technology, Watertown, Mass.
Micro-Circuits Co., New Buffalo, Mich.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.

Inks, Marking

Ackerman Gould Co., Inc., Oceanside, N.Y.
Black Light Corp. Amer., San Gabriel, Cal.
Caig Labs., Inc., Westbury, N.Y.
Epoxy Technology, Watertown, Mass.
Esterline Angus Div., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
General Elec., W. Lynn, Mass.
GTI Corp. (E), Pittsburgh, Pa.
Koh-I-Noor Rapidograph, Bloomsbury, N.J.
Lake Chemical Co., Chicago, Ill.
London Chemical Co., Bensenville, Ill.
Markal Co., Chicago, Ill.
Markem Corp., Keene, N.H.
Matthews, Jas & Co., Pittsburgh, Pa.
Meloy Laboratories Inc., Springfield, Va.
Omega Engrg., Inc., Stamford, Conn.
Phillips Process Co., Inc., Rochester, N.Y.
Podgor, Joseph Co., Pennsauken, N.J.
Randolph Prods. Co., Carlstadt, N.J.
Raytheon Co., Quincy, Mass.
Shannon Luminous Mat'ls., Hollywood, Cal.
Sprayon Prods., Inc., Bedford Hgts., Ohio
Tempil Div., So. Plainfield, N.J.
3M Co., St. Paul, Minn.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
Westinghouse Elec., Bloomfield, N. J.

Insertion Loss Measurement Systems

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Alford Mfg. Co., Winchester, Mass.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Emerson & Cuming, Inc., Canton, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Maury Microwave Corp., Cucamonga, Calif.
Narda Microwave Corp., Plainview, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Solar Elctrns. Co., Hollywood, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.
Wide Band Engrg. Co., Phoenix, Ariz.
Wiltron Co., Palo Alto, Calif.

Inserts—See Bushings

Instrument Cases—See Cabinets; Cases, Instrument

Instrument Parts, Precision—See Bearings; Gears; Springs; etc.

Instruments, Elect. Measuring—See Analyzers; Bridges; Comparators; Meters; etc.

Insulating Compounds

Brand Dielectrics, Inc., N. Windham, Conn.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Dixon Corp., Bristol, R.I.
Eastman Chem. Prods., Kingsport, Tenn.
Epoxy Technology, Watertown, Mass.
General Elec. Co., Waterford, N.Y.
Hardman Inc., Belleville, N.J.
National Beryllia Corp., Haskell, N.J.
Pennsylvania Ind'l. Chem. Corp., Clairton, Pa.
SWS Silicones Div., Adrian, Mich.
3M Co., St. Paul, Minn.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Westinghouse Elec., W. Mifflin, Pa.

Insulation Materials

American Lava Corp., Chattanooga, Tenn. Vol 3•1074
Centralab Elctrns Div., Milwaukee, Wisc Vol 3•1075
Columbia Tech., Woodside, N.Y. Vol 3•516,517,1076
Armstrong Cork Co., Lancaster, Pa.
Bird, Richard H. & Co., Inc., Waltham, Mass.
Brand Dielectrics, Inc., N. Windham, Conn.
Cleveland Mica Co., Lakewood, Ohio
Cole-Flex Corp., W. Babylon, N.Y.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Dixon Corp., Bristol, R.I.
Dow Chemical Co., Midland, Mich.
Eastman Chem. Prods., Kingsport, Tenn.
Electro-Science Labs., Pennsauken, N. J.
General Elec. Co., Waterford, N.Y.
Hardman Inc., Belleville, N.J.
Laminated Fabricators, San Bruno, Calif.
Murata Mfg. Co. Ltd., Kyoto, Japan
National Beryllia Corp., Haskell, N.J.
National Tel-Tronics, Meadville, Pa.
NVF Co., Yorklyn, Del.
Penn Fibre & Specialty, Phila., Pa.
Perfection Mica Co., Bensenville, Ill.
Rogers Corp., Rogers, Conn.
Rostone Corp., Lafayette, Ind.
Schjeldahl, G.T. Co., Northfield, Minn.
Schweitzer, Peter J. Div., Lee, Mass.
Spaulding Fibre Co., Inc., Tonawanda, N.Y.
Synthane Taylor Corp., Valley Forge, Pa.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Transcon Mfg. Co., Dallas, Tex.
Union Carbide, Carbon Prods. Div., New York, N.Y.
Union Carbide, Chemicals & Plastics, New York, N.Y.
United Mineral & Chem. Corp., New York, N.Y.
Varflex Corp., Rome, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Westinghouse Elec., W. Mifflin, Pa.
Zippertubing Co., Los Angeles, Calif.

Insulation Parts, Fabricated

Centralab Elctrns Div., Milwaukee, Wisc Vol 3•1075
Columbia Tech., Woodside, N.Y. Vol 3•1076
Atlantic Optical Moulding Co., Dudley, Mass.
Brand Dielectrics, Inc., N. Windham, Conn.
Cleveland Mica Co., Lakewood, Ohio
Cole-Flex Corp., W. Babylon, N.Y.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Concord Elctrns., New York, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Dixon Corp., Bristol, R.I.
Grayhill Inc., LaGrange, Ill.
Laminated Fabricators, San Bruno, Calif.
National Beryllia Corp., Haskell, N.J.
National Tel-Tronics, Meadville, Pa.
NVF Co., Yorklyn, Del.
Penn Fibre & Specialty, Phila., Pa.
Perfection Mica Co., Bensenville, Ill.
Precision Paper Tube Co., Wheeling, Ill.
Quartzite Processing, Inc., Malden, Mass.
Rostone Corp., Lafayette, Ind.
Spaulding Fibre Co., Inc., Tonawanda, N.Y.
Star Porcelain Co., Trenton, N.J.
Stevens Prods., Inc., E. Orange, N.J.
Synthane Taylor Corp., Valley Forge, Pa.
Thermalloy Co., Inc., Dallas, Tex.
3M Co., St. Paul, Minn.
Tran-Tec Corp., Columbus, Neb.
United Mineral & Chem. Corp., New York, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Insulators, Antenna

Accurate Elctrns. Corp., Elyria, Ohio
Alberox Corp., New Bedford, Mass.
American Lava Corp., Chattanooga, Tenn.
Basic Ceramics Inc., Hawthorne, N.J.
Birnbach Co., Inc., Freeport, N.Y.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Johnson E. F. Co., Waseca, Minn.
Lapp Insulator Div., Interpace Corp., LeRoy, N.Y.
Nat'l. Ceramic Co., Trenton, N.J.
Norelcom Inds., Inc., Farmingdale, N.Y.
Phelps Dodge Comm., North Haven, Conn.
Rohn Mfg., Peoria, Ill.
Star Porcelain Co., Trenton, N.J.
Synthane Taylor Corp., Valley Forge, Pa.

Insulators, Bushing (Metallized)—See Bushings

Insulators, Test & Battery Clip

Mueller Elec. Co., Cleveland, Ohio Vol 3•703
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•795
Accurate Elctrns. Corp., Elyria, Ohio
Birnbach Co., Inc., Freeport, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan

Integrated Circuit Packaging Systems

Elctrn. Molding Corp., Woonsocket, R.I. Vol 3•666
Robinson-Nugent, New Albany, Ind. Vol 4•376-380*
Scanbe Mfg. Corp., El Monte, Cal. Vol 3•772,773
Texas Instruments, Attleboro, Mass. Vol 3•925
Amphenol Ind'l. Div., Chicago, Ill.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Augat Inc., Attleboro, Mass.
Berg Electronics, New Cumberland, Pa.
Bivar, Inc., Santa Ana, Cal.
Burndy Corp., Norwalk, Conn.
Christiansen Radio Inc., Laguna Beach, Cal.
Control Data, Westlake Village, Cal.
Coors Porcelain Co., Golden, Colo.
Digitronics Corp., Albertson, N.Y.
Douglas Electronics, Inc., San Leandro, Cal.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
GTI Corp. (E), Pittsburgh, Pa.
IFE Div., E. Providence, R. I.
Ind'l. Control Co., Farmingdale, N.Y.
Kates Scientific Instrs., Inc., Watertown, Mass.
Malco, A Microdot Co., Inc., Chicago, Ill.
Modpak, Waltham, Mass.
National Beryllia Corp., Haskell, N.J.
Schjeldahl, G.T. Co., Northfield, Minn.
Spec Plastics Inc., No. Hollywood, Cal.
Techmar Corp., Los Angeles, Cal.
Tekform Prods. Co., Anaheim, Cal.
Teledyne Mec., Palo Alto, Cal.
Texas Instruments, Attleboro, Mass.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Transcon Mfg. Co., Dallas, Tex.
Uthe Technology Int'l., Sunnyvale, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.
Zippertubing Co., Los Angeles, Calif.

IC's, Active Filters

Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cermetek, Inc., Mountain View, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Integrated Microsystems Inc., Mt. View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Adders, Full, Half, Modulo-2-Also see IC's Arithmetic Logic Units

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., MOS IC Mktg., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Alterable Read-Only Memories—See IC's Memories

IC's, Amplifiers, Audio

Plessey Semiconductors, Farmingdale, N.Y. ..... Vol 2•600,601
Amperex Elctrn., Slatersville, R.I.
Elctrn. Assocs., W. Long Branch, N.J.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Micro Components Corp., Cranston, R.I.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Current

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*

IC's, Amplifiers, Instrumentation

Burr-Brown Resch. Corp., Tucson, Ariz.
Elctrn. Assocs., W. Long Branch, N.J.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Leeds & Northrup Corp., No. Wales, Pa.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
TRW Semiconductors, Lawndale, Cal.

IC's, Amplifiers, Logarithmic

Plessey Semiconductors, Farmingdale, N.Y. ..... Vol 2•600
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
RHG Elctrns. Lab., Deer Park, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Operational

Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Lansdale Transistor & Elctrns., Inc., Lansdale, Pa. ..... Vol 2•907
Precision Monolithics Inc., Santa Clara, Cal. ..... Vol 4•435*
RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
ILC Data Device Corp., Hicksville, N.Y.
Intronics, Inc., Newton, Mass.
Leeds & Northrup Corp., No. Wales, Pa.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Philbrick, Dedham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Amplifiers, Operational, Micropower

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*
Beckman Instrs., Helipot Div., Fullerton, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Leeds & Northrup Corp., No. Wales, Pa.
Lithic Systems, Inc., Cupertino, Cal.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Raytheon, Mt. View, Calif.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Siliconix, Inc., Santa Clara, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Philbrick, Dedham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Amplifiers, Radio-Frequency

Plessey Semiconductors, Farmingdale, N.Y. ..... Vol 2•600
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Micro Components Corp., Cranston, R.I.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nucleonic Prods., Canoga Pk, Cal.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
RHG Elctrns. Lab., Deer Park, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Teledyne Philbrick, Dedham, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
TRW Semiconductors, Lawndale, Cal.

IC's, Amplifiers, Sample-And-Hold—See IC's Sample-And-Hold Circuits

IC's, Amplifiers, Sense-Also see IC's Comparators, Analog

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
ITT Semiconductors, W. Palm Beach, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nucleonic Prods., Canoga Pk, Cal.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Philbrick, Dedham, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, And Gates—See IC's Logic Circuits

IC's, And-Or-Invert Gates—See IC's Logic Circuits

IC's, Arithmetic Logic Units (ALU)-Also see IC's Adders

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*
Cal-Tex Semiconductor, Santa Clara, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Leeds & Northrup Corp., No. Wales, Pa.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Associative Memories—See IC's Memories

IC's, Asynchronous Counters—See IC's Counters

IC's, Bidirectional Counters—See IC's, Counters

IC's, Binary Counters—See IC's Counters

IC's, Bistable Multivibrators—See IC's Multivibrators

IC's, Breadboard Circuits

Christiansen Radio Inc., Laguna Beach, Cal. ..... Vol 2•323
EI Instruments, Derby, Conn.
Lithic Systems, Inc., Cupertino, Cal.
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
Proto Matic Co., Cincinnati,, Ohio
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Buffers—See IC's Logic Circuits

IC's, Bus Drivers—See IC's Data Bus Drivers

IC's, Calculator Kits

Antex Inds., Inc., Palo Alto, Cal.
Cal-Tex Semiconductor, Santa Clara, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.

Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
Intel Corp., Santa Clara, Cal.
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
RCA Solid State Div., Somerville, N. J.
Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Central Processing Units (CPU)

Intel Corp., Santa Clara, Cal.
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Character Generators, Dot-Matrix

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Intel Corp., Santa Clara, Cal.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Precision Dynamics Corp., Burbank, Cal.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Chroma Amplifiers Demodulators, Signal Processors

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Clock Drivers

Electronic Laboratory Supply, Philadelphia, Pa. ..... Vol 2•596
Monitor Prods., S. Pasadena, Cal. Vol 2•430,431
Spectrum Technology, Goleta, Cal. Vol 2•446,447
Amperex Elctrn., Slatersville, R.I.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Cermetek, Inc., Mountain View, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
Integrated Microsystems Inc., Mt. View, Cal.
Intel Corp., Santa Clara, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Siliconix, Inc., Santa Clara, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Code Converters—See IC's Encoders and Decoders

IC's, Communications Circuits

Plessey Semiconductors, Farmingdale, N.Y. ..... Vol 2•600,601
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Integrated Microsystems Inc., Mt. View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Micro Components Corp., Cranston, R.I.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
TRW Semiconductors, Lawndale, Cal.

IC's, Comparators, Analog-Also see IC's Amplifiers Sense

Lansdale Transistor & Elctrns., Inc., Lansdale, Pa. ..... Vol 2•907
Precision Monolithics Inc., Santa Clara, Cal. ..... Vol 4•435*
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Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Siliconix, Inc., Santa Clara, Cal.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Comparators, Digital

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Content-Addressable Memories—See IC's Memories

IC's, Converters, Analog-To-Digital

Hybrid Sys. Corp., Burlington, Mass. Vol 1•346-348
Precision Monolithics Inc., Santa Clara, Cal. ..... Vol 4•435*
Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
National Semiconductor, Santa Clara, Cal.
Ragen Precision Inds., Inc., N. Arlington, N.J.
RCA Solid State Div., Somerville, N. J.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Converters, —See IC's Encoders and Decoders

IC's, Converters, Digital-To-Analog

Burr-Brown Resch. Corp., Tucson, Ariz. Vol 1•328
Hybrid Sys. Corp., Burlington, Mass. Vol 1•346-348
Precision Monolithics Inc., Santa Clara, Cal. ..... Vol 4•435*
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Beckman Instrs., Helipot Div., Fullerton, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
ILC Data Device Corp., Hicksville, N.Y.
Micro Networks, Worcester, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Siliconix, Inc., Santa Clara, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Converters, Voltage-To-Frequency

Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Counters

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. ..... Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. ..... Vol 4•436*
EI Instruments, Derby, Conn.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Solid State Scientific, Montgomeryville, Pa.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Counter Adapters—See IC's Counters

IC's, Current Regulators

Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Integrated Microsystems Inc., Mt. View, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Data Bus Drivers

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, d-c Amplifiers

Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Control Technology Co., L.I.C., N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Decade Counters—See IC's Counters

IC's, Decoders, Binary-To-Octal—See IC's Encoders and Decoders

IC's, Decoder/Drivers, Binary-Code-Decimal (BCD) to Decimal—See IC's Encoder and Decoders

IC's, Decoders, One-of-16—See IC's Encoders and Decoders

IC's, Decoders, Seven-Segment Displays—See IC's Encoders and Decoders

IC's, Demultiplexers—See IC's Multiplexers

IC's, Differential Amplifiers—See IC's Amplifiers, Operational

IC's, digital multiplexers—See IC's Multiplexers, Digital

IC's, Digital-To-Analog Converters—See IC's Converters, Digital-To-Analog

IC's, Diode Matrices

Beckman Instrs., Helipot Div., Fullerton, Cal.
Harris Semiconductor, Melbourne, Fla.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
Solitron Devices, San Diego, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Discriminators, FM—See IC's Television, AM/FM Sound Circuits

IC's, Display Drivers, Seven-Segment, Nine-Segment Nixie, Etc.

Alco Elctrn. Prods., North Andover, Mass.
Antex Inds., Inc., Palo Alto, Cal.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Hybrid Technology Corp., Arlington, Tex.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Signetics. Corp., Sunnyvale, Calif.
Solid State Scientific, Montgomeryville, Pa.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's Down Counters—See IC's Counters

IC's Encoders and Decoders

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4•436*
Solid State Scientific, Montgomeryville, Pa. Vol 2•606
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
Intel Corp., Santa Clara, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's Exclusive Or Gates—See IC's Logic Circuits

IC's Expanders—See IC's Logic Circuits

IC's Flip-Flops J-K, R-S, R-S-T, Type D, Pulse Triggered Etc.—See IC's Logic Circuit

IC's Four-Quadrant Multipliers—See IC's Multipliers Analog

IC's Frequency Dividers—See IC's Counters

IC's Frequency-Shift Keyers

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Integrated Microsystems Inc., Mt. View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.

IC's, Frequency Synthesizers

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
ITT Semiconductors, W. Palm Beach, Fla.
Lithic Systems, Inc., Cupertino, Cal.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Function Generators

Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
ILC Data Device Corp., Hicksville, N.Y.
Lithic Systems, Inc., Cupertino, Cal.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Gates—See IC's Logic Circuits

IC's, Hexadecimal Counters—See IC's Counters

IC's, Intermediate-Frequency Amplifiers—See IC's Amplifiers, Radio Frequency

IC's, Inverters—See IC's Logic Circuits

IC's, Keyboard Encoders—See Encoders and Decoders

IC's Lamp Drivers—See IC's Logic Circuits

IC's Latch—See IC's Logic Circuits

IC's, Level Shifters, Translators—See IC's Logic Circuits

IC's Line Driver/Receivers

Cermetek, Inc., Mountain View, Cal.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
ILC Data Device Corp., Hicksville, N.Y.
Integrated Microsystems Inc., Mt. View, Cal.
Intel Corp., Santa Clara, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Siliconix, Inc., Santa Clara, Cal.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Line Driver/Transmitters—See IC's Line Driver/Receivers

IC's Linear Multipliers—See IC's Multipliers Analog

IC's Logic Circuits

Electronic Laboratory Supply, Philadelphia, Pa. Vol 2•596
Plessey Semiconductors, Farmingdale, N.Y. Vol 2•601-603
Solid State Scientific, Montgomeryville, Pa. Vol 2•606
EI Instruments, Derby, Conn.
ILC Data Device Corp., Hicksville, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Look-Up Sine, Cosine Table Memories—See IC's Memories

IC's, MOS Clock Drivers—See IC's Clock Drivers

IC's Memories

Electronic Laboratory Supply, Philadelphia, Pa. Vol 2•596
Plessey Semiconductors, Farmingdale, N.Y. Vol 2•604
RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4•436*
Solid State Scientific, Montgomeryville, Pa. Vol 2•606
Advanced Memory Systems, Inc., Sunnyvale, Cal
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Intel Corp., Santa Clara, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Micropower Operational Amplifiers—See IC's Amplifiers Operational, Micropower

IC's, Mixers—See IC's Communications Circuits

IC's, Modulator/Demodulators, Balanced

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Integrated Microsystems Inc., Mt. View, Cal.
Lithic Systems, Inc., Cupertino, Cal.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multiplexers, Analog

Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
ITT Semiconductors, W. Palm Beach, Fla.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
Ragen Precision Inds., Inc., N. Arlington, N.J.
RCA Solid State Div., MOS IC Mktg., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Siliconix, Inc., Santa Clara, Cal.
Solid State Scientific, Montgomeryville, Pa.
Solitron Devices, San Diego, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multiplexers, Digital

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. .... Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4•436*
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multipliers, Analog

Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Intronics, Inc., Newton, Mass.
Leeds & Northrup Corp., No. Wales, Pa.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Silicon Gen'l. Inc., Westminster, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Multivibrators

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, NAND Gates—See IC's Logic Circuits

IC's, NOR Gates—See IC's Logic Circuits

IC's, One-Shot Multivibrators —See IC's Multivibrators

IC's, Opto-Electronic Amplifiers

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
RCA Solid State Div., Somerville, N. J.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, OR/NOR Gates—See IC's Logic Circuits

IC's, Oscillators

Monitor Prods., S. Pasadena, Cal. Vol 2•430,431
Spectrum Technology, Goleta, Cal. Vol 2•446,447
Vectron Labs., Inc., Norwalk, Conn. Vol 2•455
Burr-Brown Resch. Corp., Tucson, Ariz.
Connor-Winfield Corp., West Chicago, Ill.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Parity Generator/Checkers

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Solitron Devices, San Diego, Cal.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Phase Lock Loop Circuits

Plessey Semiconductors, Farmingdale, N.Y. Vol 2•601
Control Technology Co., L.I.C., N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Raytheon, Mt. View, Calif.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Power Amplifiers (1 W Minimum)

Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Control Technology Co., L.I.C., N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Lithic Systems, Inc., Cupertino, Cal.
Micro Components Corp., Cranston, R.I.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Power Gates—See IC's Logic Circuits

IC's, Programmable Operational Amplifiers—See IC's, Amplifiers, Operational

IC's, Programmable Read-Only Memories—See IC's Memories

IC's Programmable Read-Write Memories—See IC's Memories

IC's, Pulse Shapers—See IC's Multivibrators

IC's, Random-Access Memories—IC's Memories

IC's, Read-Mostly Memories—See IC's Memories

IC's, Read-Only Memories—See IC's Memories

IC's, Read-Write Memories—See IC's Memories

IC's Receiver/Transmitter, Asynchronous

General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
RHG Elctrns. Lab., Deer Park, N.Y.
Sperry Elctrn. Tube, Gainesville, Fla.

IC's, Recievers, AM, FM

HRB-Singer, Inc., State College, Pa.
Lithic Systems, Inc., Cupertino, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
RCA Solid State Div., Somerville, N. J.
RHG Elctrns. Lab., Deer Park, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's Receivers, Teletype

Cermetek, Inc., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.

IC's, Relay Drivers—See IC's Logic Circuits

IC's, Sample-And-Hold Circuits

Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
ILC Data Device Corp., Hicksville, N.Y.
National Semiconductor, Santa Clara, Cal.
RCA Solid State Div., Somerville, N. J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Schmitt Triggers—See IC's Logic Circuits

IC's, Shift Registers, Static or Dynamic

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4•436*
Solid State Scientific, Montgomeryville, Pa. Vol 2•606
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Microelectronics Div., Hicksville, N.Y.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
Intel Corp., Santa Clara, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Mostek Corp., Carrollton, Tex.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Plessey Semiconductors, Farmingdale, N.Y.
Raytheon, Mt. View, Calif.
Signetics. Corp., Sunnyvale, Calif.
Siliconix, Inc., Santa Clara, Cal.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Stewart-Warner Microcircuits, Div., Sunnyvale, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.

IC's, Single-Shot Multivibrators—See IC's Multivibrators

IC's, Subtractors—See IC's Logic Circuits

IC's, Switches, Analog

Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
Harris Semiconductor, Melbourne, Fla.
Hughes Aircraft Co., MOS Dept. (E3/4) Microelectronic Prods. Div., Newport Beach, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Solid State Div., Somerville, N. J.
Siliconix, Inc., Santa Clara, Cal.
Solid State Scientific, Montgomeryville, Pa.
Solitron Devices, San Diego, Cal.
Sprague Elec. Co., No. Adams, Mass.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Synchronous Counters—See IC's Counters

IC's, Television, AM/FM Sound Circuits

Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
ITT Semiconductors, W. Palm Beach, Fla.
Lithic Systems, Inc., Cupertino, Cal.
Micro Components Corp., Cranston, R.I.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nippon Electric/NEC America, N.Y., N.Y.
Nucleonic Prods., Canoga Pk, Cal.
Plessey Semiconductors, Farmingdale, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RCA Solid State Div., Somerville, N. J.
Signetics. Corp., Sunnyvale, Calif.
Sprague Elec. Co., No. Adams, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

IC's, Three-State Logic (TSL)

Motorola Semiconductor Prods., Phoenix, Ariz.

IC's, Transconductance Operational Amplifiers—See IC's, Amplifiers, Operational

IC's, Transistor Arrays

Siliconix, Inc., Santa Clara, Cal.
Sprague Elec. Co., No. Adams, Mass.

IC's, Translators, ECL to TTL, ECL to MOS, etc.

Motorola Semiconductor Prods., Phoenix, Ariz.

IC's, Transmitters, Teletype

Cermetek, Inc., Mountain View, Cal.

IC's, Up Counters—See IC's Counters

IC's, Video Amplifiers—See IC's, Amplifiers, Radio-Frequency

IC's, Voltage-Controlled Oscillators—See IC's Oscillators

IC's, Voltage Regulators

RCA Solid State Div., Somerville, N. J. Vol 4•436*
RCA Solid State Div., MOS IC Mktg., Somerville, N. J. Vol 4•436*
RCA Solid State Div., Linear Integrated Circuits, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Packaged Circuit Functions, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Thyristors & Rectifiers, Somerville, N. J. Vol 4•436*
RCA Solid State Div., Transistors, Somerville, N. J. Vol 4•436*
Advanced Energy Conversion, Belmont, Cal.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
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Bowmar/ALI, Inc., Acton, Mass.
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Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
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Lenox Instr. Co., Philadelphia, Pa.
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Microwave Assocs., Inc., Burlington, Mass.
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Premier Microwave, Port Chester, N.Y.
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RCA Elctrns. Comps., Harrison, N.J.
Special Microwave Devices Oper., Waltham, Mass.
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Bud Radio, Willoughby, Ohio
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Zippertubing Co., Los Angeles, Calif.

Kits, Potentiometer, Rheostat
Dale Elctrns., Inc., Yankton, S.D.
New England Instr., Natick, Mass.
Ohmite Mfg. Co., Skokie, Ill.

Kits, Power Supply
Tecnetics, Inc., Boulder, Colo. Vol 1•896
Tele-Dynamics/Wanlass, Fort Washington, Pa. ..... Vol 1•901
BECO, Inc., Salem, Va.
BF Elctrns., Solana Beach, Calif.
E-Tronics, Sepulveda, Cal.
EI Instruments, Derby, Conn.
Heath Co., Benton Harbor, Mich.
Lambda Elctrns., Melville, N.Y.
Opad Elec. Co., Inc., New York, N.Y.
POWERTEC INC., Chatsworth, Cal.
Universal Elctrns. Co., Irvine, Cal.

Kits, Printed Circuit
Augat Inc., Attleboro, Mass.
BECO, Inc., Salem, Va.
Bishop Graphics, No. Hollywood, Cal.
Cambridge Thermionic, Cambridge, Mass
Centron Engrg., Torrance, Cal.
Christiansen Radio Inc., Laguna Beach, Cal.
Circuit-Stik, Inc., Torrance, Cal.
Cordover, Carl & Co., Mineola, N.Y.
Douglas Electronics, Inc., San Leandro, Cal.
Electro-Science Labs., Pennsauken, N. J.
ESE, Inglewood, Cal.
GC Electronics, Rockford, Ill.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Keystone Elctrns. Corp., New York, N.Y.
Micro-Circuits Co., New Buffalo, Mich.
Scanbe Mfg. Corp., El Monte, Cal.
Techinques, Inc., Englewood, N.J.
3M Co., St. Paul, Minn.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.

Kits, Programming Board
LVC Inds. Inc., Flushing, N.Y. Vol 2•1046
EI Instruments, Derby, Conn.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Kits, Shielding
Ferronics, Inc., Fairport, N.Y. Vol 3•1009
Estes Engrg. Co., Gardena, Calif.
LectroMagnetics, Inc., Los Angeles, Cal.
Modpak, Waltham, Mass.
Russell Inds., Inc., Lynbrook, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Kits, Switch Assembling
Chicago Switch, Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Grayhill Inc., LaGrange, Ill.
International Electro Exchange Corp., Eden Prairie, Minn.
Jonard Inds. Corp., Bronx, N.Y.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Key Tronic Corp., Spokane, Wash.
Seacor, Inc., Norwood, N.J.

Kits, Terminal
Vaco Prods. Co., Chicago, Ill. .. Vol 3•953
Accurate Elctrns. Corp., Elyria, Ohio
Amp Inc., Harrisburg, Pa.
Augat Inc., Attleboro, Mass.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Circon Corp., Santa Barbara, Ca.
Communications Technology Corp., Los Angeles, Cal.
Hoffman Engrg. Co., Anoka, Minn.
Hollingsworth Solderless Terminal, Phoenixville, Pa.
Ico/Rally, Palo Alto, Cal.
Keystone Elctrns. Corp., New York, N.Y.
Magnum Elec. Corp., Erie, Mich.
Smith, Herman H., Inc., Bklyn., N.Y.
Thomas & Betts Co., Elizabeth, N.J.
3M Co., St. Paul, Minn.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Waldom Elctrns., Inc., Chicago, Ill.

Kits, Test Equipment
ESE, Inglewood, Cal. ..... Vol 2•337
BECO, Inc., Salem, Va.
Digitech Data Inds., Inc., Ridgefield, Conn.
EI Instruments, Derby, Conn.
GC Electronics, Rockford, Ill.
Heath Co., Benton Harbor, Mich.
Jonard Inds. Corp., Bronx, N.Y.

Keystone Elctrns. Corp., New York, N.Y.
Logiconcepts Inc., Los Alamitos, Cal.
Magnaflux Corp., Chicago, Ill.
Microlab/FXR, Livingston, N.J.
Modpak, Waltham, Mass.
Multicore Sales Corp., Westbury, N.Y.
Schauer Mfg. Corp., Cincinnati, Ohio
Shannon Luminous Mat'ls., Hollywood, Cal.
Tech Serv., Inc., Fogelsville, Pa.
Telonic Inds., Inc., Laguna Beach, Calif.
Triplett Corp., Bluffton, Ohio
Vector Elctrn. Co., Inc., Sylmar, Cal.

Kits, Training Aid

Allied Elctrns., Chicago, Ill.
AMF Electical Prods., Alexandria, Va.
Arra Inc., Bay Shore, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Chartpak, Leeds, Mass.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Digiac Corp., Plainview, N.Y.
Digital Equip. Corp., Maynard, Mass.
EI Instruments, Derby, Conn.
Heath Co., Benton Harbor, Mich.
Logiconcepts Inc., Los Alamitos, Cal.
Microlab/FXR, Livingston, N.J.
PIC Design Division, Ridgefield,, Conn.
PRD Elctrns., Inc., Westbury, N.Y.
Rank Precision Inds., Des Plaines, Ill.
RCA Elctrns. Comps., Harrison, N.J.
Scientific Measurements, Wilmette, Ill.
Smith, Herman H., Inc., Bklyn., N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Worner Elctrn. Devices, Rankin, Ill.

Kits, Transistor Mounting—See Pads, Transistor Mounting

Knives & Knife Sets

Channellock, Inc., Meadville, Pa. Vol 3•1235
American Safety Razor, Staunton, Va
Chartpak, Leeds, Mass.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
General Hardware Mfg. Co., New York, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Techni-Tool, Inc., Philadelphia, Pa.
Uber Grafic Instrs., Palo Alto, Calif.
X-Acto, Long Island City, N.Y.
Xcelite, Inc., Orchard Park, N.Y.

Knobs

Alco Elctrn. Prods., North Andover, Mass. Vol 2•456-458,460
Electronic Hardware Corp., Jamaica, N.Y. Vol 2•489
Millen, James Mfg., Malden, Mass. Vol 2•521
NOBEX Div., Burlingame, Cal. Vol 2•502,503
Radial Controls Div. Nicely Corp., Indianapolis, Ind. Vol 2•524
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•824
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Aerospace Knob Co., So. El Monte, Calif.
Allied Elctrns., Chicago, Ill.
Birnbach Co., Inc., Freeport, N.Y.
Buckeye Stamping Co., Columbus, Ohio
Cambridge Thermionic, Cambridge, Mass
Control Inds. Inc., Inwood, N.Y.
Davies, Harry Molding Co., Chicago, Ill.
Dimco-Gray Co., Dayton, Ohio
Ind'l. Devices, Edgewater, N.J.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Kurz-Kasch Incorporated, Dayton, Ohio
Millen, James Mfg., Malden, Mass.
Norelcom Inds., Inc., Farmingdale, N.Y.
Paul, F.H. & Stein Bros., New York, N.Y.
PIC Design Division, Ridgefield,, Conn.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
Rostone Corp., Lafayette, Ind.
Russell Inds., Inc., Lynbrook, N.Y.
Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Stake Fastener Co., S. El Monte, Calif.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Vemaline Prods. Co., Wyckoff, N.J.
Waldom Elctrns., Inc., Chicago, Ill.
Western Indicator Co., So. El Monte, Cal.
Westmoreland Plastics Co., Latrobe, Pa.

Klystron, Tubes—See Tubes, Klystron

Labels, Pressure-Sensitive, Adhesive

Datak Corp., Passaic, N.J. Vol 2•479
Display Devices, Inc., Encinitas, Cal. Vol 2•485
Acme Model Engrg. Co., Ridgefield, N.J.
Althor Prods., Brooklyn, N.Y.
Bishop Graphics, No. Hollywood, Cal.
Brady, W.H. Co., Milwaukee, Wisc.
Decalcraft Corp., Hatfield, Pa.
K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan
Labelon Corp., Canandaigua, N.Y.
Manger Elec. Co., Inc., Stamford, Conn.
Meyercord Co., Wheaton, Ill.
Monarch Marking Sys., Dayton, Ohio
Photo Chemical Prods. Cal., Santa Monica, Cal.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
Tapecon, Inc., Rochester, N.Y.
Thomas & Betts Co., Elizabeth, N.J.
3M Co., St. Paul, Minn.
Topflight Corp., York, Pa.
Uniroyal, Inc., New York, N.Y.

Labels, Temperature Indicating

Brady, W.H. Co., Milwaukee, Wisc.
Camwil, Inc., Honolulu, Haw.
Omega Engrg., Inc., Stamford, Conn.
Tempil Div., So. Plainfield, N.J.

Laboratories, Testing—See Services, Electrical Measurement; Services Environmental Testing

Laboratory Furniture—See Benches, Consoles, Stools, Tables (Lab and Shop)

Lacing, Cable—See Cords & Tapes, Lacing

Laminates, Metal Clad

Display Devices, Inc., Encinitas, Cal. Vol 2•485
Mica Corporation, Culver City, Calif. Vol 4•495*
Alpha Metals, Inc., Jersey City, N.J.
Burlington Opers. Div., Burlington, Mass.
Cadilac Plastics & Chems., Detroit, Mich.
Central Plastics Dists., Chicago, Ill.
Cincinnati Dev. & Mfg. Co., Cincinnati, Ohio
Devco Engrg., W. Caldwell, N.J.
Dixon Corp., Bristol, R.I.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Fansteel Inc., N Chicago, Ill.
General Elec., Coshocton, Ohio
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Keystone Elctrns. Corp., New York, N.Y.
Laminated Shim Co., Inc., Glenbrook, Conn.
New England Laminates Co., Inc., Glenbrook, Conn.
Norplex Div. UOP, LaCrosse, Wisc.
NVF Co., Yorklyn, Del.
Penn Fibre & Specialty, Phila., Pa.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Rogers Corp., Rogers, Conn.
Schjeldahl, G.T. Co., Northfield, Minn.
Stevens Prods., Inc., E. Orange, N.J.
Synthane Taylor Corp., Valley Forge, Pa.
Tapecon, Inc., Rochester, N.Y.
Thiokol Chemical Div., Trenton, N.J.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Westinghouse Elec., W. Mifflin, Pa.
Whittaker Corp., Los Angeles, Cal.
Zero Mfg. Co., Burbank, Cal.

Laminates, Plastic Impregnated (Unclad)

Cadilac Plastics & Chems., Detroit, Mich.
Central Plastics Dists., Chicago, Ill.
Cincinnati Dev. & Mfg. Co., Cincinnati, Ohio
Comco Plastics, Inc., Richmond Hill, N.Y.
Fansteel Inc., N Chicago, Ill.
General Elec., Coshocton, Ohio
Glastic Corp., Cleveland, Ohio
Haysite Div., Erie, Pa.
Keystone Elctrns. Corp., New York, N.Y.
Laminated Fabricators, San Bruno, Calif.
Mica Corporation, Culver City, Calif.
Natvar Corp., Rahway, N.J.
New England Laminates Co., Inc., Glenbrook, Conn.
Norplex Div. UOP, LaCrosse, Wisc.
NVF Co., Yorklyn, Del.
Penn Fibre & Specialty, Phila., Pa.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Precision Paper Tube Co., Wheeling, Ill.
Rogers Corp., Rogers, Conn.
Schjeldahl, G.T. Co., Northfield, Minn.
Spaulding Fibre Co., Inc., Tonawanda, N.Y.
Stevens Prods., Inc., E. Orange, N.J.
Synthane Taylor Corp., Valley Forge, Pa.
Thiokol Chemical Div., Trenton, N.J.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Triac Elctrn. Sys., Forest Hills, N. Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Westinghouse Elec., W. Mifflin, Pa.
Whittaker Corp., Los Angeles, Cal.

Laminates, Plastic (With Integral Heating Elements)

Cox & Co., Inc., New York, N.Y.
Rogers Corp., Rogers, Conn.
Synthane Taylor Corp., Valley Forge, Pa.
Triac Elctrn. Sys., Forest Hills, N. Y.

Laminations, Magnetic Recording Head

SGL Inds., Inc., Westville, N.J. Vol 3•1038
Buckbee-Mears Co., St. Paul, Minn.
Hamilton Technology, Inc., Lancaster, Pa.
Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y.

Laminations, Transformer & Inductor

Arnold Engineering Co., Marengo, Ill. Vol 3•1005
SGL Inds., Inc., Westville, N.J. Vol 3•1038
Allegheny Ludlum Steel Co., Pittsburgh, Pa.
Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y.
Laminated Shim Co., Inc., Glenbrook, Conn.
Magnetic Metals Co., Camden, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Thomas & Skinner, Inc., Indianapolis, Ind.

Lamp Adapters

Display Devices, Inc., Encinitas, Cal. Vol 2•484
Arcolectric Switch Corp., No. Hollywood, Cal.
Dialight Corp., Brooklyn, N.Y.
Elctrn. Molding Corp., Woonsocket, R.I.
GTE Sylvania Inc., Danvers, Mass.
Int'l. Prods., Atchison, Kans.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Sloan Co., Sun Valley, Cal.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Lamp Drivers

Beckman Instrs., Helipot Div., Fullerton, Cal.
Cermetek, Inc., Mountain View, Cal.
Data Display Products, Los Angeles, Cal.
Electro-Module, Inc., Pomona, Cal.
GRM Corp., Medford, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Devices, Edgewater, N.J.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Ledex, Inc., Dayton, Ohio
Lithic Systems, Inc., Cupertino, Cal.
Luminator Div., Plano, Tex.
TEC, Inc., Tucson, Ariz.

Lamp Holders—See Sockets, Lamp & Lamp Assemblies

Lamp Pullers—See Pullers, Lamp

Lamps, Dial & Pilot, Incandescent

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Circon Corp., Santa Barbara, Ca.
Clare-Pendar Co., Post Falls, Idaho
Control Switch, Inc., Folcroft, Pa.
Devco Engrg., W. Caldwell, N.J.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
GTE Sylvania Inc., Danvers, Mass.
Info-Lite Corp., Corona, N.Y.
Int'l. Prods., Atchison, Kans.
Lear Siegler, Grand Rapids, Mich.
Ledex, Inc., Dayton, Ohio
Licon Div., Chicago, Ill.
Mura Corp., Jericho, N.Y.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Penn Keystone Corp., Ansonia, Conn.
Pinlites, Fairfield, N.J.
Precision Dynamics Corp., Burbank, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Vemaline Prods. Co., Wyckoff, N.J.
Westinghouse Elec., Bloomfield, N. J.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Lamps, Electroluminescent—See Panels, Electroluminescent

Lamps, Exciter, Photographic

Christie Elec., Los Angeles, Cal.
EG & G, Inc., Salem, Mass.
GTE Sylvania Inc., Danvers, Mass.
GTE Sylvania Inc., Danvers, Mass.
Hamamatsu Corp. (E), Middlesex, N. J.
Lamps, Inc., Torrance, Cal.
Shigoto Inds., Ltd., New York, N.Y.

Torr Labs., Los Angeles, Cal.
Westinghouse Elec., Bloomfield, N. J.
Xenon Corp., Medford, Mass.

Lamps, Flashtube

General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio Vol 2•490
Apollo Corp., Shinagawa-Ku, Tokyo, Japan
Edmund Scientific Co., Barrington, N.J.
EG & G, Inc., Salem, Mass.
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GTE Sylvania Inc., Danvers, Mass.
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Illumination Inds., Inc., Sunnyvale, Cal.
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Mura Corp., Jericho, N.Y.
Torr Labs., Los Angeles, Cal.
U.S. Scientific Instrs., Watertown, Mass.
Voltarc Tubes, Fairfield, Conn.
West Coast Resch. Corp., Los Angeles, Calif.
Xenon Corp., Medford, Mass.

Lamps, Glow—See Lamps, Neon

Lamps, Infrared

Advanced Kinetics, Costa Mesa, Calif.
Caig Labs., Inc., Westbury, N.Y.
Casso-Solar Inc., Kew Gardens, N.Y.
Chicago Miniature Lamp Works, Chicago, Ill.
Christie Elec., Los Angeles, Cal.
Eimac, San Carlos, Calif.
Gamma Sci., San Diego, Cal.
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Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
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Scientific Technology, Mountain View, Cal.
Skan-A-Matic Corp., Elbridge, N. Y.
TRW Instrs., El Segundo, Cal.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Western Coil & Elec. Co., Racine, Wisc.
Westinghouse Elec., Bloomfield, N. J.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Lamps, Magnifying, Inspection

Allied Elctrns., Chicago, Ill.
Chemical Etching Equip. & Supply, Alexandria, Va.
New Era Products, Cleveland, Ohio

Lamps, Mercury Vapor

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Black Light Corp. Amer., San Gabriel, Cal.
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Edmund Scientific Co., Barrington, N.J.
Epic, Inc., New York, N.Y.
Fusion Systems Corp., Rockville, Md.
Gaertner Scientific Corp., Chicago, Ill.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
GTE Sylvania Inc., Danvers, Mass.
Ionics, Inc., Watertown, Mass
Kemlite Labs., Inc., Chicago, Ill.
Oriel Corp. of America, Stamford, Conn.
Shannon Luminous Mat'ls., Hollywood, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Thermal Amer. Fused Quartz, Montville, N.J.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
Voltarc Tubes, Fairfield, Conn.
Westinghouse Elec., Bloomfield, N. J.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Lamps, Miniature & Subminiature

Alco Elctrn. Prods., North Andover, Mass. Vol 2•459,460
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Mura Corp., Jericho, N.Y.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Pinlites, Fairfield, N.J.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Ray-O-Vac Div., Madison, Wisc.
Shigoto Inds., Ltd., New York, N.Y.
Skan-A-Matic Corp., Elbridge, N. Y.
Techni-Tool, Inc., Philadelphia, Pa.
Titan Tool Supply Co., Inc., Buffalo, N.Y.
Union Carbide, Consumer Prods., New York, N.Y.
Vemaline Prods. Co., Wyckoff, N.J.
Welch Allyn, Inc., Skaneateles Falls, N.Y.
Western Indicator Co., So. El Monte, Cal.
Westinghouse Elec., Bloomfield, N. J.

Lamps, Neon

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Black Light Corp. Amer., San Gabriel, Cal.
Chicago Miniature Lamp Works, Chicago, Ill.
Circon Corp., Santa Barbara, Ca.
Int'l. Prods., Atchison, Kans.
Kemlite Labs., Inc., Chicago, Ill.
Lamps, Inc., Torrance, Cal.
Ledex, Inc., Dayton, Ohio
Licon Div., Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Marco-Oak, Anaheim, Cal.
Master Specialties, Costa Mesa, Cal.
Mura Corp., Jericho, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Sloan Co., Sun Valley, Cal.
Vemaline Prods. Co., Wyckoff, N.J.
Voltarc Tubes, Fairfield, Conn.

Lamps, Projection

Christie Elec., Los Angeles, Cal.
Drake Mfg., Harwood Hgts., Ill.
Edmund Scientific Co., Barrington, N.J.
Eimac, San Carlos, Calif.
GTE Sylvania Inc., Danvers, Mass.
GTE Sylvania Inc., Danvers, Mass.
Illumination Inds., Inc., Sunnyvale, Cal.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
ITT Electron Tube, Easton, Pa.
Shigoto Inds., Ltd., New York, N.Y.
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Lamps, Solid State-Also see Diodes, Light-Emitting

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Ind'l Elctrn. Engrs., Van Nuys, Cal.
Inter-Market, Inc., Glenview, Ill.
Lamps, Inc., Torrance, Cal.
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
Licon Div., Chicago, Ill.
LVC Inds. Inc., Flushing, N.Y.
National Semiconductor, Santa Clara, Cal.
OPCOA, Inc., Edison, N.J.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Scientific Technology, Mountain View, Cal.
Sensor Technology, Chatsworth, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Spectronics, Inc., Richardson, Tex.
Texas Instruments, Dallas, Tex.

Lamps, Stroboscopic

General Radio Co., Concord, Mass.
Heimann GmbH, Mt. Vernon, N.Y.
Illumination Inds., Inc., Sunnyvale, Cal.
Voltarc Tubes, Fairfield, Conn.

Lamps, Tungsten Halogen

Hamamatsu Corp. (E), Middlesex, N. J. Vol 2•1186
Lamps, Inc., Torrance, Cal. Vol 2•514,515
Edmund Scientific Co., Barrington, N.J.
Gamma Sci., San Diego, Cal.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
GTE Sylvania Inc., Danvers, Mass.
GTE Sylvania Inc., Danvers, Mass.
Oriel Corp. of America, Stamford, Conn.
Shigoto Inds., Ltd., New York, N.Y.
Welch Allyn, Inc., Skaneateles Falls, N.Y.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Lamps, Ultraviolet

Hamamatsu Corp. (E), Middlesex, N. J. Vol 2•1186
Illumination Inds., Inc., Sunnyvale, Cal. Vol 2•682
Christie Elec., Los Angeles, Cal.
Fusion Systems Corp., Rockville, Md.
Gaertner Scientific Corp., Chicago, Ill.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Heath Co., Benton Harbor, Mich.
Oriel Corp. of America, Stamford, Conn.
Shannon Luminous Mat'ls., Hollywood, Cal.
Voltarc Tubes, Fairfield, Conn.
Western Coil & Elec. Co., Racine, Wisc.
Wild Heerbrugg Instrs., Farmingdale, N.Y.
Xenon Corp., Medford, Mass.

Lamps, Xenon

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Atlas Electric Devices, Chicago, Ill.
Chemical Etching Equip. & Supply, Alexandria, Va.
EG&G, Inc., Bedford, Mass.
Eimac, San Carlos, Calif.
Fusion Systems Corp., Rockville, Md.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
GTE Sylvania Inc., Danvers, Mass.
Ionics, Inc., Watertown, Mass
Mann, David W. Co., Burlington, Mass.
Mura Corp., Jericho, N.Y.
Oriel Corp. of America, Stamford, Conn.
Shigoto Inds., Ltd., New York, N.Y.
U.S. Scientific Instrs., Watertown, Mass.
Varian Assocs., Palo Alto, Cal.
Voltarc Tubes, Fairfield, Conn.
Wild Heerbrugg Instrs., Farmingdale, N.Y.
Xenon Corp., Medford, Mass.

Laser Energy Monitors—See Monitors, Laser Energy

Laser Q Switches

Display Devices, Inc., Encinitas, Cal. Vol 2•484
Advanced Kinetics, Costa Mesa, Calif.
Andersen Labs. Inc., Bloomfield, Conn.
Datalight Inc., Bloomfield, Conn.
General Scanning, Watertown, Mass.
Gould Labs., Cleveland, Ohio
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hadron Inc., Westbury, N.Y.
Kappa Scientific Corp., Santa Barbara, Cal.
Lasermetrics, Inc., Rochelle Park, N.J.
Maxwell Labs., Inc., San Diego, Calif.
Optics International, Tenafly, N.J.
Raytheon Co., Waltham, Mass.
Union Carbide, San Diego, Cal.
Valpey Corp., Holliston, Mass.

Lasers, Gas

Nippon Electric/NEC America, N.Y., N.Y. Vol 2•523
Advanced Kinetics, Costa Mesa, Calif.
Bausch & Lomb, Rochester, N.Y.
Edmund Scientific Co., Barrington, N.J.
Gaertner Scientific Corp., Chicago, Ill.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hadron Inc., Westbury, N.Y.
Honeywell, Minneapolis, Minn.
Maxwell Labs., Inc., San Diego, Calif.
Molectron Corp., Sunnyvale, Cal.
Optics Technology, Palo Alto, Calif.
Raytheon Co., Waltham, Mass.
R.C.A. Aerospace Sys. Div., Burlington, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Spectra-Physics, Inc., Mountain View, Calif.
Thermal Amer. Fused Quartz, Montville, N.J.
TRW Instrs., El Segundo, Cal.
Union Carbide, San Diego, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Lead Assemblies & Receptacles, High Voltage-Also See Connectors; Cable Assemblies

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Rowe Inds., Div., Toledo, Ohio Vol 3•770,771
Accurate Elctrns. Corp., Elyria, Ohio
Amp Inc., Harrisburg, Pa.
Amphenol Connector Div., Broadview, Ill.
Beman Mfg., Inc., New Cumberland, Pa.

Ceramaseal, Inc., New Lebanon Center, N.Y.
Co-Operative Inds., Inc., Chester, N.J.
De Soto Elec. Prods., De Soto, Mo.
Dearborn Wire & Cable Co., Rosemont, Ill.
Dielectric Sciences, Burlington, Mass
Electronic Coil Corp., Plainville, Conn.
Estes Engrg. Co., Gardena, Calif.
Excel Specialty Corp., Chicago, Ill.
General Lab. Assocs., Norwich, N.Y.
Gore, W.L. & Assocs., Inc., Newark, Del.
Hermetic Seal Corp., Rosemead, Cal.
Jettron Prods., Hanover, N.J.
Lynn Elctrns. Corp., Feasterville, Pa.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Paraplegics Mfg., Bensenville, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Reynolds Inds., Inc., Marina Del Rey, Cal.
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Wireflex Inc., Calumet City, Ill.

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AGFA-Gevaert, Inc., Teterboro, N.J.
Amersil, Inc., Hillside, N.J.
Bausch & Lomb, Rochester, N.Y.
Bishop Graphics, No. Hollywood, Cal.
CAI Div. Bourns Inc., Barrington, Ill.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Concord Communications Sys., Farmingdale, N.Y.
Cosmicar Optical Co., Ltd., Nerima-Ku, Tokyo, Japan
Edmund Scientific Co., Barrington, N.J.
Esco Products, Oak Ridge, NJ
Fairchild Space & Defense Sys., Syosset, N.Y.
Gaertner Scientific Corp., Chicago, Ill.
General Electrodynamics Corp., Garland, Tex.
General Hardware Mfg. Co., New York, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Heitz, Karl, Inc., New York, N.Y.
Heliotek, Sylmar, Calif.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
Kollsman Instr. Co., Syosset, N.Y.
Lenox Instr. Co., Philadelphia, Pa.
Olympus Corp. America, New Hyde Park, N.Y.
Optics International, Tenafly, N.J.
Opto-Metric Tools, Rockleigh, N.J.
Oriel Corp. of America, Stamford, Conn.
Perkin-Elmer Corp., Instr. Div., Norwalk, Conn.
Rank Precision Inds., Des Plaines, Ill.
RCA Corp., Camden, N.J.
Santa Barbara Resch. Ctr., Goleta, Calif.
Shigoto Inds., Ltd., New York, N.Y.
Singer Co., Glendale, Cal.
Statek Corp., Orange, Cal.
Stereotronics Television Co., Sherman Oaks, Cal.
Valpey Corp., Holliston, Mass.
Whittaker Corp., Los Angeles, Cal.
Zoomar, Inc., Glen Cove, N.Y.

Lenses, R-F

Emerson & Cuming, Inc., Canton, Mass.
Simpson Elec. Co., Chicago, Ill.
Teledyne Micronetics, San Diego, Calif.
Valpey Corp., Holliston, Mass.

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Cinefot International Corp., New York, N.Y.
Dialight Corp., Brooklyn, N.Y.
Drake Mfg., Harwood Hgts., Ill.
Edmund Scientific Co., Barrington, N.J.
Esco Products, Oak Ridge, NJ
General Electrodynamics Corp., Garland, Tex.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
Kollsman Instr. Co., Syosset, N.Y.
Lenox Instr. Co., Philadelphia, Pa.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Stereotronics Television Co., Sherman Oaks, Cal.
Tekform Prods. Co., Anaheim, Cal.

Light Sources, Isotope Excited—See Sources, Light

Lighting Equipment, Emergency

ATR Elctrns., Inc., St. Paul, Minn.
Kidde, Walter & Co., Belleville, N.J.
New Era Products, Cleveland, Ohio
North Electric Co., Galion, Ohio
Power Inc., Burnsville, Minn.
Precision Dynamics Corp., Burbank, Cal.
Ratelco, Inc., Seattle, Wash.
Titan Tool Supply Co., Inc., Buffalo, N.Y.
Tri-Ex Tower Corp., Visalia, Calif.
Utah Elctrns., Huntington, Ind.
Whittaker Corp., Los Angeles, Cal.

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Lights, Arc

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Atlas Electric Devices, Chicago, Ill.
Chemical Etching Equip. & Supply, Alexandria, Va.
Edmund Scientific Co., Barrington, N.J.
Eimac, San Carlos, Calif.
Gates, Geo. W. & Co., Franklin Sq., N.Y.
Hamamatsu Corp. (E), Middlesex, N. J.
Illumination Inds., Inc., Sunnyvale, Cal.
Kemlite Labs., Inc., Chicago, Ill.
Oriel Corp. of America, Stamford, Conn.

Lights, Dial, Panel, Pilot, & Accessories

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ADC Prods., Minneapolis, Minn.
Aeronautical Elec. Co., Inc., Chicago, Ill.
Allen-Bradley Co., Milwaukee, Wisc.
Amp Inc., Harrisburg, Pa.
Arcolectric Switch Corp., No. Hollywood, Cal.
Chicago Miniature Lamp Works, Chicago, Ill.
Chicago Switch, Chicago, Ill.
Circon Corp., Santa Barbara, Ca.
Clare-Pendar Co., Post Falls, Idaho
Control Switch, Inc., Folcroft, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Devco Engrg., W. Caldwell, N.J.
Electro Switch Corp., Weymouth, Mass.
Furnas Elec. Co., Batavia, Ill.
General Elec. Company, Providence, R.I.
General Illumination, Inc., St. Paul, Minn.
Genisco Technology Corp., Eldema Div., Compton, Cal.
GTE Sylvania Inc., Danvers, Mass.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
International Electro Exchange Corp., Eden Prairie, Minn.
Int'l. Prods., Atchison, Kans.
Korry Mfg. Co., Seattle, Wash.
Litronix, Cupertino, Cal.
Master Specialties, Costa Mesa, Cal.
Molex Inc., Lisle, Ill.
Mura Corp., Jericho, N.Y.
OPCOA, Inc., Edison, N.J.
Penn Keystone Corp., Ansonia, Conn.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Precision Dynamics Corp., Burbank, Cal.
Raytheon Co., Burlington, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Square D Co., Park Ridge, Ill.
Stacoswitch, Inc., Costa Mesa, Cal.
Union Carbide, Consumer Prods., New York, N.Y.
Vemaline Prods. Co., Wyckoff, N.J.
W-F Products, Inc., Denver, Co.
Westmoreland Plastics Co., Latrobe, Pa.

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Chicago Miniature Lamp Works, Chicago, Ill.
Control Switch, Inc., Folcroft, Pa.
Devco Engrg., W. Caldwell, N.J.
General Illumination, Inc., St. Paul, Minn.
GTE Sylvania Inc., Danvers, Mass.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Inter-Market, Inc., Glenview, Ill.
Key Tronic Corp., Spokane, Wash.
Lamps, Inc., Torrance, Cal.
Ledex, Inc., Dayton, Ohio
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Marco-Oak, Anaheim, Cal.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Mura Corp., Jericho, N.Y.
OPCOA, Inc., Edison, N.J.
Signalite, Neptune, N.J.
Signet Scientific Co., Burbank, Cal.
Sloan Co., Sun Valley, Cal.
Vemaline Prods. Co., Wyckoff, N.J.
W.V. Industries Inc., Franklin Lakes, N.J.

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Lights, Infrared

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Autotron, Inc., Danville, Ill.
Chemical Etching Equip. & Supply, Alexandria, Va.
Chicago Miniature Lamp Works, Chicago, Ill.
Christie Elec., Los Angeles, Cal.
Eimac, San Carlos, Calif.
GTE Sylvania Inc., Danvers, Mass.
Litronix, Cupertino, Cal.
OAL Assocs., Inc., Westbury, N.Y.
OPCOA, Inc., Edison, N.J.
Precision Dynamics Corp., Burbank, Cal.
Scientific Technology, Mountain View, Cal.
Sensor Corp., Scottsdale, Pa.
Sensor Technology, Chatsworth, Cal.
Spectronics, Inc., Richardson, Tex.

Lights, Neon, Test—See Lights, Press-To-Test

Lights, Oil-Tight

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Allen-Bradley Co., Milwaukee, Wisc.
Chicago Miniature Lamp Works, Chicago, Ill.
Control Switch, Inc., Folcroft, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Data Display Products, Los Angeles, Cal.
Drake Mfg., Harwood Hgts., Ill.
Furnas Elec. Co., Batavia, Ill.
Ledex, Inc., Dayton, Ohio
Marco-Oak, Anaheim, Cal.
OPCOA, Inc., Edison, N.J.
Sloan Co., Sun Valley, Cal.
Square D Co., Park Ridge, Ill.
Vemaline Prods. Co., Wyckoff, N.J.

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Allen-Bradley Co., Milwaukee, Wisc.
Carling Electric, W. Hartford, Conn.
Chicago Miniature Lamp Works, Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Control Switch, Inc., Folcroft, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Dialight Corp., Brooklyn, N.Y.
Drake Mfg., Harwood Hgts., Ill.
Electro Switch Corp., Weymouth, Mass.
Furnas Elec. Co., Batavia, Ill.
General Illumination, Inc., St. Paul, Minn.
Ind'l. Devices, Edgewater, N.J.
Korry Mfg. Co., Seattle, Wash.
LVC Inds. Inc., Flushing, N.Y.
Master Specialties, Costa Mesa, Cal.
Square D Co., Park Ridge, Ill.
TEC, Inc., Tucson, Ariz.
Vemaline Prods. Co., Wyckoff, N.J.

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B & K Instrs., Inc., Cleveland, Ohio
Chadwick-Helmuth Co., Inc., Monrovia, Calif.
Edmund Scientific Co., Barrington, N.J.
EG & G, Inc., Salem, Mass.
EG&G, Inc., Bedford, Mass.
Eimac, San Carlos, Calif.
General Radio Co., Concord, Mass.
GTE Sylvania Inc., Danvers, Mass.
Heimann GmbH, Mt. Vernon, N.Y.
Heitz, Karl, Inc., New York, N.Y.
Illumination Inds., Inc., Sunnyvale, Cal.
Kemlite Labs., Inc., Chicago, Ill.
Mura Corp., Jericho, N.Y.
Pioneer Elec. & Resch. Corp., Forest Park, Ill.
Power Instrs., Skokie, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
U.S. Scientific Instrs., Watertown, Mass.
Voltarc Tubes, Fairfield, Conn.
Xenon Corp., Medford, Mass.

Lights, Ultraviolet

Atlas Electric Devices, Chicago, Ill.
Black Light Corp. Amer., San Gabriel, Cal.
Christie Elec., Los Angeles, Cal.
Clean Room Prods., Farmingdale, N.Y.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Edmund Scientific Co., Barrington, N.J.
Eimac, San Carlos, Calif.
Esco Products, Oak Ridge, NJ
Gates, Geo. W. & Co., Franklin Sq., N.Y.
GTE Sylvania Inc., Danvers, Mass.
Hamamatsu Corp. (E), Middlesex, N. J.
Illumination Inds., Inc., Sunnyvale, Cal.
Kemlite Labs., Inc., Chicago, Ill.
Magnaflux Corp., Chicago, Ill.
Sara Scientific Co., San Francisco, Calif.
Shannon Luminous Mat'ls., Hollywood, Cal.
TRW Instrs., El Segundo, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
Voltarc Tubes, Fairfield, Conn.

Wild Heerbrugg Instrs., Farmingdale, N.Y.
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Bowmar/ALI, Inc., Acton, Mass.
Datron Systems, Chatsworth, Cal.
Furnas Elec. Co., Batavia, Ill.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Perfect Gear & Instr. Corp., Northridge, Calif.
PIC Design Division, Ridgefield,, Conn.
Planet Instr., Gardena, Cal.
Sterling Instr., New Hyde Pk., NY
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tapeswitch Corp. Amer., Farmingdale, N.Y.

Limiters, Current

Airpax Elctrns., Inc., Cambridge, Md.
Arnold Magnetics, Culver City, Cal.
Burndy Corp., Norwalk, Conn.
Carbone Corp., Boonton, N.J.
CGS Units, Inc., Rochester, N.Y.
Coil Co. of Amer., Northvale, N.J.
Diversified Elctrns., Evansville, Ind
Environmental Communications Inc., Santa Ana, Cal.
Halmar Elctrns., Inc., Columbus, Ohio
Kepco, Inc., Flushing, N.Y.
Lambda Elctrns., Melville, N.Y.
P.E.T., Inc., Pittsburgh, Pa.
Robicon Corp., Pittsburgh, Pa.
Texas Instruments, Attleboro, Mass.

Limiters, Microwave

Aertech Inds., Sunnyvale, Calif.
Airtron, Morris Plains, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
Arra Inc., Bay Shore, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Collins Radio Co., Dallas, Tex.
Engelmann Microwave, Montville, N.J.
Environmental Communications Inc., Santa Ana, Cal.
General Microwave Corp., Farmingdale, N.Y.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Norsal Industries, Inc., Brentwood, N.Y.
Physical Elctrn. Labs., Menlo Park, Calif.
RCA Elctrns. Comps., Harrison, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Ryka Scientific, Inc., Sunnyvale, Cal.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vector Industries, Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.

Limiters, Surge

ATR Elctrns., Inc., St. Paul, Minn.
Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
Environmental Communications Inc., Santa Ana, Cal.
Joslyn Elctrn. Sys., Goleta, Cal.
RFL Inds., Comms. Div., Boonton, N.J.

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Environmental Communications Inc., Santa Ana, Cal.
Microwave Assocs., Inc., Burlington, Mass.
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Avtron Mfg., Inc., Cleveland, Ohio
Electronautics, Littleton, Mass.
Elctrn. Meas. Inc., Neptune, N.J.
Kepco, Inc., Flushing, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.
Varian Assocs., Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Wide Band Engrg. Co., Phoenix, Ariz.

Locators, Metal

Gardiner Elctrns., Phoenix, Ariz.
Heath Co., Benton Harbor, Mich.
Rank Precision Inds., Des Plaines, Ill.
Schonstedt Instr. Co., Reston, Va.
Sensor Corp., Scottsdale, Pa.
Stearns Magnetics Inc., Cudahy, Wisc.

Locators, Open-Short

Associated Resch., Chicago, Ill.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Cablemaster Div., No. Hollywood, Cal.
Communications Technology Corp., Los Angeles, Cal.
Counterscan Systems, Sutton, Neb.
Hipotronics, Inc., Brewster, N.Y.
Peschel Instrs., Cape Coral, Fla.
Railway Comm., Raytown, Mo.
Slaughter Co., Ardmore, Okla.
Tektronix, Inc., Beaverton, Ore.
Tempo Instrument, Inc., Plainview, N.Y.
Wiltron Co., Palo Alto, Calif.

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Accurate Elctrns. Corp., Elyria, Ohio
Birnbach Co., Inc., Freeport, N.Y.
Bowmar/ALI, Inc., Acton, Mass.
Electronic Hardware Corp., Jamaica, N.Y.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Lambda Elctrns., Melville, N.Y.
Millen, James Mfg., Malden, Mass.
PIC Design Division, Ridgefield,, Conn.
Positronic Inds., Springfield, Mo.
Quadrastat Controls Corp., Glendale, Cal.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
Smith, Herman H., Inc., Bklyn., N.Y.
Vemaline Prods. Co., Wyckoff, N.J.
Waters Mfg., Inc., Wayland, Mass.

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Chemplast, Inc., Wayne, N.J.
Chemtronics, Inc., Brooklyn, N.Y.
Cole-Flex Corp., W. Babylon, N.Y.
Dow Corning Corp., Midland, Mich.
Edwards High Vacuum, Grand Island, N.Y.
Elctrn. Chemical Corp., Jersey City, N.J.
GC Electronics, Rockford, Ill.
General Elec. Co., Waterford, N.Y.
Jonard Inds. Corp., Bronx, N.Y.
Loctite Corp., Newington, Conn.
LPS Research Labs., Los Angeles, Cal.
MacDonald & Co., Glendale, Calif.
Merix Chem. Co., Chicago, Ill.
Miller-Stephenson Chem. Co., Inc., Danbury, Conn.
Nye, William F., Inc., New Bedford, Mass.
Ram Chems., Gardena, Calif.
Shannon Luminous Mat'ls., Hollywood, Cal.
SWS Silicones Div., Adrian, Mich.
Tech Spray, Amarillo, Tex.
Techni-Tool, Inc., Philadelphia, Pa.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Workman Elctrn. Prods., Inc., Sarasota, Fla.
X-Acto, Long Island City, N.Y.

Lugs—See Terminals, Lug

Luminescent Chemicals—See Chemicals, Luminescent

Luminous Paints—See Paints, Luminous

LVDT's—See Transducers, Displacement

Machines, Blueprint—See Blueprint Machines

Machines, Cleaning-Also See Cleaners, Ultrasonic

Aubin, A.E. Co., Glastonbury, Conn.
Baron-Blakeslee, Div. Purex Corp., Chicago, Ill.
Chemcut Corp., State College, Pa.
Chemical Etching Equip. & Supply, Alexandria, Va.
Clean Room Prods., Farmingdale, N.Y.
Cobehn, Inc., Fairfield, N.J.
Conforming Matrix Corp., Toledo, Ohio
Cyclo-Tronics, Inc., Chicago, Ill.
Electrovert, Mt. Vernon, N.Y.
Gagne Assocs., Inc., Binghamton, N.Y.
Inland Mfg. Co., Omaha, Neb.
Kepro Cir. Sys., Inc., St. Louis, Mo.
London Chemical Co., Bensenville, Ill.
Mann, Henry Inc., Feasterville, Pa.
Marcal Electro-Sonics, Los Angeles, Cal.
Phillips Mfg. Co., Chicago, Ill.
Sara Scientific Co., San Francisco, Calif.
Systron Donner Computer Systems Div., Concord, Cal.
Technic, Inc., Providence, R.I.
Tronic Corp., Belmont, Calif.
Ultrasonic Corp., Pipestone, Minn.
Wells Elctrns., Inc., So. Bend, Ind.
Zenrad Controls Co., Santa Barbara, Ca.

Machines, Coil-Winding

Arnold Magnetics, Culver City, Cal. Vol 1•607
Coil Winding Equip. Co., Oyster Bay, N.Y.
Eubanks Engrg., Monrovia, Calif.
Freudenberg, B., Inc., New York, N.Y.
Kahle Engrg. Co., Union City, N.J.
Possis Corp., Minneapolis, Minn.
Solatron Enterprises, Inglewood, Calif.
Stevens, Geo. Mfg. Co., Inc., Chicago, Ill.
Techni-Tool, Inc., Philadelphia, Pa.
Universal Mfg. Co., Inc., Irvington, N.J.

Machines, Component Handling, Feeding, Insertion & Sorting

Black & Webster, Inc., Waltham, Mass.
Conrac Corp., Cedar Rapids, Iowa
E-Systems Inc., Dallas, Tex.
Eraser Co., Syracuse, N.Y.
Freudenberg, B., Inc., New York, N.Y.
Goodrich Div., Hudsonville, Mich.
GTI Corp. (E), Pittsburgh, Pa.
IPT Corp., Sunnyvale, Cal.
Mann, Henry Inc., Feasterville, Pa.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Universal Instrs., Binghamton, N.Y.

Machines, Crimping—See Tools, Crimping & Swaging

Machines, Etching, & Processing Printed Circuit

Chemcut Corp., State College, Pa.
Chemical Etching Equip. & Supply, Alexandria, Va.
Cyclo-Tronics, Inc., Chicago, Ill.
Edwards High Vacuum, Grand Island, N.Y.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Materials Resch. Corp., Orangeburg, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Superior Elec., Bristol, Conn.

Machines, Hermetic Sealing

Associate General Labs., Inc., Brookfield, Ill.
Conforming Matrix Corp., Toledo, Ohio
GTI Corp. (E), Pittsburgh, Pa.
Kahle Engrg. Co., Union City, N.J.
Solid State Equipment Corp., Fort Washington, Pa.

Machines, Induction Heating (Electronic)

Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
Jade Corp., Huntingdon Valley, Pa. Vol 1•384
Cycle-Dyne, Inc., Jamaica, N.Y.
Taylor-Winfield Corp., Warren, Ohio
Westinghouse Elec., Sykesville, Md.

Machines, Lead Cutting & Forming

Harwil Co., Santa Monica, Calif.
Mann, Henry Inc., Feasterville, Pa.
Tech. Devices Co., Culver City, Calif.

Machines, Marking & Numbering

Ackerman Gould Co., Inc., Oceanside, N.Y.
Black & Webster, Inc., Waltham, Mass.
Bostitch, E. Greenwich, R.I.
Brady, W.H. Co., Milwaukee, Wisc.
Conrac Corp., Westminister, Cal.
GTI Corp. (E), Pittsburgh, Pa.
Hermes Plastics, Inc., New York, N.Y.
IPT Corp., Sunnyvale, Cal.
Kingsley Mach. Co., Hollywood, Calif.
Lectroetch, E. Cleveland, Ohio
Markem Corp., Keene, N.H.
Matthews, Jas & Co., Pittsburgh, Pa.
Monarch Marking Sys., Dayton, Ohio
Solatron Enterprises, Inglewood, Calif.
Universal Instrs., Binghamton, N.Y.

Machines, Mask Alignment & Exposure

Jade Corp., Huntingdon Valley, Pa. Vol 1•384
Chemical Etching Equip. & Supply, Alexandria, Va.
IPT Corp., Sunnyvale, Cal.
Mann, David W. Co., Burlington, Mass.
Opto-Metric Tools, Rockleigh, N.J.,
Oriel Corp. of America, Stamford, Conn.
Research Devices, Berkeley Heights, N.J.

Machines, Metallizing, Vacuum—See Deposition Equipment, Vacuum

Machines, Parts Cleaning—See Machines, Cleaning

Machines, Plastic Molding

Alden Sys. Co., Inc., Westboro, Mass.
Chemical Etching Equip. & Supply, Alexandria, Va.
Custom Sci. Instrs., Inc., Whippany, N.J.
Di-Acro, Lake City, Minn.
H-P-M Div., Mt. Gilead, Ohio
Hull Corp., Hatboro, Pa.
K-Tech., Inc., Framingham, Mass.

Mann, Henry Inc., Feasterville, Pa.
Pentronix, Div., Lincoln Pk., Mich.
Wabash Metal Prods., Wabash, Ind.

Machines, Plating
Aubin, A.E. Co., Glastonbury, Conn.
Chemical Etching Equip. & Supply, Alexandria, Va.
Harshaw Chem. Co., Cleveland, Ohio
Opad Elec. Co., Inc., New York, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Selectrons, Ltd., New York, N.Y.
Technic, Inc., Providence, R.I.
3M Co., St. Paul, Minn.

Machines, Printed Circuit Design & Artwork Generation
W-F Products, Inc., Denver, Co. Vol 1•934
Mann, David W. Co., Burlington, Mass.

Machines, Printed Circuit Drilling & Punching
A P Products, Inc., Painesville, Ohio
Chemical Etching Equip. & Supply, Alexandria, Va.
Di-Acro, Lake City, Minn.
Gardner-Denver Co., Quincy, Ill.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Mann, Henry Inc., Feasterville, Pa.
Superior Elec., Bristol, Conn.
Universal Instrs., Binghamton, N.Y.

Machines & Accessories, Semiconductor Manufacturing
Allied Chemical Corp., Morristown, N.J.
Amersil, Inc., Hillside, N.J.
Applied Materials Tech., Santa Clara, Cal.
Ewald Instrs. Corp., Kent, Conn.
GTI Corp. (E), Pittsburgh, Pa.
Hull Corp., Hatboro, Pa.
IPT Corp., Sunnyvale, Cal.
Kahle Engrg. Co., Union City, N.J.
Lepel High Frequency Labs., Maspeth, N.Y.
Pentronix, Div., Lincoln Pk., Mich.
Red Point Corp., Burbank, Calif.
Research Devices, Berkeley Heights, N.J.
Solid State Equipment Corp., Fort Washington, Pa.
Systonics, Inc., Winchester, Mass.
Tekform Prods. Co., Anaheim, Cal.
Temptronix Inc., Newton, Mass.
Universal Instrs., Binghamton, N.Y.
Wentworth Labs, Inc., Broadfield, Conn.

Machines, Shock Testing—See Testers, Shock

Machines, Solderability Testing
Chemical Etching Equip. & Supply, Alexandria, Va.
Electrovert, Mt. Vernon, N.Y.
Freudenberg, B., Inc., New York, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Multicore Sales Corp., Westbury, N.Y.

Machines, Soldering—See Soldering Equip.

Machines, Spinner, Photo-Resist
Headway Research, Inc., Garland, Tex.

Machines, Terminal Installing
Amp Inc., Harrisburg, Pa.
Ark-Les Switch Corp., Watertown, Mass.
Berg Electronics, New Cumberland, Pa.
Black & Webster, Inc., Waltham, Mass.
Burndy Corp., Norwalk, Conn.
Elco, Willow Grove, Pa.
Molex Inc., Lisle, Ill.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Smith, Herman H., Inc., Bklyn., N.Y.
Universal Instrs., Binghamton, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Waldom Elctrns., Inc., Chicago, Ill.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Machines, Transistor Assembling
GTI Corp. (E), Pittsburgh, Pa.
IPT Corp., Sunnyvale, Cal.
Kahle Engrg. Co., Union City, N.J.
Solid State Equipment Corp., Fort Washington, Pa.

Machines, Vibration Fatigue Testing—See Vibration Test Systems

Machines, Wafer Alignment—See Machines, Mask Alignment & Exposure

Machines, Whiteprint—See Whiteprint Machines

Machines, Wire Marking, Hand & Automatic—See Wire Marking Machines

Machines, Wire Measuring & Cutting—See Wire Measuring & Cutting Machines

Machines, Wire Wrapping-Also See Wire Wrapping Tools
General Radio Co., Concord, Mass.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Mann, Henry Inc., Feasterville, Pa.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Standard Logic, Santa Ana, Cal.
Superior Elec., Bristol, Conn.
Universal Instrs., Binghamton, N.Y.
Zippertubing Co., Los Angeles, Calif.

Magnetic Analyzers—See Analyzers, Magnetic

Magnetic Core Testers—See Testers, Magnetic Core

Magnetic Field Indicators—See Indicators, Magnetic Field

Magnetic Foil—See Foil, Magnetic

Magnetic Iron Oxides
Indiana General, Valparaiso, Ind.

Magnetic Recording Tape—See Tapes, Recording, Magnetic

Magnetic Shields & Materials—See Shields, Magnetic

Magnetic Tape Recorders—See Recorders, Magnetic Tape-Also See Data Recorders

Magnetizers
LDJ Electronics, Troy, Mich..... Vol 1•476
RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Thomas & Skinner, Inc., Indianapolis, Ind. ..... Vol 1•515
Advanced Kinetics, Costa Mesa, Calif.
Arnold Engineering Co., Marengo, Ill.
Barnes & Reinecke, Inc., Chicago, Ill.
Coil Co. of Amer., Northvale, N.J.
GRM Corp., Medford, N.J.
Indiana General, Valparaiso, Ind.
Mag-Con, Inc., New Brighton, Minn.
Magnaflux Corp., Chicago, Ill.
Stearns Magnetics Inc., Cudahy, Wisc.

Magnetometers
Ohio Semitronics, Columbus, Ohio Vol 1•491
RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Advanced Kinetics, Costa Mesa, Calif.
Automation Inds., Danbury, Conn.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Electro-Mechanics Co., Austin, Tex.
Honeywell, Minneapolis, Minn.
LDJ Electronics, Troy, Mich.
Princeton Applied Resch. Corp., Princeton, N.J.
Rank Precision Inds., Des Plaines, Ill.
Schonstedt Instr. Co., Reston, Va.
Varian Assocs., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Magnetoresistors, Hall
American Aerospace Controls Inc., Farmingdale, N.Y. ..... Vol 2•332
LDJ Electronics, Troy, Mich.
Oxford Instr. Corp., Annapolis, Md.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.

Magnetron Testers—See Testers, Magnetron

Magnetrons—See Tubes, Magnetron

Magnets, Electromagnetic
Advanced Kinetics, Costa Mesa, Calif.
Coil Co. of Amer., Northvale, N.J.
Component Specialties, Temple City, Cal.
High Voltage Engrg. Corp., Burlington, Mass.
LDJ Electronics, Troy, Mich.
Ogallala Elctrns., Ogallala, Neb.
Process & Instrs. Corp., Brooklyn, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Stearns Magnetics Inc., Cudahy, Wisc.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Corp., Concord, Cal.
TDK Elctrns. Corp., Long Island City, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Varian Assocs., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Magnets, Focusing—See Magnets, Permanent

Magnets (Lab. Type)
LDJ Electronics, Troy, Mich..... Vol 1•476
Coil Co. of Amer., Northvale, N.J.
Colt Industries, Elizabethtown, Ky.
General Hardware Mfg. Co., New York, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
RFL Inds., Instr. Div., Boonton, N.J.
Shigoto Inds., Ltd., New York, N.Y.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Magnets, Permanent
Arnold Engineering Co., Marengo, Ill. Vol 3•1004
Ferronics, Inc., Fairport, N.Y. Vol 3•1009
Allen-Bradley Co., Milwaukee, Wisc.
Barker Elec. Sls., Ship Bottom, NJ
Bunting Magnetics Co., Franklin Park, Ill.
Ceramic Magnetics, Inc., Fairfield, N.J.
Colt Industries, Elizabethtown, Ky.
Edmund Scientific Co., Barrington, N.J.
Ferroxcube Corp., Saugerties, N.Y.
General Hardware Mfg. Co., New York, N.Y.
General Magnetic Corp., Detroit, Mich.
Hamilton Technology, Inc., Lancaster, Pa.
Hoskins Mfg. Co., Detroit, Mich.
Hudson Wire Co, Ossining, N.Y.
Indiana General, Valparaiso, Ind.
Moody Tools, Inc., Providence, R.I.
Murata Mfg. Co. Ltd., Kyoto, Japan
Nucleonic Prods., Canoga Pk, Cal.
Ogallala Elctrns., Ogallala, Neb.
Reed Switch Dev. Co., Greenwich, Conn.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Stackpole Carbon Co., Magnet Div., Kane, Pa.
Stearns Magnetics Inc., Cudahy, Wisc.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Thomas & Skinner, Inc., Indianapolis, Ind.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.

Magnets, Superconducting
Advanced Kinetics, Costa Mesa, Calif.
American Magnetics, Oak Ridge, Tenn.
Colt Industries, Elizabethtown, Ky.
Columbia Superconductor & Cryogenics Co., Allentown, Pa.
Oxford Instr. Corp., Annapolis, Md.
Rol-a-chart Div., Diamond Springs, Ca.
Varian Assocs., Palo Alto, Cal.

Magnifying Glasses, Inspection
Bausch & Lomb, Rochester, N.Y.
EG&G, Inc., Bedford, Mass.
Mann, Henry Inc., Feasterville, Pa.
Opto-Metric Tools, Rockleigh, N.J.

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Markers, Dry Transfer—See Kits, Marking

Markers, Identification—See Labels; Nameplates

Markers, R-F—See Generators, Marker

Markers, Terminal—See Kits, Marking, etc.

Markers, Wire, Tab & Sleeve—See Wire Markers

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Masers
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Conforming Matrix Corp., Toledo, Ohio

Mask Alignment & Exposure Systems—See Machines, Mask Alignment & Exposure

Masking Films—See Films, Masking

Masks, Fabrication, Deposition—See Services, Mask Making

Masts, Antenna—See Antenna Towers & Supports

Materials, Graphite
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Emerson & Cuming, Inc., Canton, Mass.
Pure Carbon Co., Inc., St. Marys, Pa.
Stackpole Carbon Co., Carbon Div., St. Marys, Pa.
Union Carbide, Carbon Prods. Div., New York, N.Y.

Materials, Self-Lubricating
Basic Ceramics Inc., Hawthorne, N.J.
Carbone Corp., Boonton, N.J.
Carborundum Co., Niagara Falls, N.Y.
Cerac, Inc., Butler, Wisc.
Chemplast, Inc., Wayne, N.J.
Dixon Corp., Bristol, R.I.
E.I. DuPont DeNemours & Co., Wilmington, Del.
GAF Corp., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Ohio Carbon Co., Cleveland, Ohio
Pure Carbon Co., Inc., St. Marys, Pa.
Rogers Corp., Rogers, Conn.
Thiokol Chemical Div., Trenton, N.J.
Union Carbide, Carbon Prods. Div., New York, N.Y.

Matrices, Computer-Also See Boards, Programming
AD Automation, Rochester, N.Y. Vol 1•386
Info-Lite Corp., Corona, N.Y..... Vol 2•510
Interswitch, Burlingame, Cal. Vol 2•1077
LVC Inds. Inc., Flushing, N.Y. Vol 2•1046
Mac Panel Co., High Pt., N.C.. Vol 3•701

Sealectro Corp., Mamaroneck, N.Y. Vol 2•1133
Virginia Panel Corp., Waynesboro, Va. Vol 3•972
A. D. Data Sys., Inc., Rochester, N.Y.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Trompeter Elctrns., Chatsworth, Cal.

Mechanical Readouts—See Readouts, Electromechanical

Memories, Buffer

Advanced Memory Systems, Inc., Sunnyvale, Cal
American Astrionics, Costa Mesa, Cal
Corning Glass Works, Raleigh, N.C.
Design Elements, Columbus, Ohio
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
NES, Inc., Itasca, Ill.
Princeton Elctrn. Prods., New Brunswick, N.J.
Signetics. Corp., Sunnyvale, Calif.
Telex Comm. Div., Minneapolis, Minn.
Texas Instruments, Dallas, Tex.

Memory Systems, Delay Line

Andersen Labs. Inc., Bloomfield, Conn. Vol 3•982
Computer Devices, Commack, N.Y. Vol 3•993
Bel Fuse, Inc., Jersey City, N.J.
Bliley Electric, Erie, Pa.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Corning Glass Works, Raleigh, N.C.
Di/An Controls, Inc., Boston, Mass.
Microsonics, Inc., Weymouth, Mass.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan

Memory Systems, Core

Ampex Corp., Redwood City, Calif.
Cambridge Memories, Inc., Concord, Mass.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Data General Corp. (E), Southboro, Ma.
Datapac, Inc., Costa Mesa, Cal.
Di/An Controls, Inc., Boston, Mass.
Digital Equip. Corp., Maynard, Mass.
Elctrn. Memories, Hawthorne, Cal.
Fabri-Tek, Inc., Minneapolis, Minn.
Fabri-Tek, Inc., Memory Products Div, Minneapolis, Minn.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Grand Rapids, Mich.
Lockheed Elctrns. Co., Watchung, N.J.
Lockheed Elctrns. Co., Los Angeles, Cal.
Standard Logic, Santa Ana, Cal.
Standard Memories, Inc., Ft. Lauderdale, Fla.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Toledo Scale, Toledo, Ohio
Varian Assocs., Palo Alto, Cal.

Memory Systems, Disc

Burroughs Corp., Pasadena, Cal. Vol 1•330
Datum, Inc., Anaheim, Calif. .... Vol 1•340
Ampex Corp., Redwood City, Calif.
Applied Magnetics Corp., Goleta, Calif.
California Computer Prods., Anaheim, Cal
Data Disc, Inc., Sunnyvale, Cal.
Data General Corp. (E), Southboro, Ma.
Digital Dev. Corp., San Diego, Calif.
Digital Equip. Corp., Maynard, Mass.
Diva, Inc., Eatontown, N.J.
Elctrn. Memories, Hawthorne, Cal.
General Instr. Corp., Hawthorne, Cal.
Gould, Inc., Cleveland, Ohio
Microdata Corp., Irvine, Cal.
NES, Inc., Itasca, Ill.
Remex, Santa Ana, Cal.
Singer Co., Glendale, Cal.
Wang Labs., Inc., Tewksbury, Mass.

Memory Systems, Drum

Datum, Inc., Anaheim, Calif. .... Vol 1•340
Digital Equip. Corp., Maynard, Mass.
General Instr. Corp., Hawthorne, Cal.
Gould, Inc., Cleveland, Ohio
Kenton Engrg. Corp., Skokie, Ill.
NES, Inc., Itasca, Ill.
RCA Govt. & Comm. Sys., Moorestown, N.J.

Memory Systems, Tape

Almond Instrs. Co., Covina, Cal Vol 1•935
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Telex Comm. Div., Minneapolis, Minn. Vol 1•376
Ampex Corp., Redwood City, Calif.
Bell & Howell Co., Pasadena, Calif.
Burroughs Corp., Pasadena, Cal.
California Computer Prods., Anaheim, Cal
Collins Radio Co., Dallas, Tex.
Data General Corp. (E), Southboro, Ma.
Data Recording Sys., Sunnyvale, Cal.
Datacom, Inc., Ft. Walton Bch., Fla.
Digital Equip. Corp., Maynard, Mass.
Diva, Inc., Eatontown, N.J.
Gould, Inc., Cleveland, Ohio
Int'l. Computer Prods., Dallas, Tex.
Microdata Corp., Irvine, Cal.
NES, Inc., Itasca, Ill.
Raymond Engrg. Inc., Middletown, Conn.
Remex, Santa Ana, Cal.
Texas Instruments, Inc., Houston, Tex.
3M Co., St. Paul, Minn.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Wang Labs., Inc., Tewksbury, Mass.

Memory Systems, Thin-Film, Planar

Cambridge Memories, Inc., Concord, Mass.
NES, Inc., Itasca, Ill.
Rogers Corp., Rogers, Conn.

Memory Systems, Thin-Film, Plated Wire

Berg Electronics, New Cumberland, Pa.
Honeywell, Minneapolis, Minn.
Tohoku Metal Inds., Ltd., Tokyo, Japan

Memory Systems, Semiconductor

American Astrionics, Costa Mesa, Cal Vol 1•321
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Advanced Memory Systems, Inc., Sunnyvale, Cal
Ampex Corp., Redwood City, Calif.
Cambridge Memories, Inc., Concord, Mass.
Clarke - Hess, New York, N.Y.
Data General Corp. (E), Southboro, Ma.
Datapac, Inc., Costa Mesa, Cal.
Di/An Controls, Inc., Boston, Mass.
Elctrn. Memories, Hawthorne, Cal.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
Lear Siegler, Inc., Santa Monica, Calif.
Mostek Corp., Carrollton, Tex.
National Semiconductor, Santa Clara, Cal.
Pacific Technology, Renton, Wash.
Ragen Precision Inds., Inc., N. Arlington, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Signetics. Corp., Sunnyvale, Calif.
Spectrum Dynamics, Inc., Ft. Lauderdale, Fla.
Standard Logic, Santa Ana, Cal.
Standard Memories, Inc., Ft. Lauderdale, Fla.
Texas Instruments, Dallas, Tex.
Xerox Data Sys., El Segundo, Cal

Metal Compounds, Foils, Powders, Sheet, Stock

Ad-Vance Magnetics, Rochester, Ind. Vol 3•1006
CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y. ..... Vol 3•1092
Alpha Metals, Inc., Jersey City, N.J.
Bram Metallurgical-Chem. Co., Phila., Pa.
Cleveland Refractory Metals Div., Solon, Ohio
Colt Industries, Elizabethtown, Ky.
Fansteel Inc., N Chicago, Ill.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Hamilton Technology, Inc., Lancaster, Pa.
Handy & Harman, New York, N.Y.
Kawecki Berylco Inds., Inc., New York, N.Y.
Leico Inds., Inc., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Materials Technology, Inc., Somerset, N.J.
NL Inds., Inc., Metal Div., New York, N.Y.
Philips Elmet Corp., Lewiston, Me.
Reynolds Metals Co., Richmond, Va.
United Mineral & Chem. Corp., New York, N.Y.

Metal Oxides

Alpha Metals, Inc., Jersey City, N.J.
Baker, J.T. Chemical Co., Phillipsburg, N.J.
Dow Chemical Co., Midland, Mich.
Goldsmith Precious Metals Div., Chicago, Ill.
GTE Sylvania, Inc., Towanda, Pa.
Handy & Harman, New York, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Int'l. Elctrn. Resch., Burbank, Cal.
Kawecki Berylco Inds., Inc., New York, N.Y.
Leico Inds., Inc., New York, N.Y.
M & T Chemicals Inc., Rahway, N.J.
Materials Resch. Corp., Orangeburg, N.Y.
Micrite Metal Mfg., Inc., Canoga Park, Cal.
Philadelphia Quartz Co., Phila., Pa.
Union Carbide, San Diego, Cal.
United Mineral & Chem. Corp., New York, N.Y.

Metal Parts—See Services, Metal Parts Fabrication

Metals, Clad

Alpha Metals, Inc., Jersey City, N.J.
Bram Metallurgical-Chem. Co., Phila., Pa.
CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y.
GTE Sylvania Inc., Newark, N.J.
Handy & Harman, New York, N.Y.
Materials Technology, Inc., Somerset, N.J.
Revere Copper and Brass, Incorporated, New York, N.Y.
Reynolds Metals Co., Richmond, Va.
Synthane Taylor Corp., Valley Forge, Pa.
Texas Instruments, Attleboro, Mass.

Metals, High Purity

CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y. ..... Vol 3•1092
Alpha Metals, Inc., Jersey City, N.J.
Anchor Alloys, Inc., Brooklyn, N.Y.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Cerac, Inc., Butler, Wisc.
Cleveland Refractory Metals Div., Solon, Ohio
Cohn, Sigmund, Mt. Vernon, N.Y.
Goldsmith Precious Metals Div., Chicago, Ill.
GTE Sylvania Inc., Newark, N.J.
Handy & Harman, New York, N.Y.
Kawecki Berylco Inds., Inc., New York, N.Y.
Kester Solder Co, Chicago, Ill.
Leico Inds., Inc., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
NL Inds., Inc., Metal Div., New York, N.Y.
Nucleonic Prods., Canoga Pk, Cal.
United Mineral & Chem. Corp., New York, N.Y.

Metals, Precious-Also See Powders, Precious Metal

CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y. ..... Vol 3•1092
Alpha Metals, Inc., Jersey City, N.J.
Anchor Alloys, Inc., Brooklyn, N.Y.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Cerac, Inc., Butler, Wisc.
Cohn, Sigmund, Mt. Vernon, N.Y.
Electro-Science Labs., Pennsauken, N. J.
Goldsmith Precious Metals Div., Chicago, Ill.
Gte Sylvania Inc., Belmont, Cal.
Handy & Harman, New York, N.Y.
Leico Inds., Inc., New York, N.Y.
Materials for Elctrns., Inc., Jamaica, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Technic, Inc., Providence, R.I.
United Mineral & Chem. Corp., New York, N.Y.

Metals, Rare

Alpha Metals, Inc., Jersey City, N.J.
Anchor Alloys, Inc., Brooklyn, N.Y.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
Bram Metallurgical-Chem. Co., Phila., Pa.
Cerac, Inc., Butler, Wisc.
Cohn, Sigmund, Mt. Vernon, N.Y.
Dow Chemical Co., Midland, Mich.
Kawecki Berylco Inds., Inc., New York, N.Y.
Leico Inds., Inc., New York, N.Y.
Materials for Elctrns., Inc., Jamaica, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Technic, Inc., Providence, R.I.
United Mineral & Chem. Corp., New York, N.Y.

Metals, Refractory

Anchor Alloys, Inc., Brooklyn, N.Y.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Cerac, Inc., Butler, Wisc.
Cleveland Refractory Metals Div., Solon, Ohio
Colt Industries, Elizabethtown, Ky.
Fansteel Inc., N Chicago, Ill.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
GTE Sylvania, Inc., Towanda, Pa.
Kawecki Berylco Inds., Inc., New York, N.Y.
Leico Inds., Inc., New York, N.Y.
Mallory Metallurgical, Indianapolis, Ind.
Materials Resch. Corp., Orangeburg, N.Y.
Philips Elmet Corp., Lewiston, Me.
Semicon Assoc., Inc., Lexington, Ky.
United Mineral & Chem. Corp., New York, N.Y.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Metals, Semiconductor—See Crystals, Semiconductor

Metal-To-Glass Alloys—See Seals, Glass-To-Metal

Meter Cases—See Cases, Equipment

Meter Controllers—See Relays, Meter

Meter Expanders—See Multipliers, Meter

Meter Shunts—See Shunts, Meter

Meter Testers—See Testers, Meter

Meters, A-C Leakage Including Adapters

ITT Jennings, San Jose, Cal Vol 1•458,459
ITT Jennings, Instrus. & Systems, San Jose, Calif. ..... Vol 1•458,459
Triplett Corp., Bluffton, Ohio .. Vol 1•523

Meters, Acceleration

Unholtz-Dickie Corp., Hamden, Conn. Vol 1•530
Advanced Dynamic Instrs. Div., Alexandria, Va.
Bendix Corp., Davenport, Iowa
Columbia Resch. Labs., Woodlyn, Pa.
Dytronics Co., Columbus, Ohio
Endevco, Pasadena, Calif.
Engdahl Enterprises, Costa Mesa, Cal.
General Radio Co., Concord, Mass.
IMPACT-O-GRAPH Div., Bedford, Ohio
Larson Aero Dev., Concord, Calif.
Metrix Instr. Co., Houston, Tex.
Reliance Elec. Co., Cleveland, Ohio
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Teledyne Geotech, Dallas, Tex.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Admittance

Freed Transformer Co., Bklyn., N.Y. Vol 1•445
Dranetz Engrg. Labs., So. Plainfield, N.J.
General Radio Co., Concord, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.

Meters, Ampere, A-C

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Faria Meter Corp., Uncasville, Conn. Vol 1•443
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Newport Labs., Inc., Santa Ana, Cal. Vol 4•417*
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Triplett Corp., Bluffton, Ohio Vol 1•516,519,527
Allied Elctrns., Chicago, Ill.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Biddle, James G., Plymouth Meeting, Pa.
Bristol Div, Waterbury, Conn
Columbia Elec. Mfg. Co., Cleveland, Ohio
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Elec., W. Lynn, Mass.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Jonard Inds. Corp., Bronx, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
LFE Corp., Waltham,, Mass.
Micro Instr. Co., Hawthorne, Cal.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Ampere, D-C

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Faria Meter Corp., Uncasville, Conn. Vol 1•443
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Newport Labs., Inc., Santa Ana, Cal. Vol 4•417*
Ohio Semitronics, Columbus, Ohio Vol 1•491
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Triplett Corp., Bluffton, Ohio Vol 1•519,527-529
Allied Elctrns., Chicago, Ill.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
Columbia Elec. Mfg. Co., Cleveland, Ohio
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Dixson Inc., Meter Div., Grand Junction, Colo.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
ESE, Inglewood, Cal.
Esterline Angus Div., Indianapolis, Ind.
Faria, Thomas G. Corp., Uncasville, Conn.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Elec., W. Lynn, Mass.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Halmar Elctrns., Inc., Columbus, Ohio
Heath Co., Benton Harbor, Mich.
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Jonard Inds. Corp., Bronx, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
LFE Corp., Waltham,, Mass.
Micro Instr. Co., Hawthorne, Cal.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Schauer Mfg. Corp., Cincinnati, Ohio
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Ampere, R-F

Ballantine Laboratories, Inc., Boonton,, N. J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ideal Precision Meter Co., Brooklyn, N. Y.
Keithley Instrs., Inc., Cleveland, Ohio
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Triplett Corp., Bluffton, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Ampere, True RMS

Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Ballantine Laboratories, Inc., Boonton,, N. J.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Columbia Elec. Mfg. Co., Cleveland, Ohio
Data Technology, Santa Ana, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
General Elec., W. Lynn, Mass.
Inservco, Inc., La Grange, Ohio
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
Scientific Columbus, Columbus, Ohio
Shigoto Inds., Ltd., New York, N.Y.
Triplett Corp., Bluffton, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Ampere-Hour

Curtis Instrs., Inc., Mt. Kisco, N.Y. Vol 1•418
Ohio Semitronics, Columbus, Ohio Vol 1•491
Data Technology, Santa Ana, Cal.
General Rand Corp., Edison, N.J.
Halmar Elctrns., Inc., Columbus, Ohio
NES, Inc., Itasca, Ill.
Sangamo Elec. Co., Springfield, Ill.
Technic, Inc., Providence, R.I.
Weston Instruments, Inc., Newark, N.J.

Meters, Attenuation

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Edison Elctrns. Div., Manchester, N.H.
General Microwave Corp., Farmingdale, N.Y.
Jewell Electrical Instrs., Manchester, N.H.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Q.V.S., Inc., East Orange, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Audio Level

Allied Elctrns., Chicago, Ill.
AUL Instrs., Inc., Flushng, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Bowmar/ALI, Inc., Acton, Mass.
Columbia Resch. Labs., Woodlyn, Pa.
Dixson Inc., Meter Div., Grand Junction, Colo.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Edison Elctrns. Div., Manchester, N.H.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Leader Instruments Corp., Long Island City, N.Y.
Modutec, Inc., Norwalk, Conn.
Pulsar Instruments, Inc., Redwood City, Cal.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
3M Co., St. Paul, Minn.
Tracor, Inc., Austin, Tex.
Triplett Corp., Bluffton, Ohio
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Cable Testing—See Testers, Cable

Meters, Capacitance

Boonton Elctrns., Parsippany, N.J. Vol 1•404,405
Freed Transformer Co., Bklyn., N.Y. Vol 1•445
Hickok Elect. Instr., Cleveland, Ohio Vol 1•452; Vol 4•409*
London Co., Cleveland, Ohio .. Vol 1•478
Beckman Instrs., Cedar Grove, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
Foxboro Co., Foxboro, Mass.
General Rand Corp., Edison, N.J.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
MSI Electronics, Inc., Woodside, N.Y.
Penn Airborne Prods., Southampton, Pa.
Robertshaw Controls Co., Richmond, Va.
Rohde & Schwarz Sls., Passaic, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Sprague Elec. Co., No. Adams, Mass.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tektronix, Inc., Beaverton, Ore.
Wiltron Co., Palo Alto, Calif.

Meters, Clamp-On

Triplett Corp., Bluffton, Ohio .. Vol 1•516
General Elec., W. Lynn, Mass.
Sticht, Herman H. Co., Inc., New York, N.Y.
Weston Instruments, Inc., Newark, N.J.

Meters, Conductance

Beckman Instrs., Cedar Grove, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
General Elec., W. Lynn, Mass.
General Radio Co., Concord, Mass.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Midland Standard Inc., Elgin, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Weston Instruments, Inc., Newark, N.J.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Meters, Counting Rate, Nuclear

Beckman Instrs., (AISSD), Fullerton, Cal.
Eldorado Electrodata, Concord, Cal.
Milletron, Inc., Pittsburgh, Pa.
NES, Inc., Itasca, Ill.
Nuclear Resch. Corp., Southampton, Pa.
NUCOR Corp., Denville, N.J.
Packard Instrument Co., Inc., Downers Grove, Ill.
Soltec Corp., No. Hollywood, Cal.
SSR Instrs. Co., Santa Monica, Cal.
Victoreen Instr., Cleveland, Ohio

Meters, Decibel Indicating

Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
CBS Laboratories, Stamford, Conn.
Chesterfield Prods. Inc., Saddle Brook, N. J.
Dixson Inc., Meter Div., Grand Junction, Colo.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Edison Elctrns. Div., Manchester, N.H.
ESE, Inglewood, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Gotham Audio Corp., New York, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Leader Instruments Corp., Long Island City, N.Y.
NES, Inc., Itasca, Ill.
Pacific Meas., Inc., Palo Alto, Calif.
Pulsar Instruments, Inc., Redwood City, Cal.
Q.V.S., Inc., East Orange, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Triplett Corp., Bluffton, Ohio
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Meters, Distortion & Noise

Freed Transformer Co., Bklyn., N.Y. Vol 1•446
London Co., Cleveland, Ohio .. Vol 1•478
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
General Radio Co., Concord, Mass.

Heath Co., Benton Harbor, Mich.
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Simpson Elec. Co., Chicago, Ill.
Soltec Corp., No. Hollywood, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Triplett Corp., Bluffton, Ohio
Vibration Instrs. Co., Anaheim, Cal.
Vu-data Corp., San Diego, Cal.

Meters, Edge-Wise

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y..... Vol 1•449
Larson Instr. Co., Inc., Orangeburg, N.Y. Vol 1•477
Simpson Elec. Co., Chicago, Ill. Vol 1•502
Airpax Elctrns., Ft. Lauderdale, Fla.
Allied Elctrns., Chicago, Ill.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
LFE Corp., Waltham,, Mass.
Mura Corp., Jericho, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Triplett Corp., Bluffton, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Elapsed Time—See Indicators, Elapsed Time

Meters, Electrometer

Beckman Instrs., (AISSD), Fullerton, Cal.
Bioelectric Instrs., Farmingdale, N.Y.
Corning Glass Works, Medfield, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Int'l. Instrs., Orange, Conn.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Keithley Instrs., Inc., Cleveland, Ohio
Milletron, Inc., Pittsburgh, Pa.
Packard Instrument Co., Inc., Downers Grove, Ill.
Princeton Applied Resch. Corp., Princeton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Simpson Elec. Co., Chicago, Ill.
Soltec Corp., No. Hollywood, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Telmar, Inc., Columbus, Ohio
Varian Assocs., Palo Alto, Cal.
Victoreen Instr., Cleveland, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Electronic Micrometer —See Micrometers, Electronic

Meters, Field Strength

Instrs. For Ind., Inc., Farmingdale, N.Y. Vol 1•461
LDJ Electronics, Troy, Mich..... Vol 1•476
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal. ..... Vol 1•507
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal. ..... Vol 1•507
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Delta-Benco Ltd., Rexdale, Ont., Can.
Edison Elctrns. Div., Manchester, N.H.
Elcom Sys., Deer Pk., N.Y.
Electro-Mechanics Co., Austin, Tex.
Honeywell, Denver, Colo.
Jerrold Electronics Corp., Philadelphia, Pa.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Leader Instruments Corp., Long Island City, N.Y.
Magnaflux Corp., Chicago, Ill.
Mobil Elctrns., Inc., Anderson, Ind.
Narda Microwave Corp., Plainview, N.Y.
Oxford Instr. Corp., Annapolis, Md.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Shurite Meters, New Haven, Conn.
Solar Elctrns. Co., Hollywood, Cal.
Varian Assocs., Palo Alto, Cal.
O. S. Walker Co., Worcester, Mass.

Meters, Fluid Flow

Airpax Elctrns., Ft. Lauderdale, Fla.
Carolina Medical Elctrns., Inc., King, N.C.
Datametrics Inc., Wilmington, Mass.
Erdco Engrg. Corp., Addison, Ill.
Lion Precision Corp, Newton, Mass.
Tylan Corp., Torrance, Calif.

Meters, Flutter & Wow

BECO, Inc., Salem, Va.
Gotham Audio Corp., New York, N.Y.
Instrumentation Prods., Camarillo, Cal.
Kenton Engrg. Corp., Skokie, Ill.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Kikusui Elctrns. Inc., New York, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
RIL Elctrns., Inc., Southampton, Pa.
Video Research Corp., Gaithersburg, Md.

Meters, Flux

LDJ Electronics, Troy, Mich..... Vol 1•476
Thomas & Skinner, Inc., Indianapolis, Ind. ..... Vol 1•515
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
RFL Inds., Instr. Div., Boonton, N.J.
O. S. Walker Co., Worcester, Mass.

Meters, F-M Deviation

Marconi Instrs., Englewood, N.J. Vol 1•484
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
A.R.F. Products, Inc., Boulder, Colo.
Edison Elctrns. Div., Manchester, N.H.
Kratos, Pasadena, Cal
London Co., Cleveland, Ohio
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Video Research Corp., Gaithersburg, Md.

Meters, Frequency

Arnoux Corp., Santa Barbara, Cal Vol 1•390
Biddle, James G., Plymouth Meeting, Pa. ..... Vol 1•399
Electronic Research Co., Shawnee Mission, Kan. ..... Vol 1•431
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
J-B-T Instrs., Inc., New Haven, Conn. Vol 2•1083
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
Anadex Instrs., Inc., Van Nuys, Calif.
Avtron Mfg., Inc., Cleveland, Ohio
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
CCA Elctrns. Corp., Gloucester, N.J.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dixson Inc., Meter Div., Grand Junction, Colo.
Edison Elctrns. Div., Manchester, N.H.
Eldorado Electrodata, Concord, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
ESE, Inglewood, Cal.
Esterline Angus Div., Indianapolis, Ind.
Frequency Elctrns., New Hyde Pk., N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
General Elec., W. Lynn, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Hathaway Instruments, Inc., Denver, Colo.
Heath Co., Benton Harbor, Mich.
Integrated Systems, Inc., Norcross, Ga.
Keltron Corp., Waltham, Mass.
Kratos, Pasadena, Cal
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
Matrix Corp., Beech Grove, Ind.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Q.V.S., Inc., East Orange, N.J.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Soltec Corp., No. Hollywood, Cal.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tempo Instrument, Inc., Plainview, N.Y.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Tracor, Inc., Austin, Tex.
TRG Prods., E. Boston, Mass.
Tucker Electronics Co., Garland, Tex.
UTE Microwave, Asbury Park, N.J.
Video Research Corp., Gaithersburg, Md.
Waters Mfg., Inc., Wayland, Mass.
Waveline, Inc., W. Caldwell, N.J.
Western Reserve Elctrns., Twinsburg, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Frequency Deviation

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
Anadex Instrs., Inc., Van Nuys, Calif.
Avtron Mfg., Inc., Cleveland, Ohio
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Edison Elctrns. Div., Manchester, N.H.
Frequency Elctrns., New Hyde Pk., N.Y.
Hathaway Instruments, Inc., Denver, Colo.
Kratos, Pasadena, Cal
Microwave/Sys., Inc., E. Syracuse, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Solidstate Controls, Inc., Columbus, Ohio
Soltec Corp., No. Hollywood, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tracor, Inc., Austin, Tex.
Video Research Corp., Gaithersburg, Md.
Weston Instruments, Inc., Newark, N.J.

Meters, Frequency (Digital)

Berkeley Instrs., Inc., Santa Ana, Cal. Vol 1•392
Electronic Research Co., Shawnee Mission, Kan. ..... Vol 1•431
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Newport Labs., Inc., Santa Ana, Cal. Vol 4•419*
North Atlantic Inds., Plainview, N.Y. Vol 1•365
American Time Products, Woodside, N.Y.
Anadex Instrs., Inc., Van Nuys, Calif.
Avtron Mfg., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
Dana Labs., Inc., Irvine, Calif.
Eldorado Electrodata, Concord, Cal.
ESE, Inglewood, Cal.
Frequency Elctrns., New Hyde Pk., N.Y.
General Radio Co., Concord, Mass.
Heath Co., Benton Harbor, Mich.
Integrated Systems, Inc., Norcross, Ga.
Keltron Corp., Waltham, Mass.
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
Milletron, Inc., Pittsburgh, Pa.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
Quan-Tech, Whippany, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Sequential Information Systems, Elmsford, N.Y.
Simpson Elec. Co., Chicago, Ill.
Speed Detectors, Bedford, Ohio
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Tracor, Inc., Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Galvanometer

Electronic Dev. Corp., Boston, Mass. Vol 1•429
Hathaway Industries Inc., Tulsa, Okla. Vol 1•451
Hathaway Instruments, Inc., Denver, Colo. ..... Vol 1•451
Shallcross, Selma, N.C. ..... Vol 1•501
Beckman Instrs., Cedar Grove, N.J.
Bell & Howell Co., Pasadena, Calif.
Coleman Instr. Div., Oak Brook, Ill.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Rand Corp., Edison, N.J.
Geo Space, Houston, Tex.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Honeywell, Denver, Colo.
Keithley Instrs., Inc., Cleveland, Ohio
Larson Instr. Co., Inc., Orangeburg, N.Y.
NES, Inc., Itasca, Ill.
Penn Airborne Prods., Southampton, Pa.
Photron Instr. Co., Cleveland, Ohio
Q.V.S., Inc., East Orange, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Weston Instruments, Inc., Newark, N.J.

Meters, Gauss

RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
Thomas & Skinner, Inc., Indianapolis, Ind. ..... Vol 1•515
Electro-Mechanics Co., Austin, Tex.
LDJ Electronics, Troy, Mich.
Matheson Gas Products, East Rutherford, N.J.
Ohio Semitronics, Columbus, Ohio
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
O. S. Walker Co., Worcester, Mass.

Meters, Grid Dip

Millen, James Mfg., Malden, Mass. Vol 1•482
Edison Elctrns. Div., Manchester, N.H.
Leader Instruments Corp., Long Island City, N.Y.
Millen, James Mfg., Malden, Mass.

Meters, Illuminated Scale

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Hickok Elect. Instr., Cleveland, Ohio
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Kratos, Pasadena, Cal

LFE Corp., Waltham,, Mass.
Modutec, Inc., Norwalk, Conn.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Triplett Corp., Bluffton, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Impedance

Bafco, Inc., Warminster, Pa. .... Vol 1•393
Alford Mfg. Co., Winchester, Mass.
Beckman Instrs., Cedar Grove, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Freed Transformer Co., Bklyn., N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Leader Instruments Corp., Long Island City, N.Y.
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
NES, Inc., Itasca, Ill.
PRD Elctrns., Inc., Westbury, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Triplett Corp., Bluffton, Ohio
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Inductance

Boonton Elctrns., Parsippany, N.J. Vol 1•403-405
Freed Transformer Co., Bklyn., N.Y. Vol 1•445
London Co., Cleveland, Ohio .. Vol 1•478
Beckman Instrs., Cedar Grove, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro-Mechanical Instr. Div., Perkasie, Pa.
General Radio Co., Concord, Mass.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Marconi Instrs., Englewood, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Sprague Elec. Co., No. Adams, Mass.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tektronix, Inc., Beaverton, Ore.

Meters, Infrared

Barnes Engrg. Co., Stamford, Conn.
Mikron Instr. Co., Ridgewood, N.J.
Omega Engrg., Inc., Stamford, Conn.

Meters, Intermodulation

Edison Elctrns. Div., Manchester, N.H.
Marconi Instrs., Englewood, N.J.

Meters, Kilovolt

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Hipotronics, Inc., Brewster, N.Y. Vol 1•455
ITT Jennings, San Jose, Cal Vol 1•458,459
ITT Jennings, Instrus. & Systems, San Jose, Calif. ..... Vol 1•458,459
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Associated Resch., Chicago, Ill.
Ballantine Laboratories, Inc., Boonton,, N. J.
Beckman Instrs., Cedar Grove, N.J.
Bertan Assocs., Inc., Hicksville, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Digilin, Inc., Glendale, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ideal Precision Meter Co., Brooklyn, N. Y.
J-Omega Co., Mountain View, Calif.
Keithley Instrs., Inc., Cleveland, Ohio
Kilovolt Corp., Hackensack, N.J.
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
Megavolt, Inc., New York, N.Y.
Modutec, Inc., Norwalk, Conn.
NES, Inc., Itasca, Ill.
Peschel Instrs., Cape Coral, Fla.
Plastic Capacitors, Inc., Chicago, Ill.
Pomona Elctrns. Co., Inc., Pomona, Cal.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Triplett Corp., Bluffton, Ohio
Universal Voltronics Corp., Mt. Kisco, N.Y.
Venus Scientific, Farmingdale, N.Y.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Kilowatt

Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Ohio Semitronics, Columbus, Ohio Vol 1•491
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Halmar Elctrns., Inc., Columbus, Ohio
Kratos, Pasadena, Cal
NES, Inc., Itasca, Ill.
Sangamo Elec. Co., Springfield, Ill.
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Simpson Elec. Co., Chicago, Ill.
Triplett Corp., Bluffton, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Laser Energy—See Monitors, Laser Energy

Meters, Light (Non Photographic)

K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan ..... Vol 2•512
Vactec, Maryland Hgts., Mo..... Vol 2•679
Atlas Electric Devices, Chicago, Ill.
Bendix Corp., Sturbridge, Mass.
Davidson Elctrn. Dev. Co., Erie, Pa.
EG & G, Inc., Salem, Mass.
Gamma Sci., San Diego, Cal.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Oriel Corp. of America, Stamford, Conn.
Photo Resch. Corp., Burbank, Calif.
Process & Instrs. Corp., Brooklyn, N.Y.
Shurite Meters, New Haven, Conn.
SSR Instrs. Co., Santa Monica, Cal.
United Detector Technology Inc., Santa Monica, Cal.
Weston Instruments, Inc., Newark, N.J.
Zoomar, Inc., Glen Cove, N.Y.

Meters, Megohm

Associated Resch., Chicago, Ill. Vol 1•389
Freed Transformer Co., Bklyn., N.Y. Vol 1•444
Hickok Elect. Instr., Cleveland, Ohio Vol 1•452,453
London Co., Cleveland, Ohio .. Vol 1•478
Slaughter Co., Ardmore, Okla. Vol 1•505
B & K Instrs., Inc., Cleveland, Ohio
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
Data Precision Corporation, Wakefield, Mass.
Digilin, Inc., Glendale, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Radio Co., Concord, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hipotronics, Inc., Brewster, N.Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
J-Omega Co., Mountain View, Calif.
Keithley Instrs., Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
Penn Airborne Prods., Southampton, Pa.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Ross Engrg. Corp., Campbell, Cal.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Triplett Corp., Bluffton, Ohio
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Microampere

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Faria Meter Corp., Uncasville, Conn. Vol 1•443
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Triplett Corp., Bluffton, Ohio Vol 1•519,527-529
Airpax Elctrns., Ft. Lauderdale, Fla.
Allied Elctrns., Chicago, Ill.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Biddle, James G., Plymouth Meeting, Pa.
Data Precision Corporation, Wakefield, Mass.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Elec., W. Lynn, Mass.
General Radio Co., Concord, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Victoreen Instr., Cleveland, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Micro-Microampere—See Meters, Nanoampere

Meters, Micro-Nanovolt—See Meters, Nanovolt

Meters, Microhm

Hickok Elect. Instr., Cleveland, Ohio Vol 1•452
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Associated Resch., Chicago, Ill.
Biddle, James G., Plymouth Meeting, Pa.
General Radio Co., Concord, Mass.
Gotham Audio Corp., New York, N.Y.
Int'l. Instrs., Orange, Conn.
Keithley Instrs., Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Weston Instruments, Inc., Newark, N.J.

Meters, Microvolt

Boonton Elctrns., Parsippany, N.J. Vol 1•406,407
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Allied Elctrns., Chicago, Ill.
Ballantine Laboratories, Inc., Boonton,, N. J.
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Doric Sci. Corp., San Diego, Calif.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Electro-Numerics, Santa Clara, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Hy-Cal Engrg., Santa Fe Springs, Cal.
Innovatek Enterprise, Millerton, N.Y.
Instrument Displays, Waltham, Mass.
Int'l. Instrs., Orange, Conn.
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
Newport Labs., Inc., Santa Ana, Cal.
North Atlantic Inds., Plainview, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Educational Prods., N.Y., N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Telmar, Inc., Columbus, Ohio
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Victoreen Instr., Cleveland, Ohio
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Microwave

Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Instrument Displays, Waltham, Mass.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
NES, Inc., Itasca, Ill.
Pacific Meas., Inc., Palo Alto, Calif.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Systron-Donner Concord Instr. Div., Concord, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Vari-L Co., Inc., Denver, Colo.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Western Reserve Elctrns., Twinsburg, Ohio

Meters, Milliampere

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Faria Meter Corp., Uncasville, Conn. Vol 1•443
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Hoyt Elec. Instr. Works, Belmont, Mass. Vol 1•456,457
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Triplett Corp., Bluffton, Ohio Vol 1•519,527-529
Airpax Elctrns., Ft. Lauderdale, Fla.
Allied Elctrns., Chicago, Ill.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Biddle, James G., Plymouth Meeting, Pa.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
General Elec., W. Lynn, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Honeywell, Ft. Washington, Pa.
Ideal Precision Meter Co., Brooklyn, N. Y.
Instrument Displays, Waltham, Mass.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Taylor Instr. Process Control Div., Rochester, N.Y.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Western Reserve Elctrns., Twinsburg, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Milliohm

Hickok Elect. Instr., Cleveland, Ohio Vol 1•452,453
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Associated Resch., Chicago, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Electro-Numerics, Santa Clara, Cal.
General Radio Co., Concord, Mass.
Innovatek Enterprise, Millerton, N.Y.
Int'l. Instrs., Orange, Conn.
Keithley Instrs., Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Triplett Corp., Bluffton, Ohio
Western Reserve Elctrns., Twinsburg, Ohio

Meters, Millivolt

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Boonton Elctrns., Parsippany, N.J. Vol 1•406,407
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Newport Labs., Inc., Santa Ana, Cal. Vol 4•417*
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Triplett Corp., Bluffton, Ohio Vol 1•528,529
Airpax Elctrns., Ft. Lauderdale, Fla.
Allied Elctrns., Chicago, Ill.
AMF Electical Prods., Alexandria, Va.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Bristol Div, Waterbury, Conn
Coleman Instr. Div., Oak Brook, Ill.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Honeywell, Ft. Washington, Pa.
Hoyt Elec. Instr. Works, Belmont, Mass.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Ideal Precision Meter Co., Brooklyn, N. Y.
Ind'l. Test Equip., Clifton, NJ
Innovatek Enterprise, Millerton, N.Y.
Instrument Displays, Waltham, Mass.
Int'l. Instrs., Orange, Conn.
J-Omega Co., Mountain View, Calif.
Jewell Electrical Instrs., Manchester, N.H.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Kratos, Pasadena, Cal
LFE Corp., Waltham,, Mass.
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
North Atlantic Inds., Plainview, N.Y.
Q.V.S., Inc., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Telmar, Inc., Columbus, Ohio
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Trio Labs, Inc., Plainview, N.Y.
Western Reserve Elctrns., Twinsburg, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Modulation

London Co., Cleveland, Ohio .. Vol 1•478
Marconi Instrs., Englewood, N.J. Vol 1•484
Avtron Mfg., Inc., Cleveland, Ohio
CCA Elctrns. Corp., Gloucester, N.J.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Edison Elctrns. Div., Manchester, N.H.
Kratos, Pasadena, Cal
NES, Inc., Itasca, Ill.
Zoomar, Inc., Glen Cove, N.Y.

Meters, Moving Scale

Jonard Inds. Corp., Bronx, N.Y.
Q.V.S., Inc., East Orange, N.J.
Sigma Instrs., Inc., Braintree, Mass.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Weston Instruments, Inc., Newark, N.J.

Meters, Multitester

GC Electronics, Rockford, Ill.. Vol 3•679
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Test & Measuring Instrs. Inc., Hicksville, N.Y. ..... Vol 4•423*
Triplett Corp., Bluffton, Ohio Vol 1•516-518,520-523,525
Amprobe Instr., Lynbrook, N.Y.
Associated Resch., Chicago, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Components Specialties, Freeport, N.Y.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Doric Sci. Corp., San Diego, Calif.
Epic, Inc., New York, N.Y.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Freed Transformer Co., Bklyn., N.Y.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Int'l. Components Corp., Farmingdale, N. Y.
J-Omega Co., Mountain View, Calif.
Jewell Electrical Instrs., Manchester, N.H.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Leader Instruments Corp., Long Island City, N.Y.
London Co., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Schauer Mfg. Corp., Cincinnati, Ohio
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Weston Instruments, Inc., Newark, N.J.

Meters, Multitester (Digital)

Allied Elctrns., Chicago, Ill. ..... Vol 1•387
California Instrs. Co., San Diego, Cal. Vol 1•409
Data Precision Corporation, Wakefield, Mass. ..... Vol 1•419
Dynascan Corp., Chicago, Ill.. Vol 1•401
Hickok Elect. Instr., Cleveland, Ohio Vol 4•409*
Julie Research Lab., New York, N.Y. Vol 1•465
Simpson Elec. Co., Chicago, Ill. Vol 1•503
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Tektronix, Inc., Beaverton, Ore. Vol 1• 513
Triplett Corp., Bluffton, Ohio Vol 1•524; Vol 4•427*
Calico Div., San Diego, Cal.
Cubic Corp., San Diego, Cal.
Dana Labs., Inc., Irvine, Calif.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dytro Corp., Hicksville, N.Y.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
ESE, Inglewood, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Rand Corp., Edison, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Leader Instruments Corp., Long Island City, N.Y.
NES, Inc., Itasca, Ill.
NOBEX Div., Burlingame, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
United Sys. Corp., Dayton, Ohio
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Multitester (Potentiometric)

Allied Elctrns., Chicago, Ill. ..... Vol 1•387
Biddle, James G., Plymouth Meeting, Pa. ..... Vol 1•399
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Doric Sci. Corp., San Diego, Calif.
Esterline Angus Div., Indianapolis, Ind.
Guildline Instrs., Inc., Larchmont, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Western Reserve Elctrns., Twinsburg, Ohio

Meters, Nanampere

Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Doric Sci. Corp., San Diego, Calif.
Elcor Prods. Welex Elctrns., Silver Spring, Md.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Simpson Elec. Co., Chicago, Ill.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Victoreen Instr., Cleveland, Ohio

Meters, Nanovolt

Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Doric Sci. Corp., San Diego, Calif.
General Elec., W. Lynn, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Quan-Tech, Whippany, N.J.
Simpson Elec. Co., Chicago, Ill.
Systron-Donner Concord Instr. Div., Concord, Cal.
Test & Measuring Instrs. Inc., Hicksville, N.Y.

Meters, Noise-Figure

Kay Elemetrics, Pine Brook, N.J. Vol 1•472
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal. ..... Vol 1•507
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal. ..... Vol 1•507
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
B & K Instrs., Inc., Cleveland, Ohio
Elcom Sys., Deer Pk., N.Y.

General Microwave Corp., Farmingdale, N.Y.
Metrix Instr. Co., Houston, Tex.
Quan-Tech, Whippany, N.J.
Solatron Enterprises, Inglewood, Calif.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Triplett Corp., Bluffton, Ohio
Vari-L Co., Inc., Denver, Colo.

Meters, Null

Brown Electro-Meas. Corp., Kirkland, Wash. ..... Vol 1•398
Freed Transformer Co., Bklyn., N.Y. Vol 1•445
Jewell Electrical Instrs., Manchester, N.H. ..... Vol 1•463
Julie Research Lab., New York, N.Y. Vol 1•467
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Triplett Corp., Bluffton, Ohio .. Vol 1•527
Ammon Instrs., Inc., Manchester, N.H.
AUL Instrs., Inc., Flushng, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Ind'l. Test Equip., Clifton, NJ
Int'l. Instrs., Orange, Conn.
Keithley Instrs., Inc., Cleveland, Ohio
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
McKee-Pedersen Instrs., Danville, Calif.
Mura Corp., Jericho, N.Y.
North Atlantic Inds., Plainview, N.Y.
Q.V.S., Inc., East Orange, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Theta Instr. Corp., Fairfield, N.J.
Trio Labs, Inc., Plainview, N.Y.
Weinschel Engrg. Co., Gaithersburg, Md.
Western Reserve Elctrns., Twinsburg, Ohio
Zi-Tech Div., Palo Alto, Cal.

Meters, Ohm

California Instrs. Co., San Diego, Cal. Vol 1•409
Freed Transformer Co., Bklyn., N.Y. Vol 1•445,447
Hickok Elect. Instr., Cleveland, Ohio Vol 1•452,453
Hipotronics, Inc., Brewster, N.Y. Vol 1•454,455
Julie Research Lab., New York, N.Y. Vol 1•467
London Co., Cleveland, Ohio .. Vol 1•478
Shalcross, Selma, N.C. ..... Vol 1•501
Slaughter Co., Ardmore, Okla. Vol 1•505
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Triplett Corp., Bluffton, Ohio Vol 1•519,527
Amprobe Instr., Lynbrook, N.Y.
Anderson, W.E., Inc., Kansas City, Mo.
Associated Resch., Chicago, Ill.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Components Specialties, Freeport, N.Y.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Digilin, Inc., Glendale, Cal.
Eldorado Electrodata, Concord, Cal.
Electro-Numerics, Santa Clara, Cal.
Electro Sci. Inds., Portland, Ore.
ESE, Inglewood, Cal.
GC Electronics, Rockford, Ill.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Int'l. Instrs., Orange, Conn.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
J-Omega Co., Mountain View, Calif.
Jewell Electrical Instrs., Manchester, N.H.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Leader Instruments Corp., Long Island City, N.Y.
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Thomas & Betts Co., Elizabeth, N.J.
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Panel (D'Arsonval Movement)

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Faria Meter Corp., Uncasville, Conn. Vol 1•443
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 1•448,449
Hickok Elect. Instr., Cleveland, Ohio Vol 4•411*
Hoyt Elec. Instr. Works, Belmont, Mass. Vol 1•456,457
Jewell Electrical Instrs., Manchester, N.H. ..... Vol 1•463
Simpson Elec. Co., Chicago, Ill. Vol 1•502
Triplett Corp., Bluffton, Ohio Vol 1•526,527
Airpax Elctrns., Ft. Lauderdale, Fla.
Ammon Instrs., Inc., Manchester, N.H.
Dixson Inc., Meter Div., Grand Junction, Colo.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
Modutec, Inc., Norwalk, Conn.
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Panel (Digital)

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•395
California Instrs. Co., San Diego, Cal. Vol 1•409
Datascan, Inc., Clifton, N.J. ..... Vol 1•421
Datel Systems Inc., Canton, Mass. Vol 1•339
Electro-Numerics, Santa Clara, Cal. Vol 1•434
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 1•448
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y. ..... Vol 1•450
Newport Labs., Inc., Santa Ana, Cal. Vol 4•417*
Simpson Elec. Co., Chicago, Ill. Vol 1• 502
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Triplett Corp., Bluffton, Ohio Vol 1•528,529
Ametek/Instrs. & Controls, Feasterville, Pa.
Analogic, Wakefield, Mass.
Calico Div., San Diego, Cal.
Computer Prods., Ft. Lauderdale, Fla.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Electronic Research Co., Shawnee Mission, Kan.
Foxboro Co., Foxboro, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Honeywell, Denver, Colo.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Instrument Displays, Waltham, Mass.
LFE Corp., Waltham,, Mass.
NES, Inc., Itasca, Ill.
RDF Corp., Hudson, N.H.
Schaevitz Engrg., Pennsauken, N.J.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
United Sys. Corp., Dayton, Ohio
Velonex, Santa Clara, Calif.
Weston Instruments, Inc., Newark, N.J.

Meters, Peak Power

Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Pioneer/Instrumentation, Cleveland, Ohio ..... Vol 1•494
Bendix, Franklin, Ind.
Electro Impulse, Inc., Red Bank, N.J.
Emergency Beacon Corp., New Rochelle, N. Y.
General Microwave Corp., Farmingdale, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Narda Microwave Corp., Plainview, N.Y.
Ohio Semitronics, Columbus, Ohio
Pacific Meas., Inc., Palo Alto, Calif.
PRD Elctrns., Inc., Westbury, N.Y.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, Period

Compuline Corp., Paoli, Pa.
Hickok Elect. Instr., Cleveland, Ohio
Simpson Elec. Co., Chicago, Ill.
Speed Detectors, Bedford, Ohio
Systron-Donner Concord Instr. Div., Concord, Cal.

Meters, Permeameter

LDJ Electronics, Troy, Mich..... Vol 1•476
Thomas & Skinner, Inc., Indianapolis, Ind. ..... Vol 1•515
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
O. S. Walker Co., Worcester, Mass.

Meters, Phase-Angle

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•423-426
Dytronics Co., Columbus, Ohio Vol 1•422
Freed Transformer Co., Bklyn., N.Y. Vol 1•447
North Atlantic Inds., Plainview, N.Y. Vol 1•365
Alford Mfg. Co., Winchester, Mass.
Chesterfield Prods. Inc., Saddle Brook, N. J.
Collins Radio Co., Dallas, Tex.
Computer Conversions Corp., East Northport, N.Y.
Control Elctrns. Co., Inc., Farmingdale, N.Y.
Feedback, Inc., Berkeley Hghts., N.J.
General Elec., W. Lynn, Mass.
General Rand Corp., Edison, N.J.
Hathaway Instruments, Inc., Denver, Colo.
Ind'l. Test Equip., Clifton, NJ
Kratos, Pasadena, Cal
Krohn-Hite, Cambridge, Mass.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Columbus, Columbus, Ohio
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Theta Instr. Corp., Fairfield, N.J.
Tracor, Inc., Austin, Tex.
Trio Labs, Inc., Plainview, N.Y.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Vibration Instrs. Co., Anaheim, Cal.
Video Research Corp., Gaithersburg, Md.
Wavetek, San Diego, Cal.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

Meters, Phase Vector Volt

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•423,426
Dytronics Co., Columbus, Ohio
Ind'l. Test Equip., Clifton, NJ
Ithaco, Inc., Ithaca, N.Y.
Kratos, Pasadena, Cal
Krohn-Hite, Cambridge, Mass.
NH Research, Inc., Santa Ana, Calif.
North Atlantic Inds., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Princeton Applied Resch. Corp., Princeton, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Theta Instr. Corp., Fairfield, N.J.
Tracor, Inc., Austin, Tex.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Wiltron Co., Palo Alto, Calif.

Meters, Picoampere

Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
Doric Sci. Corp., San Diego, Calif.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Keithley Instrs., Inc., Cleveland, Ohio
London Co., Cleveland, Ohio
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Victoreen Instr., Cleveland, Ohio

Meters, Power Factor

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•426
Associated Resch., Chicago, Ill.
Beckman Instrs., Cedar Grove, N.J.
Davidson Elctrn. Dev. Co., Erie, Pa.
Edison Elctrns. Div., Manchester, N.H.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Kratos, Pasadena, Cal
NH Research, Inc., Santa Ana, Calif.
Q.V.S., Inc., East Orange, N.J.
Scientific Columbus, Columbus, Ohio
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Weston Instruments, Inc., Newark, N.J.

Meters, Power, R-F

Bendix, Franklin, Ind. ..... Vol 2•609
Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Boonton Elctrns., Parsippany, N.J. Vol 1•407
Systron-Donner Corp., Concord, Cal. Vol 1•510
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•510
Systron-Donner Datapulse Div., Culver City, Cal. ..... Vol 1•510
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal. ..... Vol 1•510
Systron-Donner Microwave Div., Van Nuys, Cal. ..... Vol 1•510
Ailtech, City of Industry, Cal.

Ballantine Laboratories, Inc., Boonton,, N. J.
Comdel, Inc., Beverly, Mass.
Drake, R.L., Co., Miamisburg, Ohio
Electro Impulse, Inc., Red Bank, N.J.
Elctrn. Navigation Inds., Inc., Rochester, N.Y.
Emergency Beacon Corp., New Rochelle, N. Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
Heath Co., Benton Harbor, Mich.
Mobil Elctrns., Inc., Anderson, Ind.
Narda Microwave Corp., Plainview, N.Y.
NES, Inc., Itasca, Ill.
Pacific Meas., Inc., Palo Alto, Calif.
PRD Elctrns., Inc., Westbury, N.Y.
Q.V.S., Inc., East Orange, N.J.
RCA Corp., Camden, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Triplett Corp., Bluffton, Ohio
Vari-L Co., Inc., Denver, Colo.

Meters, Pyrometer

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•395
Newport Labs., Inc., Santa Ana, Cal. Vol 4•418*
Triplett Corp., Bluffton, Ohio .. Vol 1•527
Alnor Instr. Co., Chicago, Ill.
Amprobe Instr., Lynbrook, N.Y.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bristol Div, Waterbury, Conn
Caig Labs., Inc., Westbury, N.Y.
Cole-Parmer Instr. Co., Chicago, Ill.
Doric Sci. Corp., San Diego, Calif.
Edison, Instr. Div., W. Orange, N.J.
Epic, Inc., New York, N.Y.
General Elec., W. Lynn, Mass.
Int'l. Instrs., Orange, Conn.
J-B-T Instrs., Inc., New Haven, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Modutec, Inc., Norwalk, Conn.
Omega Engrg., Inc., Stamford, Conn.
Pacific Transducer Corp., Los Angeles, Calif.
Pioneer/Instrumentation, Cleveland, Ohio
Raytek, Inc., Mountain View, Cal.
Simpson Elec. Co., Chicago, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Thermo Elec. Co., Inc., Saddle Brook, N.J.

Meters, Q

Freed Transformer Co., Bklyn., N.Y. Vol 1•445
Marconi Instrs., Englewood, N.J. Vol 1•485
Dranetz Engrg. Labs., So. Plainfield, N.J.
Hy-Cal Engrg., Santa Fe Springs, Cal.
J-Omega Co., Mountain View, Calif.
Rohde & Schwarz Sls., Passaic, N.J.

Meters, Ratio

Freed Transformer Co., Bklyn., N.Y. Vol 1•446,447
Ithaco, Inc., Ithaca, N.Y. ..... Vol 2•317
Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
Bailey Meter Co., Wickliffe, Ohio
Computer Instrs., Hempstead, N.Y.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Doric Sci. Corp., San Diego, Calif.
Dytro Corp., Hicksville, N.Y.
Edison, Instr. Div., W. Orange, N.J.
Electric Tachometer Corp., Philadelphia, Pa.
Electro-Numerics, Santa Clara, Cal.
Electro Sci. Inds., Portland, Ore.
Esterline Angus Div., Indianapolis, Ind.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Innovatek Enterprise, Millerton, N.Y.
MSI Electronics, Inc., Woodside, N.Y.
North Atlantic Inds., Plainview, N.Y.
Pacific Meas., Inc., Palo Alto, Calif.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Vari-L Co., Inc., Denver, Colo.

Meters, Recording

Amprobe Instr., Lynbrook, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bristol Div, Waterbury, Conn
Dytro Corp., Hicksville, N.Y.
Electronic Dev. Corp., Boston, Mass.
Esterline Angus Div., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Honeywell, Ft. Washington, Pa.
Leeds & Northrup Corp., No. Wales, Pa.
Omega Engrg., Inc., Stamford, Conn.
Pacific Transducer Corp., Los Angeles, Calif.
Recorder Systems Div., E. Greenwich, R.I.
Schaevitz Engrg., Pennsauken, N.J.
Simpson Elec. Co., Chicago, Ill.
Singer Co., Philadelphia, Pa.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Texas Instruments, Inc., Houston, Tex.
Veeder-Root, Hartford, Conn.
Vu-data Corp., San Diego, Cal.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Meters, Reflectometer

Tektronix, Inc., Beaverton, Ore. Vol 1•513
Beckman Instrs., (AISSD), Fullerton, Cal.
Emergency Beacon Corp., New Rochelle, N. Y.
Gamma Sci., San Diego, Cal.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Lion Precision Corp, Newton, Mass.
Narda Microwave Corp., Plainview, N.Y.
New-Tronics Corp., Brookpark, Ohio
Rohde & Schwarz Sls., Passaic, N.J.
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.

Meters, R-F

Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Ballantine Laboratories, Inc., Boonton,, N. J.
Bendix, Franklin, Ind.
Elctrn. Navigation Inds., Inc., Rochester, N.Y.
Emergency Beacon Corp., New Rochelle, N. Y.
General Microwave Corp., Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ideal Precision Meter Co., Brooklyn, N. Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Pacific Meas., Inc., Palo Alto, Calif.
Q.V.S., Inc., East Orange, N.J.
Simpson Elec. Co., Chicago, Ill.
Triplett Corp., Bluffton, Ohio
Vari-L Co., Inc., Denver, Colo.

Meters, RFI

Instrs. For Ind., Inc., Farmingdale, N.Y. Vol 1•461
Astro Comm. Lab., Gaithersburg, Md.
Electro/Data, Inc., Garland, Tex.
Electro-Mechanics Co., Austin, Tex.
Honeywell, Denver, Colo.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Tucker Electronics Co., Garland, Tex.

Meters, S-Unit

Allied Elctrns., Chicago, Ill.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Hoyt Elec. Instr. Works, Belmont, Mass.
Mura Corp., Jericho, N.Y.
Shurite Meters, New Haven, Conn.

Meters, Snap-Around

Amprobe Instr., Lynbrook, N.Y.
Columbia Elec. Mfg. Co., Cleveland, Ohio
Esterline Angus Div., Indianapolis, Ind.
Simpson Elec. Co., Chicago, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Triplett Corp., Bluffton, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Standing Wave Ratio

Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Alford Mfg. Co., Winchester, Mass.
Bendix, Franklin, Ind.
Drake, R.L., Co., Miamisburg, Ohio
Dynascan Corp., Chicago, Ill.
Emergency Beacon Corp., New Rochelle, N. Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Heath Co., Benton Harbor, Mich.
Johnson E. F. Co., Waseca, Minn.
Narda Microwave Corp., Plainview, N.Y.
New-Tronics Corp., Brookpark, Ohio
PRD Elctrns., Inc., Westbury, N.Y.
Radiation Devices Co., Baltimore, Md.
Rank Precision Inds., Des Plaines, Ill.
Telonic Inds., Inc., Laguna Beach, Calif.
Vari-L Co., Inc., Denver, Colo.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Meters, Temperature (Contacting)

Electronic Research Co., Shawnee Mission, Kan. ..... Vol 1•431
Harrel, Inc., E. Norwalk, Conn. Vol 2•1163
NES, Inc., Itasca, Ill. ..... Vol 1•363
Newport Labs., Inc., Santa Ana, Cal. Vol 4•418*
Omega Engrg., Inc., Stamford, Conn. Vol 2•1173
Triplett Corp., Bluffton, Ohio Vol 1•519,524
Aerotronic Assocs., Inc., Contoocook, N.H.
Amprobe Instr., Lynbrook, N.Y.
Bailey Instrs., Inc., Saddle Brook, N.J.
Bailey Meter Co., Wickliffe, Ohio
Bay Labs., Inc., Cleveland, Ohio
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Datametrics Inc., Wilmington, Mass.
Digilin, Inc., Glendale, Cal.
Doric Sci. Corp., San Diego, Calif.
Esterline Angus Div., Indianapolis, Ind.
Faria, Thomas G. Corp., Uncasville, Conn.
General Elec., W. Lynn, Mass.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Jewell Electrical Instrs., Manchester, N.H.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Mann, Henry Inc., Feasterville, Pa.
Modutec, Inc., Norwalk, Conn.
NL Inds., Inc., Hightstown, N.J.
Pacific Transducer Corp., Los Angeles, Calif.
RDF Corp., Hudson, N.H.
Relco Prods., Denver, Colo.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Rosemount Nashville Inc., Lavergne, Tenn.
Stow Labs., Inc., Hudson, Mass.
Telmar, Inc., Columbus, Ohio
VirTis Co., Gardiner, N.Y.
Wahl, Wm. Corp., Los Angeles, Cal.
Westronics, Inc., Ft. Worth, Tex.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Meters, Temperature, Dial-Type (Non-Contacting)

—See Pyrometers

Meters, Thermal Transfer

Ballantine Laboratories, Inc., Boonton,, N. J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Julie Research Lab., New York, N.Y.
NES, Inc., Itasca, Ill.
Precision Timer Co., Westbrook, Conn.
RDF Corp., Hudson, N.H.
Thermo Sys., Inc., St. Paul, Minn.

Meters, Time Interval

—See Timers, Interval

Meters, Vacuum Tube Volt (VTVM)

Dynascan Corp., Chicago, Ill.. Vol 1•401
Ballantine Laboratories, Inc., Boonton,, N. J.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
North Atlantic Inds., Plainview, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Ross Engrg. Corp., Campbell, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Trio Labs, Inc., Plainview, N.Y.
Triplett Corp., Bluffton, Ohio

Meters, Vibration

Dytronics Co., Columbus, Ohio Vol 1•422
Unholtz-Dickie Corp., Hamden, Conn. Vol 1•530
Advanced Dynamic Instrs. Div., Alexandria, Va.
Bell & Howell Co., Pasadena, Calif.
Biddle, James G., Plymouth Meeting, Pa.
Columbia Resch. Labs., Woodlyn, Pa.
Endevco, Pasadena, Calif.
Epic, Inc., New York, N.Y.
General Radio Co., Concord, Mass.
Ithaco, Inc., Ithaca, N.Y.
Kaman Sciences Corp., Colorado Springs, Colo.
L.A.B. Corp., Skaneateles, N.Y.
Larson Aero Dev., Concord, Calif.
Metra Instruments, Inc., Mt. View, Cal.
Metrix Instr. Co., Houston, Tex.
PCB Piezotronics, Inc., Depew, N.Y.
Reliance Elec. Co., Cleveland, Ohio
Robertshaw Controls Co., Richmond, Va.
Rohde & Schwarz Sls., Passaic, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Tech Serv., Inc., Fogelsville, Pa.
United Detector Technology Inc., Santa Monica, Cal.
Vibra-Metrics, Inc., E. Haven, Conn.
Vibration Instrs. Co., Anaheim, Cal.

Meters, Volt

Beede Electrical Instr. Co., Inc., Penacook, N.H. ..... Vol 1•394
Boonton Elctrns., Parsippany, N.J. Vol 1•406-408
Electro-Mechanical Instr. Div., Perkasie, Pa. ..... Vol 1•433
Electronic Dev. Corp., Boston, Mass. Vol 1•429
Faria Meter Corp., Uncasville, Conn. Vol 1•443

Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
ITT Jennings, San Jose, Cal Vol 1•458,459
ITT Jennings, Instrus. & Systems, San Jose, Calif. ..... Vol 1•458,459
Julie Research Lab., New York, N.Y. Vol 1•467,469
Modutec, Inc., Norwalk, Conn. Vol 1•486-489
Pioneer/Instrumentation, Cleveland, Ohio ..... Vol 1•494
Precision Standards Corp., Santa Ana, Cal. ..... Vol 1•495
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Systron-Donner Corp., Concord, Cal. Vol 1•511
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•511
Test & Measuring Instrs. Inc., Hicksville, N.Y. ..... Vol 4•423*
Triplett Corp., Bluffton, Ohio Vol 1•519,525,527,529
Airpax Elctrns., Ft. Lauderdale, Fla.
Allied Elctrns., Chicago, Ill.
Ammon Instrs., Inc., Manchester, N.H.
Amprobe Instr., Lynbrook, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Biddle, James G., Plymouth Meeting, Pa.
Bristol Div, Waterbury, Conn
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
E-H Resch. Labs., Inc., Oakland, Cal.
Eldorado Electrodata, Concord, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Ind'l. Test Equip., Clifton, NJ
Instrument Displays, Waltham, Mass.
Int'l. Instrs., Orange, Conn.
J-Omega Co., Mountain View, Calif.
Jewell Electrical Instrs., Manchester, N.H.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Kratos, Pasadena, Cal
Lambda Elctrns., Melville, N.Y.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
LFE Corp., Waltham,, Mass.
London Co., Cleveland, Ohio
Marconi Instrs., Englewood, N.J.
Mura Corp., Jericho, N.Y.
NES, Inc., Itasca, Ill.
Newport Labs., Inc., Santa Ana, Cal.
North Atlantic Inds., Plainview, N.Y.
Q.V.S., Inc., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Telmar, Inc., Columbus, Ohio
Trio Labs, Inc., Plainview, N.Y.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Volt, Deviation

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•427
AMF Electical Prods., Alexandria, Va.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Doric Sci. Corp., San Diego, Calif.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Electronic Dev. Corp., Boston, Mass.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Rand Corp., Edison, N.J.
Int'l. Instrs., Orange, Conn.
Keithley Instrs., Inc., Cleveland, Ohio
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
NES, Inc., Itasca, Ill.
Precision Standards Corp., Santa Ana, Cal.
Simpson Elec. Co., Chicago, Ill.
Voltex Co., Inc., Farmingdale, N.Y.
Weston Instruments, Inc., Newark, N.J.

Meters, Volt, Differential—See Meters, Volt

Meters, Volt, Digital (DVM) & Accessories

Biddle, James G., Plymouth Meeting, Pa. ..... Vol 1•399
Boonton Elctrns., Parsippany, N.J. Vol 1•406,407
Dytro Corp., Hicksville, N.Y. .... Vol 1•342
Hickok Elect. Instr., Cleveland, Ohio Vol 1•452,453; Vol 4•407-409*
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Newport Labs., Inc., Santa Ana, Cal. Vol 4•417*
Systron-Donner Corp., Concord, Cal. Vol 1•511
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Test & Measuring Instrs. Inc., Hicksville, N.Y. ..... Vol 4•423*
Triplett Corp., Bluffton, Ohio Vol 1•528,529
Astrosystems, Inc., Lake Success, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Bay Labs., Inc., Cleveland, Ohio
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Bristol Div, Waterbury, Conn
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
Computer Prods., Ft. Lauderdale, Fla.
Dana Labs., Inc., Irvine, Calif.
Data Precision Corporation, Wakefield, Mass.
Data Technology, Santa Ana, Cal.
Datascan, Inc., Clifton, N.J.
Digilin, Inc., Glendale, Cal.
Dixson Inc., Meter Div., Grand Junction, Colo.
Doric Sci. Corp., San Diego, Calif.
Dynascan Corp., Chicago, Ill.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Electronic Dev. Corp., Boston, Mass.
Electronic Research Co., Shawnee Mission, Kan.
ESE, Inglewood, Cal.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Heath Co., Benton Harbor, Mich.
IEC Electronics Corp., E. Rochester, N.Y.
Innovatek Enterprise, Millerton, N.Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
J-Omega Co., Mountain View, Calif.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Leader Instruments Corp., Long Island City, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Micro Instr. Co., Hawthorne, Cal.
Monitor Labs, Inc., San Diego, Cal.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
Pacific Meas., Inc., Palo Alto, Calif.
Penn Airborne Prods., Southampton, Pa.
Phoenix Data Inc., Phoenix, Ariz.
Practical Automation, Inc., Shelton, Conn.
Rohde & Schwarz Sls., Passaic, N.J.
Ross Engrg. Corp., Campbell, Cal.
Sensor Corp., Scottsdale, Pa.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Systron-Donner Microwave Div., Van Nuys, Cal.
Systron Donner Trygon Elctrns. Sub., Westbury, N.Y.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Transducer Controls Corp., Covina, Calif.
United Sys. Corp., Dayton, Ohio
Vidar Corp., Mountain View, Cal.
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.
Wiltron Co., Palo Alto, Calif.

Meters, Volt, Electrostatic

Custom Sci. Instrs., Inc., Whippany, N.J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Weston Instruments, Inc., Newark, N.J.

Meters, Volt, Frequency Selective

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•427
B & K Instrs., Inc., Cleveland, Ohio
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Elcom Sys., Deer Pk., N.Y.
Kratos, Pasadena, Cal
Marconi Instrs., Englewood, N.J.
Princeton Applied Resch. Corp., Princeton, N.J.
Quan-Tech, Whippany, N.J.
Railway Comm., Raytown, Mo.
Rohde & Schwarz Sls., Passaic, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Weston Instruments, Inc., Newark, N.J.

Meters, Volt, Log-Conversion

Ballantine Laboratories, Inc., Boonton,, N. J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Kratos, Pasadena, Cal
Modutec, Inc., Norwalk, Conn.
NES, Inc., Itasca, Ill.
Pacific Meas., Inc., Palo Alto, Calif.
Q.V.S., Inc., East Orange, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Wiltron Co., Palo Alto, Calif.

Meters, Volt, Potentiometric

Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bristol Div, Waterbury, Conn
Doric Sci. Corp., San Diego, Calif.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro Sci. Inds., Portland, Ore.
Electronic Dev. Corp., Boston, Mass.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Keithley Instrs., Inc., Cleveland, Ohio
Precision Standards Corp., Santa Ana, Cal.
Telmar, Inc., Columbus, Ohio

Meters, Volt, R-F

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Triplett Corp., Bluffton, Ohio Vol 1• 519,527
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Microwave Corp., Farmingdale, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Jerrold Electronics Corp., Philadelphia, Pa.
Marconi Instrs., Englewood, N.J.
Micro Instr. Co., Hawthorne, Cal.
Q.V.S., Inc., East Orange, N.J.
Radiation Devices Co., Baltimore, Md.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Ross Engrg. Corp., Campbell, Cal.
Simpson Elec. Co., Chicago, Ill.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Volt, Sampling

Dranetz Engrg. Labs., So. Plainfield, N.J. ..... Vol 1•427
Automated Meas., Oakland, Calif.
E-H Resch. Labs., Inc., Oakland, Cal.
Micro Instr. Co., Hawthorne, Cal.
NES, Inc., Itasca, Ill.

Meters, Volt, True RMS

Boonton Elctrns., Parsippany, N.J. Vol 1•406-408
Hickok Elect. Instr., Cleveland, Ohio Vol 1•453
AMF Electical Prods., Alexandria, Va.
B & K Instrs., Inc., Cleveland, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Data Technology, Santa Ana, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electro-Numerics, Santa Clara, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Ind'l. Test Equip., Clifton, NJ
Inservco, Inc., La Grange, Ohio
Intronics, Inc., Newton, Mass.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Jewell Electrical Instrs., Manchester, N.H.
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leader Instruments Corp., Long Island City, N.Y.
Marconi Instrs., Englewood, N.J.
Q.V.S., Inc., East Orange, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Columbus, Columbus, Ohio
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Thermo Sys., Inc., St. Paul, Minn.
Triplett Corp., Bluffton, Ohio
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Volt-Ohm-Milliampere (VOM)

Allied Elctrns., Chicago, Ill. ..... Vol 1•387
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Amprobe Instr., Lynbrook, N.Y.
AUL Instrs., Inc., Flushng, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Data Technology, Santa Ana, Cal.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
ESE, Inglewood, Cal.
General Rand Corp., Edison, N.J.
Heath Co., Benton Harbor, Mich.

Keithley Instrs., Inc., Cleveland, Ohio
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron-Donner Concord Instr. Div., Concord, Cal.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Western Reserve Elctrns., Twinsburg, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, VU

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Allied Elctrns., Chicago, Ill.
Altec Div., Anaheim, Calif.
Ammon Instrs., Inc., Manchester, N.H.
Beede Electrical Instr. Co., Inc., Penacook, N.H.
Dixson Inc., Meter Div., Grand Junction, Colo.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Edison Elctrns. Div., Manchester, N.H.
Electro-Mechanical Instr. Div., Perkasie, Pa.
Hoyt Elec. Instr. Works, Belmont, Mass.
Ideal Precision Meter Co., Brooklyn, N. Y.
Int'l. Instrs., Orange, Conn.
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
Mura Corp., Jericho, N.Y.
Q.V.S., Inc., East Orange, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Shurite Meters, New Haven, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Vu-data Corp., San Diego, Cal.
Weston Instruments, Inc., Newark, N.J.

Meters, Watt

Bendix, Franklin, Ind. ..... Vol 2•609
Bird Elctrn., Cleveland, Ohio.... Vol 1•396
Clarke - Hess, New York, N.Y. Vol 1•411
Ohio Semitronics, Columbus, Ohio Vol 1•491
Triplett Corp., Bluffton, Ohio .. Vol 1•519
Ailtech, City of Industry, Cal.
Barnes & Reinecke, Inc., Chicago, Ill.
Cubic Corp., San Diego, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
General Elec., W. Lynn, Mass.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
Intronics, Inc., Newton, Mass.
Kratos, Pasadena, Cal
Larson Instr. Co., Inc., Orangeburg, N.Y.
LFE Corp., Waltham,, Mass.
Marconi Instrs., Englewood, N.J.
NH Research, Inc., Santa Ana, Calif.
Proto Matic Co., Cincinnati,, Ohio
Scientific Columbus, Columbus, Ohio
Scientific Educational Prods., N.Y., N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

Meters, Watt-Hour

Ohio Semitronics, Columbus, Ohio Vol 1•491
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Halmar Elctrns., Inc., Columbus, Ohio
Hickok Elect. Instr., Cleveland, Ohio
NES, Inc., Itasca, Ill.
Sangamo Elec. Co., Springfield, Ill.
Scientific Columbus, Columbus, Ohio
Weston Instruments, Inc., Newark, N.J.

Meters, Wave

Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Marconi Instrs., Englewood, N.J.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.

Meters, Waveguide—See Meters, Microwave

Microcircuit Production Equip.

Baron-Blakeslee, Div. Purex Corp., Chicago, Ill.
CGS Units, Inc., Rochester, N.Y.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Electro Sci. Inds., Portland, Ore.
Environmental Communications Inc., Santa Ana, Cal.
GTI Corp. (E), Pittsburgh, Pa.
Hadron Inc., Westbury, N.Y.
Hull Corp., Hatboro, Pa.
IPT Corp., Sunnyvale, Cal.
Mann, David W. Co., Burlington, Mass.
Materials Resch. Corp., Orangeburg, N.Y.
Podgor, Joseph Co., Pennsauken, N.J.
Sprague Elec. Co., No. Adams, Mass.
TRW Instrs., El Segundo, Cal.
Uthe Technology Int'l., Sunnyvale, Cal.

Microcircuits—See Circuits, Integrated; Circuits, Hybrid

Microfilm Production Equipment

W-F Products, Inc., Denver, Co. Vol 1•934

Microfilm Retrieval Systems

W-F Products, Inc., Denver, Co. Vol 1•934
Hadron Inc., Westbury, N.Y.
Johnson Research Corp., Farmingdale, N.Y.
3M Co., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Western Reserve Elctrns., Twinsburg, Ohio

Micrometers, Electronic

Kaman Sciences Corp., Colorado Springs, Colo.
Lion Precision Corp, Newton, Mass.
Minnetech Labs, Minneapolis, Minn.
Opto-Metric Tools, Rockleigh, N.J.
Sensor Corp., Scottsdale, Pa.
Spatial Data Systems, Inc., Goleta, Cal.
Transducer Controls Corp., Covina, Calif.

Microphone Accessories (Including Stands, Holders, Booms)

Atlas Sound Div., Parsippany, N.J.
General Radio Co., Concord, Mass.
Primo Company Ltd., Tokyo, Japan
Turner Div., Cedar Rapids, Iowa

Microphones, Carbon

Astatic Corp., Conneaut, Ohio
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
ISC/Telephonics Div, Huntington, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Telex Comm. Div., Minneapolis, Minn.
Turner Div., Cedar Rapids, Iowa

Microphones, Cardioid

AKG, New York, N.Y.
Allied Elctrns., Chicago, Ill.
Altec Div., Anaheim, Calif.
Astatic Corp., Conneaut, Ohio
Audiotronics, N. Hollywood, Cal.
Bogen Div., Paramus, N.J.
Concord Communications Sys., Farmingdale, N.Y.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
Executone, Inc., Long Island City, N.Y.
GC Electronics, Rockford, Ill.
Gotham Audio Corp., New York, N.Y.
Knowles Elctrns., Inc., Franklin Park, Ill.
Mura Corp., Jericho, N.Y.
RCA Corp., Camden, N.J.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Turner Div., Cedar Rapids, Iowa
University Sound, Anaheim, Cal.

Microphones, Ceramic

Astatic Corp., Conneaut, Ohio
B & K Instrs., Inc., Cleveland, Ohio
Chesapeake Instr. Corp., Shadyside, Md.
Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
General Radio Co., Concord, Mass.
Knowles Elctrns., Inc., Franklin Park, Ill.
Linden Labs., Inc., State College, Pa.
Primo Company Ltd., Tokyo, Japan
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Sonotone Corp., Elmsford, N.Y.
Telex Comm. Div., Minneapolis, Minn.
Turner Div., Cedar Rapids, Iowa

Microphones, Condenser

Primo Company Ltd., Tokyo, Japan Vol 1•317
AKG, New York, N.Y.
Altec Div., Anaheim, Calif.
B & K Instrs., Inc., Cleveland, Ohio
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
General Radio Co., Concord, Mass.
Gotham Audio Corp., New York, N.Y.
Knowles Elctrns., Inc., Franklin Park, Ill.
Mura Corp., Jericho, N.Y.
Sennheiser Elctrn. Corp., New York, NY

Microphones, Contact

Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.

Microphones, Crystal

Astatic Corp., Conneaut, Ohio
Columbia Resch. Labs., Woodlyn, Pa.
Components Specialties, Freeport, N.Y.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
Primo Company Ltd., Tokyo, Japan
RCA Corp., Camden, N.J.
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.

Microphones, Dynamic

AKG, New York, N.Y.
Allied Elctrns., Chicago, Ill.
Altec Div., Anaheim, Calif.
Astatic Corp., Conneaut, Ohio
Audiotronics, N. Hollywood, Cal.
Bogen Div., Paramus, N.J.
Components Specialties, Freeport, N.Y.
Concord Communications Sys., Farmingdale, N.Y.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
Executone, Inc., Long Island City, N.Y.
GC Electronics, Rockford, Ill.
ISC/Telephonics Div, Huntington, N.Y.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
Kulite Semiconductor Prod., Ridgefield, N.J.
Mura Corp., Jericho, N.Y.
Primo Company Ltd., Tokyo, Japan
RCA Corp., Camden, N.J.
Saxton Prods., Congers, N.Y.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Telex Comm. Div., Minneapolis, Minn.
Turner Div., Cedar Rapids, Iowa
University Sound, Anaheim, Cal.

Microphones, Magnetic

Bogen Div., Paramus, N.J.
Conrac Corp., Cedar Rapids, Iowa
Knowles Elctrns., Inc., Franklin Park, Ill.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Sonotone Corp., Elmsford, N.Y.

Microphones, Noise-Cancelling

AKG, New York, N.Y.
Altec Div., Anaheim, Calif.
Astatic Corp., Conneaut, Ohio
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
Executone, Inc., Long Island City, N.Y.
Heitz, Karl, Inc., New York, N.Y.
ISC/Telephonics Div, Huntington, N.Y.
Knowles Elctrns., Inc., Franklin Park, Ill.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
Sennheiser Elctrn. Corp., New York, NY
Shure Bros., Inc., Evanston, Ill.
Telex Comm. Div., Minneapolis, Minn.
Turner Div., Cedar Rapids, Iowa

Microphones, Omnidirectional

Columbia Resch. Labs., Woodlyn, Pa.
Primo Company Ltd., Tokyo, Japan
Turner Div., Cedar Rapids, Iowa

Microphones, Pressure

AKG, New York, N.Y.
Altec Div., Anaheim, Calif.
B & K Instrs., Inc., Cleveland, Ohio
Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Cedar Rapids, Iowa
Electro-Voice, Inc., Buchanan, Mich.
Kistler Instr. Co., Redmond, Wash.
Knowles Elctrns., Inc., Franklin Park, Ill.
RCA Corp., Camden, N.J.
Sennheiser Elctrn. Corp., New York, NY
Shure Bros., Inc., Evanston, Ill.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Stow Labs., Inc., Hudson, Mass.
Turner Div., Cedar Rapids, Iowa

Microphones, Ribbon

Conrac Corp., Cedar Rapids, Iowa
RCA Corp., Camden, N.J.
Shure Bros., Inc., Evanston, Ill.

Microphones, Sound-Powered

Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Cedar Rapids, Iowa
ISC/Telephonics Div, Huntington, N.Y.

Microphones, Throat

Conrac Corp., Cedar Rapids, Iowa
Sennheiser Elctrn. Corp., New York, NY
Sonotone Corp., Elmsford, N.Y.

Microphones, Velocity

Altec Div., Anaheim, Calif.
RCA Corp., Camden, N.J.
Sennheiser Elctrn. Corp., New York, NY
Shure Bros., Inc., Evanston, Ill.

Microphones, Wireless

Concord Communications Sys., Farmingdale, N.Y.
Mura Corp., Jericho, N.Y.
Primo Company Ltd., Tokyo, Japan
RCA Corp., Camden, N.J.
Ryka Scientific, Inc., Sunnyvale, Cal.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.

Microscopes

Bausch & Lomb, Rochester, N.Y.
Christie Elec., Los Angeles, Cal.
Edmund Scientific Co., Barrington, N.J.
Esco Products, Oak Ridge, NJ
Gaertner Scientific Corp., Chicago, Ill.
Gamma Sci., San Diego, Cal.
Hacker Instrs., Inc., Fairfield, N.J.
Heitz, Karl, Inc., New York, N.Y.
Jonard Inds. Corp., Bronx, N.Y.
Lenox Instr. Co., Philadelphia, Pa.
Nikon, Inc., Instr. Div., Ehrenreich Photo-Optical Ind., Garden City, N.Y.
Olympus Corp. America, New Hyde Park, N.Y.
Pacific Transducer Corp., Los Angeles, Calif.
Stereotronics Television Co., Sherman Oaks, Cal.
Techni-Tool, Inc., Philadelphia, Pa.
Titan Tool Supply Co., Inc., Buffalo, N.Y.

Unitron Instr. Co., Newton Highlands, Mass.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Microscopes, Electron

Bausch & Lomb, Rochester, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.

Microscopes, Infrared

Barnes Engrg. Co., Stamford, Conn.
Research Devices, Berkeley Heights, N.J.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Microscopes, Measuring

Bausch & Lomb, Rochester, N.Y.
CELCO, Mahwah, N.J.
Edmund Scientific Co., Barrington, N.J.
Gaertner Scientific Corp., Chicago, Ill.
Hacker Instrs., Inc., Fairfield, N.J.
Lenox Instr. Co., Philadelphia, Pa.
Nikon, Inc., Instr. Div., Ehrenreich Photo-Optical Ind., Garden City, N.Y.
Olympus Corp. America, New Hyde Park, N.Y.
Opto-Metric Tools, Rockleigh, N.J.
Rank Precision Inds., Des Plaines, Ill.
Titan Tool Supply Co., Inc., Buffalo, N.Y.
Unitron Instr. Co., Newton Highlands, Mass.

Microscopes, Ultraviolet

Black Light Corp. Amer., San Gabriel, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
Wild Heerbrugg Instrs., Farmingdale, N.Y.

Microwave Duplexers

Systron-Donner Corp., Concord, Cal. Vol 1•510
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•510
Systron-Donner Datapulse Div., Culver City, Cal. ..... Vol 1•510
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal. ..... Vol 1•510
Systron-Donner Microwave Div., Van Nuys, Cal. ..... Vol 1•510
Americon Microwave Inds., Inc., Waltham, Mass.
Arra Inc., Bay Shore, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Norsal Industries, Inc., Brentwood, N.Y.
OPtimax Inc., Colmar, Pa.
Technical Research & Mfg. Co., Manchester, N.H.
Theta-Com CATV, Phoenix, Ariz
UTE Microwave, Asbury Park, N.J.
Varian Assocs., Palo Alto, Cal.

Microwave Line Stretchers

Systron-Donner Corp., Concord, Cal. Vol 1•510
Systron-Donner Concord Instr. Div., Concord, Cal. ..... Vol 1•510
Systron-Donner Datapulse Div., Culver City, Cal. ..... Vol 1•510
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal. ..... Vol 1•510
Systron-Donner Microwave Div., Van Nuys, Cal. ..... Vol 1•510
Aircom, Inc., Union, N.H.
Alford Mfg. Co., Winchester, Mass.
Arra Inc., Bay Shore, N.Y.
General Radio Co., Concord, Mass.
Lorch Elctrns. Corp., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Mismatches, Microwave, Precision

Texscan Corp., Indianapolis, Ind. Vol 1•514
Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
Aircom, Inc., Union, N.H.
Alford Mfg. Co., Winchester, Mass.
Americon Microwave Inds., Inc., Waltham, Mass.
Arra Inc., Bay Shore, N.Y.
General Radio Co., Concord, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.

Mixer-Preamplifiers, Microwave

Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Airtron, Morris Plains, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
E & M Laboratories, Inc., Westlake Village, Cal.
Environmental Communications Inc., Santa Ana, Cal.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
LNR Communications, Inc., Farmingdale, N.Y.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Omni-Spectra, Inc., Tempe, Ariz.
OPtimax Inc., Colmar, Pa.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Spectra Sonics, Ogden, Utah
Technical Research & Mfg. Co., Manchester, N.H.
Transco Prods., Inc., Venice, Cal.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.

Mixers, Audio

Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Altec Div., Anaheim, Calif.
Ampex Corp., Redwood City, Calif.
Bogen Div., Paramus, N.J.
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Dallas, Tex.
Davis J.W. & Co., Dallas, Texas
Edison Elctrns. Div., Manchester, N.H.
Fairchild Sound Equip., Commack, N.Y.
Gotham Audio Corp., New York, N.Y.
Lithic Systems, Inc., Cupertino, Cal.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Shure Bros., Inc., Evanston, Ill.
Spectra Sonics, Ogden, Utah

Mixers, Microwave

Anaren Microwave, Inc., Syracuse, N.Y. Vol 4•438*
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
RHG Elctrns. Lab., Deer Park, N.Y. Vol 2•619
R L C Elctrns., Inc., Mt. Kisco, N.Y. Vol 2•620
Vari-L Co., Inc., Denver, Colo. Vol 2•623-626
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Americon Microwave Inds., Inc., Waltham, Mass.
Anzac Elctrns., Waltham, Mass.
CES Elctrns., Brooklyn, N.Y.
Collins Radio Co., Dallas, Tex.
E & M Laboratories, Inc., Westlake Village, Cal.
Elcom Sys., Deer Pk., N.Y.
Engelmann Microwave, Montville, N.J.
Frequency Engrg. Labs., Farmingdale, N.J.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Radio Co., Concord, Mass.
HRB-Singer, Inc., State College, Pa.
LNR Communications, Inc., Farmingdale, N.Y.
Loral Elctrn. Sys., Bronx, N.Y.
Merrimac Inds., Inc., West Caldwell, N.J.
Micro-Now Instr., Chicago, Ill.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Prods., Inc., Chatsworth, Cal.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Mini-Circuits Lab., Brooklyn, N.Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
Omni-Spectra, Inc., Tempe, Ariz.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Raytheon Co., Waltham, Mass.
Rodelco, Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vector Industries, Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.

Mixers, R-F

Anaren Microwave, Inc., Syracuse, N.Y. Vol 4•438*
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
Mini-Circuits Lab., Brooklyn, N.Y. Vol 2•616,617
R L C Elctrns., Inc., Mt. Kisco, N.Y. Vol 2•620
Vari-L Co., Inc., Denver, Colo. Vol 2•623-626
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Americon Microwave Inds., Inc., Waltham, Mass.
Anzac Elctrns., Waltham, Mass.
C-COR Elctrns., State College, Pa.
Comdel, Inc., Beverly, Mass.
E & M Laboratories, Inc., Westlake Village, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elcom Sys., Deer Pk., N.Y.
Engelmann Microwave, Montville, N.J.
Frequency Engrg. Labs., Farmingdale, N.J.
General Radio Co., Concord, Mass.
HRB-Singer, Inc., State College, Pa.
Lithic Systems, Inc., Cupertino, Cal.
Merrimac Inds., Inc., West Caldwell, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Miteq Inc., Hauppauge, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Omni-Spectra, Inc., Tempe, Ariz.
OPtimax Inc., Colmar, Pa.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Summit Engrg. Corp., Bozeman, Mont.
Systron-Donner Microwave Div., Van Nuys, Cal.
Transco Prods., Inc., Venice, Cal.
Varian, Beverly, Mass.
Vector Industries, Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Modems—See Modulator/Demodulators, Data

Modulation Transfer Analyzers—See Analyzers, Transfer Function

Modulator/Demodulators, Data

Almond Instrs. Co., Covina, Cal Vol 1•935
Control Technology Co., L.I.C., N.Y. Vol 2•986
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Anaren Microwave, Inc., Syracuse, N.Y.
Applied Digital Data Systems, Inc., Hauppauge, N.Y.
Bowmar/ALI, Inc., Acton, Mass.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burroughs Corp., Pasadena, Cal.
Cermetek, Inc., Mountain View, Cal.
Codex Corp., Newton, Mass.
Computer Conversions Corp., East Northport, N.Y.
Data-Control Systems, Danbury, Conn.
Elctrn. Comm., Inc., St. Petersburg, Fla.
General Data Inds. Inc. Inc., Wilton, Conn.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
General Microwave Corp., Farmingdale, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hathaway Instruments, Inc., Denver, Colo.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Integrated Systems, Inc., Norcross, Ga.
International Communications Corp., A Milgo Co., Miami, Fla.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Natel Engrg. Co., Canoga Pk., Cal.
NES, Inc., Itasca, Ill.
Re-el Circuits, Inc., Saddle Brook, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Signetics. Corp., Sunnyvale, Calif.
Singer - Tele-Signal, Woodbury, N.Y.
Tasker Systems, Chatsworth, Cal.

Modulator/Demodulators, Laser

American Time Products, Woodside, N.Y.
Bertan Assocs., Inc., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Harshaw Chem. Co., Cleveland, Ohio
Kappa Scientific Corp., Santa Barbara, Cal.
Optical Communications, Inc., Orlando, Fla.
Radiation Devices Co., Baltimore, Md.
Raytheon Co., Waltham, Mass.
Union Carbide, San Diego, Cal.

Modulators, A-M

Clarke - Hess, New York, N.Y. Vol 1•411
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Transmagnetics Inc., Farmingdale, N. Y. Vol 1•379
Anaren Microwave, Inc., Syracuse, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Dallas, Tex.
Control Technology Co., L.I.C., N.Y.
E & M Laboratories, Inc., Westlake Village, Cal.
Elcom Sys., Deer Pk., N.Y.
Feedback, Inc., Berkeley Hghts., N.J.
General Magnetics, Bloomfield, N.J.

General Microwave Corp., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
Lithic Systems, Inc., Cupertino, Cal.
Lorch Elctrns. Corp., Englewood, N.J.
Melpar, Falls Church, Va.
Millen, James Mfg., Malden, Mass.
Mini-Circuits Lab., Brooklyn, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
Signetics. Corp., Sunnyvale, Calif.
Vari-L Co., Inc., Denver, Colo.
Watkins Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

Modulators, F-M

Almond Instrs. Co., Covina, Cal Vol 1•935
Solid State Elctrns. Corp., Sepulveda, Cal. ..... Vol 1•937
Anaren Microwave, Inc., Syracuse, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Clarke - Hess, New York, N.Y.
Data-Control Systems, Danbury, Conn.
Dynalab Corp., Van Nuys, Cal.
Eimac, San Carlos, Calif.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Environmental Communications Inc., Santa Ana, Cal.
GTE Lenkurt Inc., San Carlos, Calif.
Ind'l. Test Equip., Clifton, NJ
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Elcom Sys., Deer Pk., N.Y.
Elctrn. Enterprises, Newark, N.J.
Energy Systems, Palo Alto, Cal.
GAF Corp., New York, N.Y.
General Microwave Corp., Farmingdale, N.Y.
GHZ Devices, Inc., So. Chelmsford, Mass.
GTE Lenkurt Inc., San Carlos, Calif.
Kilovolt Corp., Hackensack, N.J.
Litton Inds., San Carlos, Calif.
Megavolt, Inc., New York, N.Y.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
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Norsal Industries, Inc., Brentwood, N.Y.
Premier Microwave, Port Chester, N.Y.
Rantec Div., Calabasas, Calif.
Raytheon Co., Waltham, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
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RHG Elctrns. Lab., Deer Park, N.Y.
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Rohde & Schwarz Sls., Passaic, N.J.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
TRG Prods., E. Boston, Mass.
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Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.
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Bowmar Instr. Corp., Ft. Wayne, Ind.
Carco Elctrns., Menlo Park, Calif.
Collins Radio Co., Dallas, Tex.
Comdel, Inc., Beverly, Mass.
Del Electronics Corp., Mt. Vernon, N.Y.
Eimac, San Carlos, Calif.
Elcom Sys., Deer Pk., N.Y.
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General Microwave Corp., Farmingdale, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
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Elcom Sys., Deer Pk., N.Y.
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Jerrold Electronics Corp., Philadelphia, Pa.
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Microlab/FXR, Livingston, N.J.
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R L C Elctrns., Inc., Mt. Kisco, N.Y.
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Hathaway Instruments, Inc., Denver, Colo.
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Reliance Elec. Co., Cleveland, Ohio
TRW/Globe Motors, Dayton, Ohio
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TRW/Globe Motors, Dayton, Ohio Vol 2•664
American Elctrns., Inc., Fullerton, Cal.
Ametek/Lamb Elec., Kent, Ohio
Ashland Elec. Prods., L.I.C., N.Y.
B & B Motor & Control, New York, NY
Bristol Saybrook Co., Old Saybrook, Conn.
Clifton Precision, Clifton Hgts., Pa.
Control Data Corp., Minneapolis, Minn.
Doerr Electric Corp., Cedarburg, Wisc.
Electric Indicator Co., Inc., Norwalk, Conn.
Electro-Craft Corp, Hopkins, Minn
General Scanning, Watertown, Mass.
Howard Inds., Milford, Ill.
Indiana Gen'l. Div., Oglesby, Ill.
ITT Jennings, San Jose, Cal
Japanese Prods. Corp., New Rochelle, N. Y.
MFE Corporation, Salem, N.H.
Micro Switch, Freeport, Ill.
Molon Motors & Coil, Rolling Meadows, Ill.
Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Reliance Elec. Co., Cleveland, Ohio
Sawyer Inds., Arcadia, Cal.
Sequential Information Systems, Elmsford, N.Y.
Servotronics, Inc., Buffalo, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Singer Co., Little Falls, N.J.
Superior Elec., Bristol, Conn.
Torque Systems, Waltham, Mass.
Transicoil, Inc., Worcester, Pa.
Vernitech, Deer Pk., N.Y.
Western Gear Corp., Pasadena, Cal.

Motors, Universal, A-C Or D-C Operation

Carter Motor Co., Chicago, Ill. Vol 2•635
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•646
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American Elctrns., Inc., Fullerton, Cal.
Ametek/Lamb Elec., Kent, Ohio
B & B Motor & Control, New York, NY
Bodine Elec. Co., Chicago, Ill.
Electric Indicator Co., Inc., Norwalk, Conn.
ITT Jennings, San Jose, Cal
Jones Motrola Corp., Stamford, Conn.
Sawyer Inds., Arcadia, Cal.
Shigoto Inds., Ltd., New York, N.Y.
TRW/Globe Motors, Dayton, Ohio

Mounts, Antenna (Nonconsumer Applications)

Geo Space Sys., Tampa, Fla. .. Vol 1•550
ABA Industries, Inc., Pinellas Pk., Fla.
Aeroflex Labs., Plainview, N.Y.
Collins Radio Co., Dallas, Tex.
Craig Sys. Corp., Lawrence, Mass.
Datron Systems, Chatsworth, Cal.
Electro-Mechanics Co., Austin, Tex.
GC Electronics, Rockford, Ill.
Hunter Spring, Hatfield, Pa.
IE Mfg. Co., Chicago, Ill.
Jerrold Electronics Corp., Philadelphia, Pa.
K-W Engrg. Works, Menomonee Falls, Wisc.
Lord Kinematics, Erie, Pa.
Microflect Co., Salem, Ore.
New-Tronics Corp., Brookpark, Ohio
Nurad, Inc., Baltimore, Md.
Phelps Dodge Comm., North Haven, Conn.
Premax Prods. Div., Niagara Falls, N.Y.
RF Systems, Inc., Cohasset, Mass.
Rohn Mfg., Peoria, Ill.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sinclair Radio Labs., Maple, Ont., Can.
Sitco Antennas, Portland, Ore.
South River Metal Prods. Co., South River, N.J.
TRG Prods., E. Boston, Mass.
Tri-Ex Tower Corp., Visalia, Calif.

Mounts, CRT & Accessories

Syntronic Instrs., Inc., Addison, Ill. Vol 3•535
CELCO, Mahwah, N.J.
Conrac Div., Covina, Calif.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Gould Data Systems, Newton Upper Falls, Mass.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Waterbury Pressed Metal Co., Waterbury, Conn.

Mounts, Crystal

Bliley Electric, Erie, Pa. .... Vol 2•388,389
Erie Frequency Control, Carlisle, Pa. Vol 2•406
Reeves-Hoffman Div., Carlisle, Pa. Vol 2•444
Accurate Elctrns. Corp., Elyria, Ohio
Aircom, Inc., Union, N.H.
CES Elctrns., Brooklyn, N.Y.
General Microwave Corp., Farmingdale, N.Y.
GTI Corp. (E), Pittsburgh, Pa.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Quaker Elctrns., Hunlock Creek, Pa.
Robinson-Nugent, New Albany, Ind.
Systron-Donner Microwave Div., Van Nuys, Cal.
TRG Prods., E. Boston, Mass.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.

Mounts, Integrated Circuit—See Sockets, Integrated Circuit

Mounts, Klystron

General Microwave Corp., Farmingdale, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Narda Microwave Corp., Plainview, N.Y.
Premier Microwave, Port Chester, N.Y.
Rank Precision Inds., Des Plaines, Ill.
TRG Prods., E. Boston, Mass.
Weinschel Engrg. Co., Gaithersburg, Md.

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Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
Aircom, Inc., Union, N.H.
CES Elctrns., Brooklyn, N.Y.
General Microwave Corp., Farmingdale, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microflect Co., Salem, Ore.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.

Mounts, Mobile Antenna—See Mounts, Antenna

Mounts, Shock & Vibration

Aeroflex Labs., Plainview, N.Y.
Air-Loc Products, Franklin, Mass.
Collins Radio Co., Cedar Rapids, Iowa
GAF Corp., New York, N.Y.
Grant Hardware Co., W. Nyack, N.Y.
Lord Kinematics, Erie, Pa.
Nikon, Inc., Instr. Div., Ehrenreich Photo-Optical Ind., Garden City, N.Y.
Stock Drive Prods., New Hyde Pk., N.Y.
TA Mfg. Corp., Los Angeles, Cal.
3M Co., St. Paul, Minn.
Uniroyal, Inc., New York, N.Y.
Zero Mfg. Co., Burbank, Cal.

Mounts, Tape Head

Int'l. Electro-Magnetics, Palatine, Ill. Vol 1•313
Cramer Division, Old Saybrook, Conn.
Nortronics, Mpls., Minn.

Mounts, Thermistor

General Microwave Corp., Farmingdale, N.Y.
Honeywell, Ft. Washington, Pa.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
Omega Engrg., Inc., Stamford, Conn.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Mounts, Transistor—See Pads, Transistor Mounting

Multiplexers, Analog

Computer Labs, Greensboro, N.C. Vol 1•335
Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Preston Scientific, Anaheim, Cal. Vol 1•369
ABA Industries, Inc., Pinellas Pk., Fla.
A. D. Data Sys., Inc., Rochester, N.Y.
Bay Labs., Inc., Cleveland, Ohio
Burr-Brown Resch. Corp., Tucson, Ariz.
Counterscan Systems, Sutton, Neb.
Datametrics Inc., Wilmington, Mass.
Datum, Inc., Anaheim, Calif.
ILC Data Device Corp., Hicksville, N.Y.
Metra Instruments, Inc., Mt. View, Cal.
Transmagnetics Inc., Farmingdale, N. Y.

Multiplexers, Digital

A. D. Data Sys., Inc., Rochester, N.Y. Vol 1•325
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ABA Industries, Inc., Pinellas Pk., Fla.
Bendix Corp, Towson, Md.
Bramco Controls, Piqua, Ohio
Counterscan Systems, Sutton, Neb.
Data General Corp. (E), Southboro, Ma.
Datum, Inc., Anaheim, Calif.
Instrumentation Tech. Corp., Northbridge, Cal.
Microwave Assocs., Inc., Burlington, Mass.
Theta Instr. Corp., Fairfield, N.J.
Transmagnetics Inc., Farmingdale, N. Y.

Multiplexers, Transmission

Preston Scientific, Anaheim, Cal. Vol 1•369
A. D. Data Sys., Inc., Rochester, N.Y.
Anaren Microwave, Inc., Syracuse, N.Y.
Bramco Controls, Piqua, Ohio
Microphase Corp., Cos Cob, Conn.
Norsal Industries, Inc., Brentwood, N.Y.

Multipliers, Analog

Burr-Brown Resch. Corp., Tucson, Ariz. Vol 1•328,329
Clarke - Hess, New York, N.Y. Vol 1•411
Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Intronics, Inc., Newton, Mass. Vol 2•316
Transmagnetics Inc., Farmingdale, N. Y. Vol 1•379
Ailtech, City of Industry, Cal.
American Aerospace Controls Inc., Farmingdale, N.Y.
Analogic, Wakefield, Mass.
Bell & Howell, Bridgeport, Conn.
Dynalab Corp., Van Nuys, Cal.
Elctrn. Assocs., W. Long Branch, N.J.
General Magnetics, Bloomfield, N.J.
GPS Corp., Framingham, Mass.
Ind'l. Test Equip., Clifton, NJ
Intech, Santa Clara, Cal.
Neff Instr. Corp., Duarte, Calif.
NES, Inc., Itasca, Ill.
Princeton Applied Resch. Corp., Princeton, N.J.
Systron Donner Computer Systems Div., Concord, Cal.
Teledyne Philbrick, Dedham, Mass.
Zeltex, Inc., Concord, Calif.

Multipliers, Crystal

Collins Radio Co., Dallas, Tex.
General Microwave Corp., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Microlab/FXR, Livingston, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Somerset Radiation Lab., Arlington, Va.
Trak Microwave, Tampa, Fla.
Vector Industries, Palo Alto, Cal.

Multipliers, Diode

AFI Industries Inc., Long Branch, N.J. Vol 4•513*
Anzac Elctrns., Waltham, Mass.
BF Elctrns., Solana Beach, Calif.
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Elctrn. Devices, Yonkers, N.Y.
Environmental Communications Inc., Santa Ana, Cal.
AFI Industries Inc., Long Branch, N. J.
GPS Corp., Framingham, Mass.
Greenray Inds., Inc., Mechanicsburg, Pa.
Microwave Assocs., Inc., Burlington, Mass.
Motorola Semiconductor Prods., Phoenix, Ariz.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
RHG Elctrns. Lab., Deer Park, N.Y.
Semtech Corp., Newbury Pk., Cal.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Varo Semiconductor, Inc., Garland, Tex.
Vector Industries, Palo Alto, Cal.

Multipliers, Frequency

Applied Research Inc., Port Washington, N.Y. ..... Vol 2•607
Hybrid Sys. Corp., Burlington, Mass. Vol 1•348
Lorch Elctrns. Corp., Englewood, N.J. Vol 2•615
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Addington Labs., Inc., Sunnyvale, Cal.
Ajax Magnethermic Corp., Warren, Ohio
American Elctrn. Labs., Inc., Lansdale, Pa.
Anadex Instrs., Inc., Van Nuys, Calif.
Anzac Elctrns., Waltham, Mass.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
Collins Radio Co., Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
Electrac, Inc., Anaheim, Calif.
Environmental Communications Inc., Santa Ana, Cal.
Frequency Elctrns., New Hyde Pk., N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
Frequency Sources, No. Chelmsford, Mass.
Greenray Inds., Inc., Mechanicsburg, Pa.
Interstate Elctrns. Corp., Anaheim, Cal.
Matrix Corp., Beech Grove, Ind.
MCL, Inc., La Grange, Ill.
Meloy Laboratories Inc., Springfield, Va.
Microlab/FXR, Livingston, N.J.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Mini-Circuits Lab., Brooklyn, N.Y.
Miteq Inc., Hauppauge, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
Mu-Del Elctrns., Silver Spring, Md.
National Semiconductor, Santa Clara, Cal.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Signetics. Corp., Sunnyvale, Calif.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Trak Microwave, Tampa, Fla.
Union Carbide, San Diego, Cal.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vector Industries, Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.

Multipliers, Hall

American Aerospace Controls Inc., Farmingdale, N.Y.
Ohio Semitronics, Columbus, Ohio
Scientific Columbus, Columbus, Ohio

Multipliers, Magnetic Analog

General Magnetics, Bloomfield, N.J. Vol 2•338
American Aerospace Controls Inc., Farmingdale, N.Y.
Transmagnetics Inc., Farmingdale, N. Y.
O. S. Walker Co., Worcester, Mass.

Multipliers, Meter

Del Electronics Corp., Mt. Vernon, N.Y. Vol 1•657
AMF Electical Prods., Alexandria, Va.
Edison Elctrns. Div., Manchester, N.H.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Mepco, Inc., Morristown, N.J.
Ross Engrg. Corp., Campbell, Cal.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Weston Instruments, Inc., Newark, N.J.

Multipliers, Servo

Control Technology Co., L.I.C., N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
General Magnetics, Bloomfield, N.J.
Glentek, Inc., Santa Monica, Calif.
Hybrid Sys. Corp., Burlington, Mass.
Ind'l. Control Co., Farmingdale, N.Y.
Scientific-Atlanta, Inc., Atlanta, Ga.
Transicoil, Inc., Worcester, Pa.

Nameplates

Datak Corp., Passaic, N.J. ..... Vol 2•479
Alco Elctrn. Prods., North Andover, Mass.
Bell Co., Inc., Trussville, Ala.
Brady, W.H. Co., Milwaukee, Wisc.
Central Plastics Dists., Chicago, Ill.
Devco Engrg., W. Caldwell, N.J.
Hermes Plastics, Inc., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Laminated Fabricators, San Bruno, Calif.
Matthews, Jas & Co., Pittsburgh, Pa.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Panelgraphic Corp., Caldwell, N.J.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Photronic Labs., Danbury, Conn.
PIC Design Division, Ridgefield,, Conn.
Shigoto Inds., Ltd., New York, N.Y.
Smith, Herman H., Inc., Bklyn., N.Y.
Sterling Instr., New Hyde Pk., NY
Tech-Etch, Inc., Hingham, Mass.
3M Co., St. Paul, Minn.
Topflight Corp., York, Pa.
Waldom Elctrns., Inc., Chicago, Ill.

Networks, Crossover, Attenuator (Audio)

ADC Prods., Minneapolis, Minn.
Altec Div., Anaheim, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Dale Elctrns., Inc., Columbus, Neb.
Dietz Design, Inc., Belton, Mo.
El-Rad Mfg. Co., Chicago, Ill.
Electro-Voice, Inc., Buchanan, Mich.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hisonic, Inc., Olathe, Kans.
Kelvin, Van Nuys, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Sennheiser Elctrn. Corp., New York, NY
Spectra Sonics, Ogden, Utah
Standard Condenser Corp., Chicago, Ill.
TT Elctrns., Inc., Los Angeles, Cal.
University Sound, Anaheim, Cal.

Utah Elctrns., Huntington, Ind.

Networks, Directional Antenna Phasing

Anaren Microwave, Inc., Syracuse, N.Y.
Anzac Elctrns., Waltham, Mass.
Artronic Instr. Co., Silver Spring, Md.
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Dallas, Tex.
Datron Systems, Chatsworth, Cal.
Dynalab Corp., Van Nuys, Cal.
GAF Corp., New York, N.Y.
ILC Data Device Corp., Hicksville, N.Y.
Merrimac Inds., Inc., West Caldwell, N.J.
Premier Microwave, Port Chester, N.Y.
RCA Missile & Surface Radar Div., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz SIs., Passaic, N.J.

Networks, Ladder

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Allen-Bradley Co., Milwaukee, Wisc.
Artronic Instr. Co., Silver Spring, Md.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Components, Inc., Biddeford, Me.
Composite Microcircuits, Waltham, Mass.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Data Delay Devices, Clifton, N.J.
Dietz Design, Inc., Belton, Mo.
Edison Elctrns. Div., Manchester, N.H.
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Precision Comps., Mt. Vernon, N.Y.
Electronic Research Co., Shawnee Mission, Kan.
ESC Elctrns. Corp., Palisades Pk., N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Halex, Inc., Torrance, Cal.
HEI, Inc., Chaska, Minn.
Hisonic, Inc., Olathe, Kans.
HyComp Inc., Maynard, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Julie Research Lab., New York, N.Y.
Kelvin, Van Nuys, Cal.
Marstan Resistor, Orange, N.J.
Mepco, Inc., Morristown, N.J.
Micro Networks, Worcester, Mass.
Pyrofilm Corp., Whippany, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Reon Resistor Corp., Frazer, Pa.
Sprague Elec. Co., No. Adams, Mass.
Tech Labs., Inc., Palisades Pk., N.J.
Tel Labs., Manchester, N.H.
TRW/IRC Fixed Resistors, Philadelphia, Pa.
TT Elctrns., Inc., Los Angeles, Cal.
Ultronix, Inc., Grand Junction, Colo.
Ward Leonard Hagerstown Div., Hagerstown, Md.

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TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan ..... Vol 3•536
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Allen Avionics, Mineola, N.Y.
American Trans-Coil Corp., Richmond Hill, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Artronic Instr. Co., Silver Spring, Md.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Centralab Elctrns Div., Milwaukee, Wisc
Columbia Components, Hempstead, N.Y.
Computer Devices, Commack, N.Y.
Computer Instrs., Hempstead, N.Y.
Data Delay Devices, Clifton, N.J.
Dietz Design, Inc., Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
Electrocom Inds., So. Bend, Indiana
Electronic Research Co., Shawnee Mission, Kan.
ESC Elctrns. Corp., Palisades Pk., N.J.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hisonic, Inc., Olathe, Kans.
Kappa Networks, Inc., Carteret, N.J.
Maxwell Labs., Inc., San Diego, Calif.
Microtran Co. Inc., Valley Stream, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Raytheon Co., Quincy, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCL Elctrns., Inc., Irvington, N.J.
RtroN Corp., Skokie, Ill.
Standard Condenser Corp., Chicago, Ill.
TMC Systems (Ariz.), Tempe, Ariz.
Torotel, Inc., Grandview, Mo.
TT Elctrns., Inc., Los Angeles, Cal.

Networks, Matching

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Alford Mfg. Co., Winchester, Mass.
Altec Div., Anaheim, Calif.
American Trans-Coil Corp., Richmond Hill, N.Y.
Anzac Elctrns., Waltham, Mass.
Balco Capacitors, Orange, N.J.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Collins Radio Co., Dallas, Tex.
Dale Elctrns., Inc., Columbus, Neb.
Data Delay Devices, Clifton, N.J.
Dietz Design, Inc., Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Precision Comps., Mt. Vernon, N.Y.
ESC Elctrns. Corp., Palisades Pk., N.J.
Freed Transformer Co., Bklyn., N.Y.
Gamble, Charles T. Inds., Riverside, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
GRM Corp., Medford, N.J.
Hisonic, Inc., Olathe, Kans.
Jerrold Electronics Corp., Philadelphia, Pa.
Julie Research Lab., New York, N.Y.
Kelvin, Van Nuys, Cal.
Marstan Resistor, Orange, N.J.
Materials Resch. Corp., Orangeburg, N.Y.
Mepco, Inc., Morristown, N.J.
Micro Networks, Worcester, Mass.
Mu-Del Elctrns., Silver Spring, Md.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Nytronics Inc., Darlington, S.C.
Premier Microwave, Port Chester, N.Y.
Pyrofilm Corp., Whippany, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Resistance Prods., Harrisburg, Pa.
Standard Condenser Corp., Chicago, Ill.
TRW/IRC Fixed Resistors, Burlington, Iowa
TT Elctrns., Inc., Los Angeles, Cal.
Vari-L Co., Inc., Denver, Colo.
Vector Industries, Palo Alto, Cal.
Ward Leonard Hagerstown Div., Hagerstown, Md.

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Anzac Elctrns., Waltham, Mass.
ARCO Elctrns., Inc., Great Neck, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Artronic Instr. Co., Silver Spring, Md.
Balco Capacitors, Orange, N.J.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Centralab Elctrns Div., Milwaukee, Wisc
Collins Radio Co,, Dallas, Tex.
Columbia Components, Hempstead, N.Y.
Computer Devices, Commack, N.Y.
Computer Instrs., Hempstead, N.Y.
Data Delay Devices, Clifton, N.J.
Dietz Design, Inc., Belton, Mo.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynalab Corp., Van Nuys, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elctrn. Assocs., W. Long Branch, N.J.
ESC Elctrns. Corp., Palisades Pk., N.J.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hisonic, Inc., Olathe, Kans.
Kappa Networks, Inc., Carteret, N.J.
Kelvin, Van Nuys, Cal.
Marstan Resistor, Orange, N.J.
Merrimac Inds., Inc., West Caldwell, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
RCL Elctrns., Inc., Irvington, N.J.
Theta Instr. Corp., Fairfield, N.J.
TT Elctrns., Inc., Los Angeles, Cal.
Vari-L Co., Inc., Denver, Colo.

Networks, Pulse Forming

Centralab Elctrns Div., Milwaukee, Wisc Vol 2•592
American Trans-Coil Corp., Richmond Hill, N.Y.
Amp Inc., Harrisburg, Pa.
Andersen Labs. Inc., Bloomfield, Conn.
Artronic Instr. Co., Silver Spring, Md.
Cober Elctrns., Inc., Stamford, Conn.
Collins Radio Co., Dallas, Tex.
Columbia Components, Hempstead, N.Y.
Computer Devices, Commack, N.Y.
Computer Instrs., Hempstead, N.Y.
Condenser Prods. Corp., Brooksville, Fla.
Custom Elctrns., Oneonta, N.Y.
Datalight Inc., Bloomfield, Conn.
Del Electronics Corp., Mt. Vernon, N.Y.
Edison Elctrns. Div., Manchester, N.H.
El-Rad Mfg. Co., Chicago, Ill.
ESC Elctrns. Corp., Palisades Pk., N.J.
Freed Transformer Co., Bklyn., N.Y.
General Lab. Assocs., Norwich, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Hisonic, Inc., Olathe, Kans.
ILC Data Device Corp., Hicksville, N.Y.
Kappa Networks, Inc., Carteret, N.J.
Kappa Scientific Corp., Santa Barbara, Cal.
Kelvin, Van Nuys, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Shallco, Inc., Smithfield, N.C.
Sprague Elec. Co., No. Adams, Mass.
Television Microtime, Inc., Bloomfield, Conn.
Tobe Deutschmann Labs., Inc., Canton, Mass.
TT Elctrns., Inc., Los Angeles, Cal.
Vari-L Co., Inc., Denver, Colo.

Networks, Rejection—See Filters

Networks, RC

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KRL Electronics, Manchester, N.H. Vol 3•1145
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Altec Div., Anaheim, Calif.
A. P. Circuit Corp., New York, N.Y.
Bell Industries, Electronic Components Div., Burbank, Cal.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Centralab Elctrns Div., Milwaukee, Wisc
Composite Microcircuits, Waltham, Mass.
Custom Elctrns., Oneonta, N.Y.
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Dynalab Corp., Van Nuys, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Precision Comps., Mt. Vernon, N.Y.
ESC Elctrns. Corp., Palisades Pk., N.J.
Gamble, Charles T. Inds., Riverside, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hybrid Technology Corp., Arlington, Tex.
Kelvin, Van Nuys, Cal.
Marstan Resistor, Orange, N.J.
Maxwell Labs., Inc., San Diego, Calif.
Mepco, Inc., Morristown, N.J.
Midwec Corp., Scottsbluff, Neb.
Murata Mfg. Co. Ltd., Kyoto, Japan
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Plastic Capacitors, Inc., Chicago, Ill.
Plessey Ceramic Div., Frenchtown, N.J.
Presin Co., Inc., Shelton, Conn.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCL Elctrns., Inc., Irvington, N.J.
Resistance Prods., Harrisburg, Pa.
RtroN Corp., Skokie, Ill.
Seacor, Inc., Norwood, N.J.
Shallco, Inc., Smithfield, N.C.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Tel Labs., Manchester, N.H.
TT Elctrns., Inc., Los Angeles, Cal.
Ultronix, Inc., Grand Junction, Colo.
Ward Leonard Hagerstown Div., Hagerstown, Md.
White Instrs., Inc., Austin, Tex.

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CTS Corp, Elkhart, Ind. Vol 2•591; Vol 3•1113-1115
Dale Elctrns., Inc., Columbus, Neb. Vol 2•594,595
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Gamble, Charles T. Inds., Riverside, N.J. ..... Vol 3•1142
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RCL Elctrns., Inc., Irvington, N.J. Vol 3•1164
Resistance Prods., Harrisburg, Pa. Vol 3•1160
SCS Corporation-Microsystems, Ft. Lauderdale, Fla. Vol 2•605
Shallcross, Selma, N.C. Vol 3•1176
TRW/IRC Fixed Resistors, Burlington, Iowa Vol 3•1187,1189
Vishay Resistor Prod. Div., Malvern, Pa. Vol 3•1198
Welwyn Canada Ltd., London, Ont., Can. Vol 2•594,595
Altec Div., Anaheim, Calif.
Arcidy Assocs., Manchester, N. H.
Beckman Instrs., (AISSD), Fullerton, Cal.
Burr-Brown Resch. Corp., Tucson, Ariz.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Components, Inc., Biddeford, Me.
Composite Microcircuits, Waltham, Mass.
Computer Devices, Commack, N.Y.
Corning Glass Works, Elctrn. Prods. Div., Corning, N.Y.
Edison Elctrns. Div., Manchester, N.H.
Electro Sci. Inds., Portland, Ore.
Elctrn. Assocs., W. Long Branch, N.J.
Elctrn. Precision Comps., Mt. Vernon, N.Y.
General Resistance, Inc., Mt. Vernon, N.Y.
GRM Corp., Medford, N.J.
Halex, Inc., Torrance, Cal.
HEI, Inc., Chaska, Minn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Julie Research Lab., New York, N.Y.
Kelvin, Van Nuys, Cal.
Keystone Carbon Co., St. Marys, Pa.
Marstan Resistor, Orange, N.J.
Mepco, Inc., Morristown, N.J.
Mini-Systems, Inc, North Attleboro, Mass.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Nytronics Inc., Darlington, S.C.
Plessey Ceramic Div., Frenchtown, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Reon Resistor Corp., Frazer, Pa.
RFL Inds., Comms. Div., Boonton, N.J.
Rodan Ind's., Anaheim, Ca.
Seacor, Inc., Norwood, N.J.
Shallco, Inc., Smithfield, N.C.
Sprague Elec. Co., No. Adams, Mass.
Statek Corp., Orange, Cal.
Tech Labs., Inc., Palisades Pk., N.J.
Tel Labs., Manchester, N.H.
Thin Film Services, Gile, Wisc.
TRW/IRC Fixed Resistors, Philadelphia, Pa.
Ultronix, Inc., Grand Junction, Colo.
Ward Leonard Hagerstown Div., Hagerstown, Md.

Noise Analyzers—See Analyzers, Noise

Null Detectors—See Indicators, Null

Numeric Readouts—See Readouts-Also See Tubes, Readout

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Oceanographic Equip. (Electronic)

Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
AMF Electical Prods., Alexandria, Va.
Austron, Inc., Austin, Tex.
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Cedar Grove, N.J.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Benthos, Inc., N. Falmouth, Mass.
Beukers Labs., Inc., Hauppauge, N.Y.
Bunker-Ramo Corp., Westlake Village, Cal
Channel Inds., Santa Barbara, Cal.
Chesapeake Instr. Corp., Shadyside, Md.
Cole Instrument Corp., Costa Mesa, Cal.
Del Electronics Corp., Mt. Vernon, N.Y.
Digitron Corp., Norristown, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Edo Western Corp., Salt Lake City, Utah
Guildline Instrs., Inc., Larchmont, N.Y.
Honeywell, Minneapolis, Minn.
Ind'l. Control Co., Farmingdale, N.Y.
Ithaco, Inc., Ithaca, N.Y.
ITT Gilfillan Div. of ITT, Van Nuys, Calif.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Lear Siegler, Inc., Santa Monica, Calif.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Micro Instr. Co., Hawthorne, Cal.
NES, Inc., Itasca, Ill.
NUSonics, Inc., Paramus, N.J.
Plessey Enviromental Sys., San Diego, Cal.
Products for Research, Inc., Danvers, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Relco Prods., Denver, Colo.
Schneider Instr. Co., Cincinnati, Ohio
Signet Scientific Co., Burbank, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Varian Assocs., Palo Alto, Cal.
Vidar Corp., Mountain View, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Oils—See Lubricants

Open-Short Locators—See Locators, Open-Short

Optical Coded Discs—See Coded Discs, Optical

Optical-Coupler Isolators—See Isolators, Opto

Optics, Fiber—See Fiber Optic Bundles

Oscillators, Audio (Module)

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California Instrs. Co., San Diego, Cal. Vol 1•647
Ferwalt, W.H., Inc., Lapwai, Idaho Vol 2•409
Fork Standards, W. Chicago, Ill. Vol 2•410-413
Frequency Devices, Inc., Haverhill, Mass. Vol 2•565
Greenray Inds., Inc., Mechanicsburg, Pa. Vol 2•414,415
Meloy Laboratories Inc., Springfield, Va. Vol 2•428
M F Elctrns. Corp., New York, N.Y. Vol 2•420
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Philamon, Inc., Westbury, N.Y. Vol 2•441
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T-F Electronics, Inc., Austin, Tex. Vol 2•452
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Accutronics, Geneva, Ill.
Ailtech, City of Industry, Cal.
Allen Elctrns. Div., Macungie, Pa.
American Time Products, Woodside, N.Y.
Arra Inc., Bay Shore, N.Y.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Clarke - Hess, New York, N.Y.
Connor-Winfield Corp., West Chicago, Ill.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamic Measurements Corp., Winchester, Ma.
Fairchild Sound Equip., Commack, N.Y.
Ind'l. Test Equip., Clifton, NJ
McCoy Elctrns. Co., Mt. Holly Springs, Pa.
National Semiconductor, Santa Clara, Cal.
Q-Tech Corp., Los Angeles, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Signetics Corp., Sunnyvale, Calif.
Tektronix, Inc., Beaverton, Ore.
Unholtz-Dickie Corp., Hamden, Conn.
Wiltron Co., Palo Alto, Calif.

Oscillators, Audio (Test)—See Generators, Audio

Oscillators, Beat Frequency (BFO)

American Time Products, Woodside, N.Y.
American Trans-Coil Corp., Richmond Hill, N.Y.
Arvin Frequency Devices, Columbus, Ind.
B & K Instrs., Inc., Cleveland, Ohio
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Frequency Elctrns., New Hyde Pk., N.Y.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
Kay Elemetrics, Pine Brook, N.J.
Marconi Instrs., Englewood, N.J.
National Semiconductor, Santa Clara, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Watkins Johnson Co., Palo Alto, Cal.

Oscillators, Bias

American Time Products, Woodside, N.Y.
Arvin Frequency Devices, Columbus, Ind.
Connor-Winfield Corp., West Chicago, Ill.
Nortronics, Mpls., Minn.
Opamp Labs. Inc., Los Angeles, Cal.

Oscillators, Bridge (Test)

Ailtech, City of Industry, Cal.
American Time Products, Woodside, N.Y.
Arvin Frequency Devices, Columbus, Ind.
Fork Standards, W. Chicago, Ill.
General Radio Co., Concord, Mass.
Ind'l. Test Equip., Clifton, NJ

Oscillators, Cavity

Applied Microwave, Westwood, Mass. Vol 1•544
Arra Inc., Bay Shore, N.Y. Vol 2•608
Ailtech, City of Industry, Cal.
Amperex Electronic Corp., Hicksville, N.Y.
Dynalab Corp., Van Nuys, Cal.
Electronic Research Co., Shawnee Mission, Kan.
Frequency Sources, No. Chelmsford, Mass.
MCL, Inc., La Grange, Ill.
Miteq Inc., Hauppauge, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Trak Microwave, Tampa, Fla.

Oscillators, Crystal Controlled (Module)

Accutronics, Geneva, Ill. Vol 2•380-383
Arvin Frequency Devices, Columbus, Ind. Vol 2•379
Austron, Inc., Austin, Tex. Vol 2•385
Bliley Electric, Erie, Pa. Vol 2•386,387
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International Crystal Mfg., Oklahoma City, Okla. Vol 4•390*
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Airtron, Morris Plains, N.J.
American Time Products, Woodside, N.Y.
Amperex Electronic Corp., Hicksville, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Arra Inc., Bay Shore, N.Y.
Collins Radio Co., Cedar Rapids, Iowa
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Croven, Ltd., Whitby, Ont., Can.
Crystal Network Prods. Corp., Erie, Pa.
Frequency Elctrns., New Hyde Pk., N.Y.
Frequency Sources, No. Chelmsford, Mass.
GAF Corp., New York, N.Y.
Gorman-Redlich Mfg. Co., Athens, Ohio
Hope Elctrns., Clifton, N.J.
Miteq Inc., Hauppauge, N.Y.
National Semiconductor, Santa Clara, Cal.
NH Research, Inc., Santa Ana, Calif.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Sierra Sys., Mountain View, Cal.
Snelgrove, C. R. Ltd., Don Mills 404 Ont., Ont. Can.
Standard Logic, Santa Ana, Cal.
Tracor, Inc., Austin, Tex.
Trak Microwave, Tampa, Fla.
Varian, Beverly, Mass.
Wavetek Indiana, Inc., Beech Grove, Ind.

Oscillators, Decade (Test)

Ailtech, City of Industry, Cal.
Arvin Frequency Devices, Columbus, Ind.
Clarke - Hess, New York, N.Y.
Exact Elctrns., Inc., Hillsboro, Ore.
Fork Standards, W. Chicago, Ill.
General Radio Co., Concord, Mass.
Ind'l. Test Equip., Clifton, NJ
NH Research, Inc., Santa Ana, Calif.

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Oscillators, LC

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Solid State Elctrns. Corp., Sepulveda, Cal.

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Arra Inc., Bay Shore, N.Y.
Bramco Controls, Piqua, Ohio
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
Douglas Randall Div., Pawcatuck, Conn.
Dynamic Measurements Corp., Winchester, Ma.
Electronic Research Co., Shawnee Mission, Kan.
Frequency Elctrns., New Hyde Pk., N.Y.
Ind'l. Test Equip., Clifton, NJ
Monitor Prods., S. Pasadena, Cal.
Motorola Inc., Chicago, Ill.
Signetics. Corp., Sunnyvale, Calif.
Spectrum Technology, Goleta, Cal.
Tektronix, Inc., Beaverton, Ore.

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Addington Labs., Inc., Sunnyvale, Cal.
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Amperex Electronic Corp., Hicksville, N.Y.
Arvin Frequency Devices, Columbus, Ind.
Avantek, Inc., Santa Clara, Cal.
Collins Radio Co., Dallas, Tex.
Dynalab Corp., Van Nuys, Cal.
E-H Resch. Labs., Inc., Oakland, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Frequency Sources, No. Chelmsford, Mass.
GAF Corp., New York, N.Y.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Hope Elctrns., Clifton, N.J.
ITT Electron Tube, Easton, Pa.
KMC Semiconductor Corp., Long Valley, N.J.
Litton Inds., San Carlos, Calif.
Marconi Instrs., Englewood, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Micro-Now Instr., Chicago, Ill.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Narda Microwave Corp., Plainview, N.Y.
Omni-Spectra, Inc., Tempe, Ariz.
Parametric Inds., Inc., Winchester, Mass.
Physical Elctrn. Labs., Menlo Park, Calif.
Plessey Semiconductors, Farmingdale, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Elctrns. Comps., Harrison, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Ryka Scientific, Inc., Sunnyvale, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.
Watkins Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Oscillators, Power (Module)

Arra Inc., Bay Shore, N.Y. ..... Vol 2•608
CML-Macarr, Inc., Edison, N.J. Vol 1•641,642
Greenray Inds., Inc., Mechanicsburg, Pa. ..... Vol 2•415
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Ailtech, City of Industry, Cal.
American Time Products, Woodside, N.Y.
Applied Microwave, Westwood, Mass.
Arvin Frequency Devices, Columbus, Ind.
California Instrs. Co., San Diego, Cal.
Clarke - Hess, New York, N.Y.
Dynalab Corp., Van Nuys, Cal.
Dynamic Measurements Corp., Winchester, Ma.
Ferwalt, W.H., Inc., Lapwai, Idaho
Ind'l. Test Equip., Clifton, NJ
Miteq Inc., Hauppauge, N.Y.
NH Research, Inc., Santa Ana, Calif.
Solid State Elctrns. Corp., Sepulveda, Cal.

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Oscillators, Pulse (Module)

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Connor-Winfield Corp., West Chicago, Ill. ..... Vol 2•400,401
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American Time Products, Woodside, N.Y.
Applied Microwave, Westwood, Mass.
Arra Inc., Bay Shore, N.Y.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cermetek, Inc., Mountain View, Cal.
Electronic Research Co., Shawnee Mission, Kan.
Ferwalt, W.H., Inc., Lapwai, Idaho
McCoy Elctrns. Co., Mt. Holly Springs, Pa.
Q-Tech Corp., Los Angeles, Cal.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Signetics. Corp., Sunnyvale, Calif.
Solid State Elctrns. Corp., Sepulveda, Cal.
Texscan Corp., Indianapolis, Ind.
Transystems Elctrn. Co., Fort Lee, N.J.

Oscillators, Pulse (Test)—See Generators, Pulse

Oscillators, Reed

American Time Products, Woodside, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
Bramco Controls, Piqua, Ohio
Motorola Inc., Chicago, Ill.

Oscillators, RC (Module)

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Oscillators, R-F (Module)

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Statek Corp., Orange, Cal.
T-F Electronics, Inc., Austin, Tex.
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Norsal Industries, Inc., Brentwood, N.Y.
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N.Y. Testing Labs., Inc., Westbury, N.Y.
Sawyer Inds., Arcadia, Cal.
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American Instr. Co., Silver Spring, Md.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Baron-Blakeslee, Div. Purex Corp., Chicago, Ill.
Blue M Engrg. Co., Blue Island, Ill.
Caig Labs., Inc., Westbury, N.Y.
Chemical Etching Equip. & Supply, Alexandria, Va.
Custom Sci. Instrs., Inc., Whippany, N.J.
Delta Design, San Diego, Cal
Despatch Oven Co., Minneapolis, Minn.
Fisher Sci. Co., Pittsburgh, Pa.
Forma Scientific, Marietta, Ohio
Hotpack Corp., Phila., Pa.
Lab-Line Instrs., Inc., Melrose Park, Ill.
Master Appliance Corp., Racine, Wisc.
Materials Resch. Corp., Orangeburg, N.Y.
N.Y. Testing Labs., Inc., Westbury, N.Y.
OAL Assocs., Inc., Westbury, N.Y.
Precision Sci. Co., Chicago, Ill.
Sara Scientific Co., San Francisco, Calif.
Standard Environmental Systems, Inc., Totowa, N.J.
Watkins Johnson Co., Palo Alto, Cal.

Ovens, Particle Reduction

Despatch Oven Co., Minneapolis, Minn.

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Baker Co., Inc., Sanford, Me.
Bemco, Inc., Pacoima, Cal.
Fisher Sci. Co., Pittsburgh, Pa.
Forma Scientific, Marietta, Ohio
High Vacuum Equip. Corp., Hingham, Mass.
Hotpack Corp., Phila., Pa.
Hull Corp., Hatboro, Pa.
Kahle Engrg. Co., Union City, N.J.
Lab-Line Instrs., Inc., Melrose Park, Ill.
Materials Resch. Corp., Orangeburg, N.Y.
OAL Assocs., Inc., Westbury, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Precision Sci. Co., Chicago, Ill.
Red Point Corp., Burbank, Calif.
Standard Environmental Systems, Inc., Totowa, N.J.
T-M Vacuum Prods., Riverton, N.J.
Varian Assocs., Palo Alto, Cal.

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Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Bendix Corp., Sidney, N.Y.
Cambridge Thermionic, Cambridge, Mass
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Composite Microcircuits, Waltham, Mass.
Coors Porcelain Co., Golden, Colo.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Hermetic Seal Corp., Rosemead, Cal.
Ind'l. Control Co., Farmingdale, N.Y.
Metalized Ceramics, Providence, R.I.
Mini-Systems, Inc, North Attleboro, Mass.
Modpak, Waltham, Mass.
National Beryllia Corp., Haskell, N.J.
Spec Plastics Inc., No. Hollywood, Cal.
Stevens Prods., Inc., E. Orange, N.J.
Tekform Prods. Co., Anaheim, Cal.
Texas Instruments, Dallas, Tex.
Texas Instruments, Attleboro, Mass.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
United Mineral & Chem. Corp., New York, N.Y.
Varian, Beverly, Mass.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Watkins Johnson Co., Palo Alto, Cal.

Pads, L & T—See Attenuators

Pads, Transistor Mounting

Bivar, Inc., Santa Ana, Cal. Vol 3•1070,1071; Vol 4•311*
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Birnbach Co., Inc., Freeport, N.Y.
Chomerics, Inc., Woburn, Mass.
Christiansen Radio Inc., Laguna Beach, Cal.
Cinch-Monadnock, Oper. of TRW Elctrn. Comps., City of Industry, Cal.
Circuit Structures Lab., Burbank, Calif.
D-Cemco, Inc., Burbank, Calif.
Delbert Blinn. Co., Pomona, Calif.
Elctrn. Molding Corp., Woonsocket, R.I.
Globe Plastics, Pomona, Cal.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
Int'l. Elctrn. Resch., Burbank, Cal.
Keystone Elctrns. Corp., New York, N.Y.
Mann, Henry Inc., Feasterville, Pa.
National Beryllia Corp., Haskell, N.J.
Nippert Co., Delaware, Ohio

Robison Elctrns., Gardena, Cal.
Sealectro Corp., Mamaroneck, N.Y.
Spec Plastics Inc., No. Hollywood, Cal.
Staver Co., Inc., Bay Shore, N.Y.
Union Carbide, Carbon Prods. Div., New York, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Weckesser Co., Inc., Chicago, Ill.
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Paints, Luminous

Black Light Corp. Amer., San Gabriel, Cal.
Edmund Scientific Co., Barrington, N.J.
N L Inds., Inc., Paint Div., New York, N. Y.
Shannon Luminous Mat'ls., Hollywood, Cal.
3M Co., St. Paul, Minn.
Ultra-Violet Prods., Inc., San Gabriel, Cal.

Paints, Metallic

Chomerics, Inc., Woburn, Mass.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Electro-Science Labs., Pennsauken, N. J.
LPS Research Labs., Los Angeles, Cal.
Micro-Circuits Co., New Buffalo, Mich.
N L Inds., Inc., Paint Div., New York, N. Y.
Randolph Prods. Co., Carlstadt, N.J.

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General Elec., Insulating Mat'l's., Schenectady, N.Y.
Methode Elctrns., Inc., Chicago, Ill.
Murata Mfg. Co. Ltd., Kyoto, Japan
N L Inds., Inc., Paint Div., New York, N. Y.
Pennsylvania Ind'l. Chem. Corp., Clairton, Pa.
Podgor, Joseph Co., Pennsauken, N.J.
Randolph Prods. Co., Carlstadt, N.J.
Sel-Rex Co. Div. Oxy Metal Finishing Corp., Nutley, N.J.
Sprayon Prods., Inc., Bedford Hgts., Ohio
Tempil Div., So. Plainfield, N.J.
3M Co., St. Paul, Minn.

Panel Equipment—See Dials; Connectors; Jacks; Lights; etc.

Panel Marking Kits—See Kits, Marking (Dial, Instrument, Equipment, etc.)

Panels, Electroluminescent

Lear Siegler, Grand Rapids, Mich.
Panelgraphic Corp., Caldwell, N.J.
Precision Dynamics Corp., Burbank, Cal.
Singer Co., Little Falls, N.J.
TEC, Inc., Tucson, Ariz.

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Connector Corp., Chicago, Ill.
Littelfuse, Inc., Des Plaines, Ill.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Mobil Elctrns., Inc., Anderson, Ind.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Singer - Tele-Signal, Woodbury, N.Y.
Taylor Industries Inc., Howell, Mich.
Underwriters Safety Device Co., Chicago, Ill.
Wadsworth Elec. Mfg. Co., Inc., Covington, Ky.

Panels, Jack

ADC Prods., Minneapolis, Minn. Vol 3•545,549,551
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Allied Systems Corp., Greensboro, N.C.
Altec Div., Anaheim, Calif.
Amp Inc., Harrisburg, Pa.
Anchor Specialty Mfg., Teterboro, N.J.
Apahouser Corp. of N.E., Boston, Mass.
Artisan Elctrns. Corp., Parsippany, N.J.
Birnbach Co., Inc., Freeport, N.Y.
Bud Radio, Willoughby, Ohio
Connector Corp., Chicago, Ill.
Drake Mfg., Harwood Hgts., Ill.
Elctrn. Molding Corp., Woonsocket, R.I.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Honeywell, Ft. Washington, Pa.
Info-Lite Corp., Corona, N.Y.
International Data Sciences, Providence, R.I.
Interswitch, Burlingame, Cal.
Johnson E. F. Co., Waseca, Minn.
Liberty Controls, Inc., Shorewood, Ill.
LVC Inds. Inc., Flushing, N.Y.
Lynn Elctrns. Corp., Feasterville, Pa.
Mac Panel Co., High Pt., N.C.
Marlin Mfg. Corp., Cleveland, Ohio
Mechanical Engraving Co., Inc., Bronx, N.Y.
Methode Elctrns., Inc., Chicago, Ill.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mobil Elctrns., Inc., Anderson, Ind.
Mupac Corp., Brockton, Mass.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Omega Engrg., Inc., Stamford, Conn.
Paraplegics Mfg., Bensenville, Ill.
Priority Services, Burbank, Cal.
RCA Corp., Camden, N.J.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Smith, Herman H., Inc., Bklyn., N.Y.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Switchcraft, Inc., Chicago, Ill.
Technical Mat'l., Mamaroneck, N.Y.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Virginia Panel Corp., Waynesboro, Va.

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Anchor Specialty Mfg., Teterboro, N.J.
Chem Aero, Inc., Wilmington, Cal.
Cutler-Hammer, Milwaukee, Wisc.
GRM Corp., Medford, N.J.
Hartman Electrical Mfg., Mansfield, Ohio
Mechanical Engraving Co., Inc., Bronx, N.Y.
Methode Elctrns., Inc., Chicago, Ill.
Mupac Corp., Brockton, Mass.

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Cabtron Sys., Inc., Northbrook, Ill.
Elctrn. Molding Corp., Woonsocket, R.I.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hartman Electrical Mfg., Mansfield, Ohio
Hoffman Engrg. Co., Anoka, Minn.
Honeywell, Ft. Washington, Pa.
Honeywell, Inc., Wabash, Ind.
Ingersoll Prods., Chicago, Ill.
Interswitch, Burlingame, Cal.
Liberty Controls, Inc., Shorewood, Ill.
Matrix Engineering Corp., Gardena, Calif.
Metal Works, Inc., Herman, Mo.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mobil Elctrns., Inc., Anderson, Ind.
Mupac Corp., Brockton, Mass.
Par-Metal Prods. Div., Brooklyn, N.Y.
Paraplegics Mfg., Bensenville, Ill.
Scientific-Atlanta, Inc., Atlanta, Ga.
Techmar Corp., Los Angeles, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.
Zero Mfg. Co., Burbank, Cal.

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Paper Shredders

Chemical Etching Equip. & Supply, Alexandria, Va.

Paper-Tape Preparation Systems

Data Specialties Inc., Highland Park, Ill.
Demex, Inc., Kansas City, Mo.
NES, Inc., Itasca, Ill.

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Hathaway Industries Inc., Tulsa, Okla. Vol 1•451
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AGFA-Gevaert, Inc., Teterboro, N.J.
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bell & Howell Co., Pasadena, Calif.
Bristol Div, Waterbury, Conn
California Computer Prods., Anaheim, Cal
Computer Instrs., Hempstead, N.Y.
Dietzgen Corp., Chicago, Ill.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Esterline Angus Div., Indianapolis, Ind.
Fitchburg Coated Products, Scranton, Pa.
Foxboro Co., Foxboro, Mass.
General Elec., W. Lynn, Mass.
General Radio Co., Concord, Mass.
Gould, Inc., Cleveland, Ohio
Graphic Controls Corp., Buffalo, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Honeywell, Ft. Washington, Pa.
Honeywell, Denver, Colo.
Houston Instr., Bellaire, Tex.
Keuffel & Esser Co., Morristown, N.J.
Laboratory Data Control, Riviera Beach, Fla.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Linear Instrs. Corp., Costa Mesa, Cal.
MFE Corporation, Salem, N.H.
Recorder Systems Div., E. Greenwich, R.I.
Schweitzer, Peter J. Div., Lee, Mass.
Soltec Corp., No. Hollywood, Cal.
Texas Instruments, Inc., Houston, Tex.
3M Co., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Palo Alto, Cal.
Westronics, Inc., Ft. Worth, Tex.

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ABA Industries, Inc., Pinellas Pk., Fla.
Aeroflex Labs., Plainview, N.Y.
Andrew Corp., Orland Pk., Ill.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Datron Systems, Chatsworth, Cal.
Emerson & Cuming, Inc., Canton, Mass.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Robicon Corp., Pittsburgh, Pa.
Scientific-Atlanta, Inc., Atlanta, Ga.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tasker Systems, Chatsworth, Cal.
Teledyne Micronetics, San Diego, Calif.

Perforators, Paper Tape (Electrically Powered)

Burroughs Corp., Pasadena, Cal.
Chalco Engrg. Corp., Gardena, Cal.
Data General Corp. (E), Southboro, Ma.
Data Specialties Inc., Highland Park, Ill.
Digitronics Corp., Albertson, N.Y.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Facit-Addo, Inc., Secaucus, N.J.
Precision Mechanisms Corp., Westbury, N.Y.
Remex, Santa Ana, Cal.
Teletype Corp., Skokie, Ill.
United Sys. Corp., Dayton, Ohio

Perforators, Paper Tape (Manually Operated)

Burroughs Corp., Pasadena, Cal.

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Phase & Voltage Analyzers—See Analyzers, Phase & Voltage

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Audiotronics, N. Hollywood, Cal.
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
Gotham Audio Corp., New York, N.Y.
Merix Chem. Co., Chicago, Ill.
Molex Inc., Lisle, Ill.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Thomson-CSF Inc., New York, N.Y.

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Amperex Electronic Corp., Hicksville, N.Y.
Bendix Corp., Sturbridge, Mass.
Gamma Sci., San Diego, Cal.
Hamamatsu Corp. (E), Middlesex, N. J.
Heath Co., Benton Harbor, Mich.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Oriel Corp. of America, Stamford, Conn.
Products for Research, Inc., Danvers, Mass.
SSR Instrs. Co., Santa Monica, Cal.

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Altec Div., Anaheim, Calif.
Electrocom Inds., So. Bend, Indiana
GC Electronics, Rockford, Ill.
Microtran Co. Inc., Valley Stream, N.Y.
NES, Inc., Itasca, Ill.
Saxton Prods., Congers, N.Y.
Shigoto Inds., Ltd., New York, N.Y.

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Air-O-Tronics Prods., Morrisville, N.Y.
GC Electronics, Rockford, Ill.
Jonard Inds. Corp., Bronx, N.Y.
Methode Elctrns., Inc., Chicago, Ill.
Sperry Information Displays Div., Scottsdale, Ariz.

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Accurate Elctrns. Corp., Elyria, Ohio
Airborn, Inc., Dallas, Tex.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Bead Elctrns., Bridgeport, Conn.
Beman Mfg., Inc., New Cumberland, Pa.
Berg Electronics, New Cumberland, Pa.
Chem Aero, Inc., Wilmington, Cal.
Circuit Assembly Corp., Santa Ana, Cal.
Connector Corp., Chicago, Ill.
Dit-MCO International, Kansas City, Mo.
Flex-Link Products, Inc., San Fernando, Cal.
GTE Sylvania Inc., Warren, Pa.
GTI Corp. (E), Pittsburgh, Pa.
LVC Inds. Inc., Flushing, N.Y.
Precision Metal Prods. Co., Stoneham, Mass.
Pylon Co., Inc., Attleboro, Mass.
Robinson-Nugent, New Albany, Ind.
Useco Div., Van Nuys, Cal.
Viking Inds., Inc., Chatsworth, Calif.
Waldom Elctrns., Inc., Chicago, Ill.

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Allen Mfg. Co., Hartford, Conn.
Art Wire & Stamping Co., Cedar Knolls, N.J.
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Bird, Richard H. & Co., Inc., Waltham, Mass.
Control Inds. Inc., Inwood, N.Y.
Deutsch Fastener Corp., Los Angeles, Cal.
Elastic Stop Nut Div., Union, N.J.
Groov-Pin Corp., Ridgefield, N.J.
GTI Corp. (E), Pittsburgh, Pa.
Hartwell Corp., Los Angeles, Calif.
Keystone Elctrns. Corp., New York, N.Y.
Norelcom Inds., Inc., Farmingdale, N.Y.
PIC Design Division, Ridgefield,, Conn.
Precision Metal Prods. Co., Stoneham, Mass.
Sterling Instr., New Hyde Pk., NY
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Plastic Films, Rods, Sheets, etc.

Blum, Julius & Co., Inc., Carlstadt, N.J.
Budd Co., Bridgeport, Pa.
Cadilac Plastics & Chems., Detroit, Mich.
Central Plastics Dists., Chicago, Ill.
Chemplast, Inc., Wayne, N.J.
Cincinnati Dev. & Mfg. Co., Cincinnati, Ohio
Cole-Flex Corp., W. Babylon, N.Y.
Comco Plastics, Inc., Richmond Hill, N.Y.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Dixon Corp., Bristol, R.I.
Dow Chemical Co., Midland, Mich.
Eastman Chem. Prods., Kingsport, Tenn.
Emerson & Cuming, Inc., Canton, Mass.
General Elec., Pittsfield, Mass.
Goodrich B. F. Chem. Co., Cleveland, Ohio
Hysol Div., Olean, N.Y.
Ico/Rally, Palo Alto, Cal.
Laminated Fabricators, San Bruno, Calif.
Natvar Corp., Rahway, N.J.
New England Laminates Co., Inc., Glenbrook, Conn.
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Precision Paper Tube Co., Wheeling, Ill.
Reynolds Metals Co., Richmond, Va.
Rogers Corp., Rogers, Conn.
Schweitzer, Peter J. Div., Lee, Mass.
Synthane Taylor Corp., Valley Forge, Pa.
Thiokol Chemical Div., Trenton, N.J.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Transcon Mfg. Co., Dallas, Tex.
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Westinghouse Elec., W. Mifflin, Pa.
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Zippertubing Co., Los Angeles, Calif.

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Adhesive Prods. Corp., Bronx, N.Y.
Allaco Prods Div., Watertown, Mass.
Amoco Chemicals Corp., Chicago, Ill
Bacon Inds., Watertown, Mass.
Cadilac Plastics & Chems., Detroit, Mich.
Chemical Prods. Corp., E. Providence, R.I.
Cincinnati Dev. & Mfg. Co., Cincinnati, Ohio
Conap, Inc., Allegany, N.Y.
Dolph, John C. Co., Monmouth Junction, N.J.
Dow Chemical Co., Midland, Mich.
Dow Corning Corp., Midland, Mich.
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Eastman Chem. Prods., Kingsport, Tenn.
E.I. DuPont DeNemours & Co., Wilmington, Del.
Emerson & Cuming, Inc., Canton, Mass.
FMC Corp., New York, N.Y.
GAF Corp., New York, N.Y.
General Elec., Selkirk, N.Y.
General Elec., Pittsfield, Mass.
General Elec. Co., Waterford, N.Y.
Goodrich B. F. Chem. Co., Cleveland, Ohio
Hardman Inc., Belleville, N.J.
Hightemp Resins, Inc., Stamford, Conn.
Hysol Div., Olean, N.Y.
M & T Chemicals Inc., Rahway, N.J.
Merix Chem. Co., Chicago, Ill.
Mobay Chem. Co., Pittsburgh, Pa.
Packaged Resins Div., Watertown, Mass.
Pennsylvania Ind'l. Chem. Corp., Clairton, Pa.
Ram Chems., Gardena, Calif.
Rogers Corp., Rogers, Conn.
Tech Spray, Amarillo, Tex.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Tra-Con, Inc., Medford, Mass.
Union Carbide, Chemicals & Plastics, New York, N.Y.
Uniroyal, Inc., New York, N.Y.
Westinghouse Elec., W. Mifflin, Pa.
Whittaker Corp., Los Angeles, Cal.

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Engineering & Elctrn. Devices, Inc., Los Angeles, Calif.
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GC Electronics, Rockford, Ill.
Hunter Tools, El Monte, Calif
Kawecki Berylco Inds., Inc., New York, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Techni-Tool, Inc., Philadelphia, Pa.
Utica Tool Co., Inc., Orangeburg, S.C.
Vigor Co., New York, N.Y.
Waldes Kohinoor, Inc., Long Island City, N.Y.
X-Acto, Long Island City, N.Y.
Xcelite, Inc., Orchard Park, N.Y.

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Air-O-Tronics Prods., Morrisville, N.Y.
Americon Microwave Inds., Inc., Waltham, Mass.
Amphenol RF Div., Danbury, Conn.
APM-Hexseal, Englewood, N.J.
Augat Inc., Attleboro, Mass.
Barker Prods. Co., Saugus, Mass.
Birnbach Co., Inc., Freeport, N.Y.
Connector Corp., Chicago, Ill.
Control Inds. Inc., Inwood, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Elctrn. Molding Corp., Woonsocket, R.I.
GC Electronics, Rockford, Ill.
General Radio Co., Concord, Mass.
Keystone Elctrns. Corp., New York, N.Y.
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Electro Development Corp., Lynnwood, Wash.
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Intronics, Inc., Newton, Mass.
ITT Jennings, San Jose, Cal
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
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Megavolt, Inc., New York, N.Y.
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NUCOR Corp., Denville, N.J.
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Standard Power, Inc., Santa Ana, Cal.
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Pioneer Magnetics, Santa Monica, Cal.
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Del Electronics Corp., Mt. Vernon, N.Y.
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EG & G, Inc., Salem, Mass.
Electro Development Corp., Lynnwood, Wash.
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Elctrn. Memories, Hawthorne, Cal.
Electronic Resch. Assocs., Moonachie, N.J.
Elgin Elctrns. Inc., Waterford, Pa.
Energy Systems, Palo Alto, Cal.
Hadron Inc., Westbury, N.Y.
Hipotronics, Inc., Brewster, N.Y.
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Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
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Ionics, Inc., Watertown, Mass
Kilovolt Corp., Hackensack, N.J.
LDJ Electronics, Troy, Mich.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Maxwell Labs., Inc., San Diego, Calif.
Megavolt, Inc., New York, N.Y.
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Power Designs, Westbury, N.Y.
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Power Technology, Inc., Little Rock, Ark.
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Tobe Deutschmann Labs., Inc., Canton, Mass.
Todd Products Corp., Farmingdale, N.Y.
Topaz Electronics, San Diego, Cal.
Trio Labs, Inc., Plainview, N.Y.
TRW Instrs., El Segundo, Cal.
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Electronic Resch. Assocs., Moonachie, N.J.
Electrostatics, Inc., San Diego, CA
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LH Research, Inc., Santa Ana, Cal.
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Trio Labs, Inc., Plainview, N.Y.
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CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
California Instrs. Co., San Diego, Cal.
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Control Data Corp., Minneapolis, Minn.
Cross Electronics Inc., Warrendale, Pa.
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B & F Instrs., Inc., Cornwells Hgts., Pa.
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Cal-Power Corp., El Segundo, Calif.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
CEA, San Luis Obispo, Cal.
Crestronics, Inc., Crestline, Cal.
Deltron, Inc., N. Wales, Pa.
Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
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Arvee Engrg. Co., Torrance, Calif.
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Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
Edison Elctrns. Div., Manchester, N.H.
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Lambda Elctrns., Melville, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
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Dynamic Measurements Corp., Winchester, Ma.
Dynamics Elctrnc. Prods., Inc., Santa Fe Springs, Cal.
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Junction Modules, Inc., Irvine, Cal.
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Intech, Santa Clara, Cal.
Keithley Instrs., Inc., Cleveland, Ohio
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Milletron, Inc., Pittsburgh, Pa.
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Neff Instr. Corp., Duarte, Calif.
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R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
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Solid State Elctrns. Corp., Sepulveda, Cal.
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Keithley Instrs., Inc., Cleveland, Ohio
National Semiconductor, Santa Clara, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
United Detector Technology Inc., Santa Monica, Cal.

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Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
AMF Electical Prods., Alexandria, Va.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Arvee Engrg. Co., Torrance, Calif.
Avantek, Inc., Santa Clara, Cal.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Environmental Communications Inc., Santa Ana, Cal.
Hope Elctrns., Clifton, N.J.
Keithley Instrs., Inc., Cleveland, Ohio
Lorch Elctrns. Corp., Englewood, N.J.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Microphase Corp., Cos Cob, Conn.
Microwave Power Devices, Plainview, N. Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
National Semiconductor, Santa Clara, Cal.
OPtimax Inc., Colmar, Pa.
Perry Amplifier, Brookline, Mass.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Trak Microwave, Tampa, Fla.
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CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Doric Sci. Corp., San Diego, Calif.
ILC Data Device Corp., Hicksville, N.Y.
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National Semiconductor, Santa Clara, Cal.
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Avantek, Inc., Santa Clara, Cal.
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Electro/Data, Inc., Garland, Tex.
HRB-Singer, Inc., State College, Pa.
LNR Communications, Inc., Farmingdale, N.Y.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Power Devices, Plainview, N. Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
OPtimax Inc., Colmar, Pa.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Premier Microwave, Port Chester, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Special Microwave Devices Oper., Waltham, Mass.
Technical Research & Mfg. Co., Manchester, N.H.
Teledyne Mec., Palo Alto, Cal.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.
Watkins Johnson Co., Palo Alto, Cal.

Preamplifiers, Receiver
Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
Aertech Inds., Sunnyvale, Calif.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Arvee Engrg. Co., Torrance, Calif.
Arvin Sys., Inc., Dayton, Ohio
Astro Comm. Lab., Gaithersburg, Md.
Avantek, Inc., Santa Clara, Cal.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
C-COR Elctrns., State College, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Environmental Communications Inc., Santa Ana, Cal.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
HRB-Singer, Inc., State College, Pa.
Ithaco, Inc., Ithaca, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
LNR Communications, Inc., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Power Devices, Plainview, N. Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
National Semiconductor, Santa Clara, Cal.
OPtimax Inc., Colmar, Pa.
Polarad Elctrn. Instrs., Lake Success, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Varian, Beverly, Mass.
Watkins Johnson Co., Palo Alto, Cal.
Wide Band Engrg. Co., Phoenix, Ariz.

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Anzac Elctrns., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Arvee Engrg. Co., Torrance, Calif.
Astro Comm. Lab., Gaithersburg, Md.
Avantek, Inc., Santa Clara, Cal.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
C-COR Elctrns., State College, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Elctrn. Navigation Inds., Inc., Rochester, N.Y.
Emergency Beacon Corp., New Rochelle, N. Y.
General Radio Co., Concord, Mass.
Honeywell, Denver, Colo.
Hope Elctrns., Clifton, N.J.
HRB-Singer, Inc., State College, Pa.
Jerrold Electronics Corp., Philadelphia, Pa.
Keithley Instrs., Inc., Cleveland, Ohio
Lear Siegler, Inc., Santa Monica, Calif.
Lorch Elctrns. Corp., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Power Devices, Plainview, N. Y.
Miteq Inc., Hauppauge, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
National Semiconductor, Santa Clara, Cal.
OPtimax Inc., Colmar, Pa.
Perry Amplifier, Brookline, Mass.
Radiation Devices Co., Baltimore, Md.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Sierra Sys., Mountain View, Cal.
Teledyne Mec., Palo Alto, Cal.
Varian Assocs., Palo Alto, Cal.
Wide Band Engrg. Co., Phoenix, Ariz.
Winegard Co., Burlington, Iowa

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Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Control Technology Co., L.I.C., N.Y.
Gould, Inc., Cleveland, Ohio
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Ithaco, Inc., Ithaca, N.Y.
McFadden Elctrns. Co., South Gate, Calif.
Melcor Elctrns. Corp., Farmingdale, N.Y.
National Semiconductor, Santa Clara, Cal.

Perry Amplifier, Brookline, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Co., Little Falls, N.J.
Soltec Corp., No. Hollywood, Cal.

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Applied Research Inc., Port Washington, N.Y.
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Beukers Labs., Inc., Hauppauge, N.Y.
Biocom, Inc., Culver City, Cal.
C-COR Elctrns., State College, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Emergency Beacon Corp., New Rochelle, N. Y.
Gould, Inc., Cleveland, Ohio
Gulton Inds., Inc., Metuchen, N.J.
Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Ithaco, Inc., Ithaca, N.Y.
LNR Communications, Inc., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Microphase Corp., Cos Cob, Conn.
Mu-Del Elctrns., Silver Spring, Md.
National Semiconductor, Santa Clara, Cal.
Neff Instr. Corp., Duarte, Calif.
OPtimax Inc., Colmar, Pa.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Scientific Communications, Garland, Tex.
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Applied Control Co., Fairfield, N.J.
Arvee Engrg. Co., Torrance, Calif.
B & K Instrs., Inc., Cleveland, Ohio
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
Bulova Watch Co., Servo Prods. Elctrns. Div., Woodside, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
CALEX (California Elctrn. Mfg. Co.), Alamo, Calif.
Chesapeake Instr. Corp., Shadyside, Md.
Columbia Resch. Labs., Woodlyn, Pa.
Control Technology Co., L.I.C., N.Y.
Cycon, Inc., Sunnyvale, Cal.
Doric Sci. Corp., San Diego, Calif.
Dynamic Measurements Corp., Winchester, Ma.
Edo Western Corp., Salt Lake City, Utah
Electronic Modules, Inc., Pasadena, Cal.
Endevco, Pasadena, Calif.
Junction Modules, Inc., Irvine, Cal.
General Radio Co., Concord, Mass.
Glentek, Inc., Santa Monica, Calif.
Gould, Inc., Cleveland, Ohio
Gulton Inds., Inc., Metuchen, N.J.
Hawkeye Instrus., Inc., Marion, Iowa
Honeywell, Denver, Colo.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Hybrid Sys. Corp., Burlington, Mass.
ILC Data Device Corp., Hicksville, N.Y.
Inservco, Inc., La Grange, Ohio
Intech, Santa Clara, Cal.
Ithaco, Inc., Ithaca, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Natel Engrg. Co., Canoga Pk., Cal.
National Semiconductor, Santa Clara, Cal.
Neff Instr. Corp., Duarte, Calif.
Newport Labs., Inc., Santa Ana, Cal.
PCB Piezotronics, Inc., Depew, N.Y.
PPM, Inc., Bedford, Ohio
Princeton Applied Resch. Corp., Princeton, N.J.
Santa Barbara Resch. Ctr., Goleta, Calif.
Sensor Corp., Scottsdale, Pa.
Sensotec, Inc., Columbus, Ohio
Solid State Elctrns. Corp., Sepulveda, Cal.
Spectra Sonics, Ogden, Utah
Tektronix, Inc., Beaverton, Ore.
Teledyne Geotech, Dallas, Tex.
Telex Comm. Div., Minneapolis, Minn.
Telmar, Inc., Columbus, Ohio
United Detector Technology Inc., Santa Monica, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Validyne Engrg. Corp., Northridge, Cal.

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Alpha Metals, Inc., Jersey City, N.J.
Cohn, Sigmund, Mt. Vernon, N.Y.
Goldsmith Precious Metals Div., Chicago, Ill.
Gte Sylvania Inc., Belmont, Cal.
Handy & Harman, New York, N.Y.
Kester Solder Co, Chicago, Ill.

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Dynalab Corp., Van Nuys, Cal.
General Rand Corp., Edison, N.J.
Heath Co., Benton Harbor, Mich.
IEC Electronics Corp., E. Rochester, N.Y.
NES, Inc., Itasca, Ill.
Soltec Corp., No. Hollywood, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan

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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Applied Research Inc., Port Washington, N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
MCL, Inc., La Grange, Ill.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Rodelco, Deer Park, N.Y.
Ryka Scientific, Inc., Sunnyvale, Cal.
Sierra Sys., Mountain View, Cal.
UTE Microwave, Asbury Park, N.J.
Vari-L Co., Inc., Denver, Colo.
Vector Industries, Palo Alto, Cal.

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Varian, Solid State West Division, Palo Alto, Cal. ..... Vol 4•440*
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Arvin Sys., Inc., Dayton, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Frequency Engrg. Labs., Farmingdale, N.J.
Maury Microwave Corp., Cucamonga, Calif.
MCL, Inc., La Grange, Ill.
Melpar, Falls Church, Va.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Mu-Del Elctrns., Silver Spring, Md.
Premier Microwave, Port Chester, N.Y.
RHG Elctrns. Lab., Deer Park, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rodelco, Deer Park, N.Y.
Ryka Scientific, Inc., Sunnyvale, Cal.
Sierra Sys., Mountain View, Cal.
Telectro Sys. Corp., Corona, N.Y.
Telonic Inds., Inc., Laguna Beach, Calif.
UTE Microwave, Asbury Park, N.J.
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Acme Model Engrg. Co., Ridgefield, N.J.
Advanced Circuitry Div., Springfield, Mo.
American Lava Corp., Chattanooga, Tenn.
Automation Services Div., Windsor, N. Y.
Bishop Graphics, No. Hollywood, Cal.
Bureau Engraving, Inc., Minneapolis, Minn.
Circuit-Stik, Inc., Torrance, Cal.
Control Data Corp., St. Louis Pk., Minn.
Defiance Circuit Corp., Lawrence, Mass.
Digital Equip. Corp., Maynard, Mass.
Electro-Science Labs., Pennsauken, N. J.
Electrol Co., Inc., York, Pa.
Elctrn. Assocs., W. Long Branch, N.J.
GTE Sylvania, Muncy, Pa.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Injectorall Elctrns. Corp., Glen Cove, N.Y.
Int'l. Elctrn. Resch., Burbank, Cal.
Lockheed Elctrns. Co., Watchung, N.J.
Methode Elctrns., Inc., Chicago, Ill.
National Tel-Tronics, Meadville, Pa.
Photocircuits Div., Kollmorgen Corp., Glen Cove, N.Y.
Rogers Corp., Rogers, Conn.
Sperry Information Displays Div., Scottsdale, Ariz.
Systron-Donner Concord Instr. Div., Concord, Cal.
Techinques, Inc., Englewood, N.J.
3M Co., St. Paul, Minn.

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Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Advanced Circuitry Div., Springfield, Mo.
American Elctrn. Labs., Inc., Lansdale, Pa.
Ansley Elctrns. Corp., Doylestown, Pa.
A.R.F. Products, Inc., Boulder, Colo.
Augat Inc., Attleboro, Mass.
Automation Services Div., Windsor, N. Y.
BECO, Inc., Salem, Va.
Bendix Corp., Detroit, Mich.
Buckbee-Mears Co., St. Paul, Minn.
Bureau Engraving, Inc., Minneapolis, Minn.
Cambridge Thermionic, Cambridge, Mass
Chem Aero, Inc., Wilmington, Cal.
Chemical Etching Equip. & Supply, Alexandria, Va.
Chicago Dynamic Inds., Chicago, Ill.
Christiansen Radio Inc., Laguna Beach, Cal.
Circuit-Stik, Inc., Torrance, Cal.
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Collins Radio Co., Cedar Rapids, Iowa
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Cordover, Carl & Co., Mineola, N.Y.
De Soto Elec. Prods., De Soto, Mo.
Defiance Circuit Corp., Lawrence, Mass.
Digital Equip. Corp., Maynard, Mass.
Douglas Electronics, Inc., San Leandro, Cal.
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Elctrn. Assocs., W. Long Branch, N.J.
Elgin Elctrns. Inc., Waterford, Pa.
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GTE Sylvania, Muncy, Pa.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
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Int'l. Elctrn. Resch., Burbank, Cal.
Jordan Controls, Milwaukee, Wisc.
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McDonnell Douglas Electronics Co., St. Charles, Mo.
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Mid-West Metal Prods., Inc., Kansas City, Kans.
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Rosemount Nashville Inc., Lavergne, Tenn.
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Stanford Applied Engrg., Santa Clara, Cal.
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Systron-Donner Concord Instr. Div., Concord, Cal.
Tech-Etch, Inc., Hingham, Mass.
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Tri-Tronics Lab., Euless, Tex.
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Kepro Cir. Sys., Inc., St. Louis, Mo.
Techinques, Inc., Englewood, N.J.
Union Carbide, Chemicals & Plastics, New York, N.Y.
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Printed Circuit Screens

Automation Services Div., Windsor, N. Y.
Cambridge Thermionic, Cambridge, Mass
Cinch-Graphik, Oper. of TRW Elctrn. Comps., City of Industry, Cal.
Kepro Cir. Sys., Inc., St. Louis, Mo.
Naz-Dar Int'l., Chicago, Ill.
Photronic Labs., Danbury, Conn.
Podgor, Joseph Co., Pennsauken, N.J.
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Teletype Corp., Skokie, Ill.
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Texas Instruments, Inc., Houston, Tex.
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Tektronix, Inc., Beaverton, Ore.
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GC Electronics, Rockford, Ill.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
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ITT Jennings, Instrus. & Systems, San Jose, Calif.
Micro Instr. Co., Hawthorne, Cal.
Peschel Instrs., Cape Coral, Fla.
RCA Elctrns. Comps., Harrison, N.J.
Ross Engrg. Corp., Campbell, Cal.
Rowe Inds., Div., Toledo, Ohio
Simpson Elec. Co., Chicago, Ill.
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Tektronix, Inc., Beaverton, Ore.
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Program Data Co., Carson, Cal.
Tektronix, Inc., Beaverton, Ore.

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Aircom, Inc., Union, N.H.
CES Elctrns., Brooklyn, N.Y.
General Microwave Corp., Farmingdale, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microdynamics, So. El Monte, Cal.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Waveline, Inc., W. Caldwell, N.J.

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Kay Elemetrics, Pine Brook, N.J.
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Narda Microwave Corp., Plainview, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
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RCA Elctrns. Comps., Harrison, N.J.
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Smith, Herman H., Inc., Bklyn., N.Y.
Solar Elctrns. Co., Hollywood, Cal.
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Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Climatronics Corp., Hauppauge, N.Y.
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Fenwal, Inc., Ashland, Mass.
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Kahl Scientific Instr. Corp., El Cajon, Calif.
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Mag-Con, Inc., New Brighton, Minn.
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Kepco, Inc., Flushing, N.Y.
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Metal Works, Inc., Herman, Mo.
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Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Inter-Computer Elctrns., sub. American Electrn. Lab., Lansdale, Pa.
ITT Gilfillan Div. of ITT, Van Nuys, Calif.
ITT Mackay Marine, Elizabeth, N.J.
Lockheed Elctrns. Co., Watchung, N.J.
Marconi Elctrns. Inc., Elmsford, N.Y.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Norden Div., Norwalk, Conn.
RCA Service Co., Camden, N.J.
Singer Co., Little Falls, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Tasker Systems, Chatsworth, Cal.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Whittaker Corp., Los Angeles, Cal.

Radar Testers—See Testers, Radar

Radioactive Light Sources—See Sources, Light, Radioactive

Radio Comm. Systems—See Comm. Systems (As Modified)

Radiographic Equipment—See X-Ray Inspection Equipment

Radiometers

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Barnes Engrg. Co., Stamford, Conn.
Beckman Instrs., (AISSD), Fullerton, Cal.
Edmund Scientific Co., Barrington, N.J.
EG & G, Inc., Salem, Mass.
Electro-Optical Inds., Inc., Santa Barbara, Cal.
Gamma Sci., San Diego, Cal.
Honeywell, Minneapolis, Minn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Kahl Scientific Instr. Corp., El Cajon, Calif.
LNR Communications, Inc., Farmingdale, N.Y.
Mikron Instr. Co., Ridgewood, N.J.
Molectron Corp., Sunnyvale, Cal.
Oriel Corp. of America, Stamford, Conn.
Raytek, Inc., Mountain View, Cal.
Santa Barbara Resch. Ctr., Goleta, Calif.
Scientific Communications, Garland, Tex.
Teledyne Geotech, Dallas, Tex.
TRG Prods., E. Boston, Mass.
United Detector Technology Inc., Santa Monica, Cal.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Radomes

Amersil, Inc., Hillside, N.J.
Andrew Corp., Orland Pk., Ill.
Basic Ceramics Inc., Hawthorne, N.J.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Emerson & Cuming, Inc., Canton, Mass.
Gabriel Elctrns. Inc., Scarborough, Me.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Jerrold Electronics Corp., Philadelphia, Pa.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
National Beryllia Corp., Haskell, N.J.
Nurad, Inc., Baltimore, Md.
Parabam, Inc., Compton, Cal.
RCA Missile & Surface Radar Div., Moorestown, N.J.

Rare Earths—See Metals, Rare

Reactors, Charging

Amersil, Inc., Hillside, N.J.
Basler Elec. Co., Highland, Ill.
Del Electronics Corp., Mt. Vernon, N.Y.
Energy Systems, Palo Alto, Cal.
Ferrodyne Corp., Venice, Calif.
NWL Transformers, Trenton, N.J.
Peschel Instrs., Cape Coral, Fla.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.

Reactors, Epitaxial—See Machines, Semiconductor Manufacturing

Reactors, Filter

Del Electronics Corp., Mt. Vernon, N.Y. Vol 1•657
Freed Transformer Co., Bklyn., N.Y. Vol 3•1254
NWL Transformers, Trenton, N.J. Vol 3•1267
Acme Elec. Corp., Cuba, N.Y.
ADC Prods., Minneapolis, Minn.
American Magnetics Corp., Carterville, Ill.
American Trans-Coil Corp., Richmond Hill, N.Y.
Arnold Magnetics, Culver City, Cal.
Basler Elec. Co., Highland, Ill.
Bicron Elctrns. Co., Canaan, Conn.
Biometrics Instrument Corp., Garland, Tex.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Douglas Randall Div., Pawcatuck, Conn.
Energy Systems, Palo Alto, Cal.
Ferrodyne Corp., Venice, Calif.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Hisonic, Inc., Olathe, Kans.
Mag-Con, Inc., New Brighton, Minn.
Microtran Co. Inc., Valley Stream, N.Y.
North Electric Co., Galion, Ohio
Peschel Instrs., Cape Coral, Fla.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
Stancor, Chicago, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
Torotel, Inc., Grandview, Mo.
Triad-Utrad Div., Huntington, Ind.
Vari-L Co., Inc., Denver, Colo.
Zaring Inds., Inc., Westfield, Ind.

Reactors, Loading

ADC Prods., Minneapolis, Minn.
Coil Co. of Amer., Northvale, N.J.
Del Electronics Corp., Mt. Vernon, N.Y.
Ferrodyne Corp., Venice, Calif.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
NWL Transformers, Trenton, N.J.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Queensboro Transformer & Mach., College Pt., N.Y.
Zaring Inds., Inc., Westfield, Ind.

Reactors, Saturable

NWL Transformers, Trenton, N.J. Vol 3•1267
Acme Elec. Corp., Cuba, N.Y.
ADC Prods., Minneapolis, Minn.
Allis-Chalmers, Milwaukee, Wisc.
American Magnetics Corp., Carterville, Ill.
Artronic Instr. Co., Silver Spring, Md.
Basler Elec. Co., Highland, Ill.
Bicron Elctrns. Co., Canaan, Conn.
Biometrics Instrument Corp., Garland, Tex.
Carson Mfg. Co., Indianapolis, Ind.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Constant Voltage Co., Chicago, Ill.
Cross Electronics Inc., Warrendale, Pa.
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Electro-Pacific, Inc., Goleta, Calif.
Elgin Elctrns. Inc., Waterford, Pa.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Microtran Co. Inc., Valley Stream, N.Y.
North Electric Co., Galion, Ohio
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Queensboro Transformer & Mach., College Pt., N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Sterling Transformer Corp., Brooklyn, N.Y.
Torotel, Inc., Grandview, Mo.
Torwico Elctrns., Inc., Lakewood, N.J.
Vari-L Co., Inc., Denver, Colo.

Readers, Badge

AMP Capitron Div./AMP Incorporated, Elizabethtown, Pa. ..... Vol 1•322,323
Sealectro Corp., Mamaroneck, N.Y. Vol 1•372,374
Hexacon Elec. Co., Roselle Park, N.J.
Hickok Elect. Instr., Cleveland, Ohio
NES, Inc., Itasca, Ill.
Spectronics, Inc., Richardson, Tex.

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Amp Inc., Harrisburg, Pa.
Burroughs Corp., Pasadena, Cal.
Dolan-Jenner Inds., Inc., Melrose, Mass.
E-Systems Inc., Dallas, Tex.
Fiber Photics, Inc., Santa Cruz, Cal.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
W.V. Industries Inc., Franklin Lakes, N.J.

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Dietzgen Corp., Chicago, Ill.
GAF Corp., New York, N.Y.
Heitz, Karl, Inc., New York, N.Y.
Johnson Research Corp., Farmingdale, N.Y.
3M Co., St. Paul, Minn.
Varian Assocs., Palo Alto, Cal.
Visidyne Inc., Burlington, Ma.
Western Reserve Elctrns., Twinsburg, Ohio

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Bendix Corp., Sturbridge, Mass.
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Chalco Engrg. Corp., Gardena, Cal.
Data General Corp. (E), Southboro, Ma.
Data Specialties Inc., Highland Park, Ill.
Datascan, Inc., Clifton, N.J.
Digital Equip. Corp., Maynard, Mass.
Digitronics Corp., Albertson, N.Y.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Facit-Addo, Inc., Secaucus, N.J.
Interswitch, Burlingame, Cal.
NES, Inc., Itasca, Ill.
Remex, Santa Ana, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Spectronics, Inc., Richardson, Tex.
Superior Elec., Bristol, Conn.
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OPCOA, Inc., Edison, N.J.
Precision Dynamics Corp., Burbank, Cal.
Sperry Information Displays Div., Scottsdale, Ariz.
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Inter-Market, Inc., Glenview, Ill.
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Wagner Elec. Corp., Livingston, N.J. Vol 2•539
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Drake Mfg., Harwood Hgts., Ill.
ENM Co., Chicago, Ill.
Gap Instr. Corp., Hauppauge, N.Y.
Hecon Corp., New Shrewsbury, N.J.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Major Data Corp., Costa Mesa, Cal.
Norden Div., Norwalk, Conn.
Penn Keystone Corp., Ansonia, Conn.
Shigoto Inds., Ltd., New York, N.Y.
Singer Co., Little Falls, N.J.
Statham Instrs., Inc., Oxnard, Cal.
Staver Co., Inc., Bay Shore, N.Y.
Superior Elec., Bristol, Conn.
Veeder-Root, Hartford, Conn.
Vernitech, Deer Pk., N.Y.
W.V. Industries Inc., Franklin Lakes, N.J.
WABCO Aerospace Dept., Pittsburgh, Pa.

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Information Transfer, Inc., Holcomb, N.Y. ..... Vol 2•803
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Chicago Miniature Lamp Works, Chicago, Ill.
Dialight Corp., Brooklyn, N.Y.
Drake Mfg., Harwood Hgts., Ill.
Electronic Research Co., Shawnee Mission, Kan.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
Litronix, Cupertino, Cal.
NES, Inc., Itasca, Ill.
OPCOA, Inc., Edison, N.J.
Precision Dynamics Corp., Burbank, Cal.
Scientific Measurements, Wilmette, Ill.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Sensor Technology, Chatsworth, Cal.
Singer Co., Little Falls, N.J.
Sperry Information Displays Div., Scottsdale, Ariz.
W.V. Industries Inc., Franklin Lakes, N.J.

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Bomac Elctrns., Inc., Northridge, Cal.
Burroughs Corp., Plainfield, N.J.
Chicago Miniature Lamp Works, Chicago, Ill.
Computer Prods., Ft. Lauderdale, Fla.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Electrons Co., Fairfield, N.J.
Fiber Photics, Inc., Santa Cruz, Cal.
General Electric Co., Miniature Lamp Dept. Prods., Cleveland, Ohio
Inter-Market, Inc., Glenview, Ill.
LFE Corp., Waltham,, Mass.
Litronix, Cupertino, Cal.
LVC Inds. Inc., Flushing, N.Y.
Master Specialties, Costa Mesa, Cal.
Monsanto-Elctrn. Spec. Prods., Cupertino, Cal.
Mura Corp., Jericho, N.Y.
National Elctrns., Geneva, Ill.
Nippon Electric/NEC America, N.Y., N.Y.
OPCOA, Inc., Edison, N.J.
Penn Keystone Corp., Ansonia, Conn.
Pinlites, Fairfield, N.J.
Precision Dynamics Corp., Burbank, Cal.
Rank Precision Inds., Des Plaines, Ill.
RCA Elctrns. Comps., Harrison, N.J.
Scientific Measurements, Wilmette, Ill.
Shigoto Inds., Ltd., New York, N.Y.
Singer Co., Little Falls, N.J.
W.V. Industries Inc., Franklin Lakes, N.J.

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Major Data Corp., Costa Mesa, Cal.
W.V. Industries Inc., Franklin Lakes, N.J.

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Environmental Communications Inc., Santa Ana, Cal.
Intricate Circuit Corp., Port Chester, N.Y.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Trutone Elctrns., Inc., No. Hollywood, Cal.

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American Elctrn. Labs., Inc., Lansdale, Pa.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Intricate Circuit Corp., Port Chester, N.Y.
Loral Elctrn. Sys., Bronx, N.Y.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.

Receivers, Carrier Telegraph

Electrocom Inds., So. Bend, Indiana
GTE Lenkurt Inc., San Carlos, Calif.
Marconi Elctrns. Inc., Elmsford, N.Y.
RFL Inds., Comms. Div., Boonton, N.J.
Thomson-CSF Inc., New York, N.Y.

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Arvin Sys., Inc., Dayton, Ohio
Astro Comm. Lab., Gaithersburg, Md.
Bendix Corp., Ft. Lauderdale, Fla.
Bendix Corp, Towson, Md.
Brelonix, Inc., Seattle, Wash
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Drake, R.L., Co., Miamisburg, Ohio
Electro/Data, Inc., Garland, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Electronic Resch. Assocs., Moonachie, N.J.
Environmental Communications Inc., Santa Ana, Cal.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Automatic Elec., Northlake, Ill.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
Honeywell, Denver, Colo.
IEC Electronics Corp., E. Rochester, N.Y.
Intricate Circuit Corp., Port Chester, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Linear Sys., Inc., Watsonville, Calif.
LNR Communications, Inc., Farmingdale, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Melpar, Falls Church, Va.
Microwave Assocs., Inc., Burlington, Mass.
Mobil Elctrns., Inc., Anderson, Ind.
Pacific Communications, Santa Ana, Cal.
Pearce-Simpson, Miami, Fla.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
Regency Elctrns., Inc., Indianapolis, Ind.
Rodelco, Deer Park, N.Y.
Scientific Communications, Garland, Tex.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.
Varian Assocs., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.

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Applied Research Inc., Port Washington, N.Y.
Arvin Sys., Inc., Dayton, Ohio
Astro Comm. Lab., Gaithersburg, Md.
Autocon Inds., Inc., Minneapolis, Minn.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
Brelonix, Inc., Seattle, Wash
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Drake, R.L., Co., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Edo Western Corp., Salt Lake City, Utah
Electro/Data, Inc., Garland, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Environmental Communications Inc., Santa Ana, Cal.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
IEC Electronics Corp., E. Rochester, N.Y.
ISC/Telephonics Div, Huntington, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Linear Sys., Inc., Watsonville, Calif.
Lorch Elctrns. Corp., Englewood, N.J.
Marconi Elctrns. Inc., Elmsford, N.Y.
Micro-Tel Corp., Baltimore, Md.
Mu-Del Elctrns., Silver Spring, Md.
OPtimax Inc., Colmar, Pa.
Pace Div., Harbor City, Calif.
Pacific Communications, Santa Ana, Cal.
Regency Elctrns., Inc., Indianapolis, Ind.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Sierra Sys., Mountain View, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Specific Products, Monrovia, Cal.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.
Watkins Johnson Co., Palo Alto, Cal.

Receivers, Frequency Shift

Autocon Inds., Inc., Minneapolis, Minn.
Bramco Controls, Piqua, Ohio
Collins Radio Co., Dallas, Tex.
Electrocom Inds., So. Bend, Indiana
Frederick Electronics Corp., Frederick, Md.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
Honeywell, Denver, Colo.
Integrated Systems, Inc., Norcross, Ga.
Marconi Elctrns. Inc., Elmsford, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.

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Beukers Labs., Inc., Hauppauge, N.Y.
Epsco, Inc., Westwood, Mass.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Micro Instr. Co., Hawthorne, Cal.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Tracor, Inc., Austin, Tex.

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Aertech Inds., Sunnyvale, Calif.
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Ailtech, City of Industry, Cal.
American Elctrn. Labs., Inc., Lansdale, Pa.
American Nucleonics Corp., Woodland Hills, Cal
Applied Research Inc., Port Washington, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Astro Comm. Lab., Gaithersburg, Md.
Avantek, Inc., Santa Clara, Cal.
Bendix Corp., N. Hollywood, Calif.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Cubic Corp., San Diego, Cal.
Dynalab Corp., Van Nuys, Cal.
Electrac, Inc., Anaheim, Calif.
Electro/Data, Inc., Garland, Tex.
Environmental Communications Inc., Santa Ana, Cal.
Farinon Electric, San Carlos, Calif.
Foxboro Co., Foxboro, Mass.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
ITT Gilfillan Div. of ITT, Van Nuys, Calif.
LNR Communications, Inc., Farmingdale, N.Y.
Loral Elctrn. Sys., Bronx, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Melpar, Falls Church, Va.
Micro-Now Instr., Chicago, Ill.
Micro-Tel Corp., Baltimore, Md.
Microlab/FXR, Livingston, N.J.
Microphase Corp., Cos Cob, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
OPtimax Inc., Colmar, Pa.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Raytheon Data Systems Co., Norwood, Mass.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Ryka Scientific, Inc., Sunnyvale, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
Teledyne Micronetics, San Diego, Calif.
Thomson-CSF Inc., New York, N.Y.
Trak Microwave, Tampa, Fla.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Solid State East Div., Micro-Link Prods., Beverly, Mass
Varian, Beverly, Mass.
Watkins Johnson Co., Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Receivers, Monitoring, Communications

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Allied Elctrns., Chicago, Ill.
Applied Research Inc., Port Washington, N.Y.
Arvin Sys., Inc., Dayton, Ohio
Brelonix, Inc., Seattle, Wash
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Conrac Div., Covina, Calif.
Drake, R.L., Co., Miamisburg, Ohio
E-Systems Inc., Dallas, Tex.
Electrac, Inc., Anaheim, Calif.
Electro/Data, Inc., Garland, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
HRB-Singer, Inc., State College, Pa.
Intricate Circuit Corp., Port Chester, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Lear Siegler, Grand Rapids, Mich.
Linear Sys., Inc., Watsonville, Calif.
Loral Elctrn. Sys., Bronx, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Melpar, Falls Church, Va.
Micro-Tel Corp., Baltimore, Md.
Mobil Elctrns., Inc., Anderson, Ind.
Pace Div., Harbor City, Calif.
Pearce-Simpson, Miami, Fla.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Resdel Engrg. Corp., Arcadia, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Communications, Garland, Tex.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.

Receivers, Multiplex

Bogen Div., Paramus, N.J.
Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Collins Radio Co., Dallas, Tex.
Dataprobe, Inc., So. Hackensack, N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hathaway Instruments, Inc., Denver, Colo.
Lear Siegler, Inc., Santa Monica, Calif.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.

Receivers, NBS

Datum, Inc., Anaheim, Calif.
Tracor, Inc., Austin, Tex.

Receivers, Panoramic

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Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
AUL Instrs., Inc., Flushng, N.Y.
Collins Radio Co., Dallas, Tex.
Electro/Data, Inc., Garland, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
Loral Elctrn. Sys., Bronx, N.Y.
Marconi Instrs., Englewood, N.J.
Micro-Tel Corp., Baltimore, Md.
Nelson Ross Elctrns., Lake Success, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific Communications, Garland, Tex.

Receivers, Phase Lock

Beukers Labs., Inc., Hauppauge, N.Y.
Datum, Inc., Anaheim, Calif.
Drake, R.L., Co., Miamisburg, Ohio
Electrac, Inc., Anaheim, Calif.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
HRB-Singer, Inc., State College, Pa.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Grand Rapids, Mich.
Lorch Elctrns. Corp., Englewood, N.J.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
Resdel Engrg. Corp., Arcadia, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Specific Products, Monrovia, Cal.
Tasker Systems, Chatsworth, Cal.
Trak Microwave, Tampa, Fla.
Varian, Beverly, Mass.

Receivers, Radar

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Bendix Corp., Ft. Lauderdale, Fla.
Bendix Corp., N. Hollywood, Calif.
Cardion Elctrns., Woodbury, N.Y.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Epsco, Inc., Westwood, Mass.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
LNR Communications, Inc., Farmingdale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Melpar, Falls Church, Va.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Nikon, Inc., Instr. Div., Ehrenreich Photo-Optical Ind., Garden City, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RHG Elctrns. Lab., Deer Park, N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Tasker Systems, Chatsworth, Cal.
Thomson-CSF Inc., New York, N.Y.
Varian, Beverly, Mass.
Vega Precision Labs., Vienna, Va.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Receivers, Radiometric—See Radiometers

Receivers, Single-Sideband

Arvin Sys., Inc., Dayton, Ohio
Barker & Williamson, Inc., Bristol, Pa.
Bendix Corp, Towson, Md.
Brelonix, Inc., Seattle, Wash
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Drake, R.L., Co., Miamisburg, Ohio
Electrac, Inc., Anaheim, Calif.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
ITT Mackay Marine, Elizabeth, N.J.
Linear Sys., Inc., Watsonville, Calif.
Lorch Elctrns. Corp., Englewood, N.J.
Marconi Elctrns. Inc., Elmsford, N.Y.
Marconi Instrs., Englewood, N.J.
Micro-Tel Corp., Baltimore, Md.
Pace Div., Harbor City, Calif.
Railway Comm., Raytown, Mo.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.

Receivers, Time Code

A.R.F. Products, Inc., Boulder, Colo.
Chrono-log Corp., Broomall, Pa.
Datatron, Inc., Santa Ana, Cal
Datum, Inc., Anaheim, Calif.
Drake, R.L., Co., Miamisburg, Ohio
Metric Sys., Ft. Walton Beach, Fla.
NES, Inc., Itasca, Ill.
Resdel Engrg. Corp., Arcadia, Cal.
Specific Products, Monrovia, Cal.
Thiem Industries, Inc., Torrance, Cal.

Receivers, Tone

Bramco Controls, Piqua, Ohio Vol 2•419
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Arvin Sys., Inc., Dayton, Ohio
Autocon Inds., Inc., Minneapolis, Minn.
BF Elctrns., Solana Beach, Calif.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Douglas Randall Div., Pawcatuck, Conn.
GTE Automatic Elec., Northlake, Ill.
Hathaway Instruments, Inc., Denver, Colo.
HB Engineering Corp., Beltsville, Md.
Honeywell, Denver, Colo.
Integrated Systems, Inc., Norcross, Ga.
Ledex, Inc., Dayton, Ohio
Mobil Elctrns., Inc., Anderson, Ind.
NES, Inc., Itasca, Ill.
OPtimax Inc., Colmar, Pa.
Regency Elctrns., Inc., Indianapolis, Ind.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Singer - Tele-Signal, Woodbury, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
T-F Electronics, Inc., Austin, Tex.

Receivers, TV—See Monitors, Video

Receivers, VLF

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American Elctrn. Labs., Inc., Lansdale, Pa.
A.R.F. Products, Inc., Boulder, Colo.
Beukers Labs., Inc., Hauppauge, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Collins Radio Co., Dallas, Tex.
Datum, Inc., Anaheim, Calif.
Drake, R.L., Co., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Frequency Elctrns., New Hyde Pk., N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Denver, Colo.
ITT Mackay Marine, Elizabeth, N.J.
Lear Siegler, Grand Rapids, Mich.
Marconi Instrs., Englewood, N.J.
Melpar, Falls Church, Va.
Micro-Tel Corp., Baltimore, Md.
Railway Comm., Raytown, Mo.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Thomson-CSF Inc., New York, N.Y.
Tracor, Inc., Austin, Tex.
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Receptacles—See Connectors; Jacks; Sockets

Receptacles, Antenna Tapping

Siemens Corp., Iselin, N.J.

Recorders, Computer Data—See Data Recorders, Computer

Recorders, Electrostatic

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Adtrol Div., Blackburg, Va.
Edo Western Corp., Salt Lake City, Utah
EG&G, Inc., Bedford, Mass.
Geo Space, Houston, Tex.
Information Displays, Inc., Mt. Kisco, N.Y.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Soltec Corp., No. Hollywood, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Palo Alto, Cal.

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Alden Sys. Co., Inc., Westboro, Mass.
Almond Instrs. Co., Covina, Cal
Amprobe Instr., Lynbrook, N.Y.
Artisan Elctrns. Corp., Parsippany, N.J.
Bailey Meter Co., Wickliffe, Ohio
Bell & Howell Co., Pasadena, Calif.
Clary Corp., San Gabriel, Calif.
Dohrmann Div., Mountain View, Cal.
Edison, Instr. Div., W. Orange, N.J.
Engdahl Enterprises, Costa Mesa, Cal.

General Scanning, Watertown, Mass.
Hathaway Instruments, Inc., Denver, Colo.
Instrumentation Prods., Camarillo, Cal.
Kenton Engrg. Corp., Skokie, Ill.
Linear Instrs. Corp., Costa Mesa, Cal.
Memodyne Corp., Newton Upper Falls, Ma.
MFE Corporation, Salem, N.H.
NES, Inc., Itasca, Ill.
Photron Instr. Co., Cleveland, Ohio
PPM, Inc., Bedford, Ohio
Resdel Engrg. Corp., Arcadia, Cal.
Recorder Systems Div., E. Greenwich, R.I.
Simpson Elec. Co., Chicago, Ill.
Soltec Corp., No. Hollywood, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Tech Serv., Inc., Fogelsville, Pa.
Telectro Sys. Corp., Corona, N.Y.
Telmar, Inc., Columbus, Ohio
Texas Instruments, Inc., Houston, Tex.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Palo Alto, Cal.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio
Zonic Tech. Labs., Cincinnati, Ohio

Recorders, F-M—See Recorders, Magnetic Tape

Recorders, Facsimile

Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Alden Sys. Co., Inc., Westboro, Mass.
Datalog Div., Litton Sys., Melville, N. Y.
Edo Western Corp., Salt Lake City, Utah
EG&G, Inc., Bedford, Mass.
Honeywell, Denver, Colo.
Instrumentation Prods., Camarillo, Cal.
Oeco Corp., Portland, Ore.
Princeton Elctrn. Prods., New Brunswick, N.J.
Telmar, Inc., Columbus, Ohio
3M Co., St. Paul, Minn.

Recorders, Film

Adtrol Div., Blacksburg, Va.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
Gould Data Systems, Newton Upper Falls, Mass.
Heitz, Karl, Inc., New York, N.Y.
Instrumentation Prods., Camarillo, Cal.
RCA Corp., Camden, N.J.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Teledyne Geotech, Dallas, Tex.
Video Research Corp., Gaithersburg, Md.

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Hallmark Standards, Inc., Mt. Vernon, N.Y.
Siemens Corp., Iselin, N.J.

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Almond Instrs. Co., Covina, Cal
Ampex Corp., Redwood City, Calif.
Audiotronics, N. Hollywood, Cal.
Automedia, Inc., Sunnyvale, Cal.
Bell & Howell Co., Pasadena, Calif.
Burroughs Corp., Pasadena, Cal.
Carolina Medical Elctrns., Inc., King, N.C.
Chalco Engrg. Corp., Gardena, Cal.
Computer Instrs., Hempstead, N.Y.
Data, Inc., Ft. Collins, Col.
Data Recording Sys., Sunnyvale, Cal.
Datum, Inc., Anaheim, Calif.
Design Elements, Columbus, Ohio
Dytro Corp., Hicksville, N.Y.
General Radio Co., Concord, Mass.
Genisco Tech. Corp., Compton, Cal.
Gotham Audio Corp., New York, N.Y.
Hathaway Instruments, Inc., Denver, Colo.
Heitz, Karl, Inc., New York, N.Y.
Honeywell, Denver, Colo.
Instrumentation Prods., Camarillo, Cal.
Interdata, Oceanport, N.J.
Interdyne, Van Nuys, Cal.
Lockheed Elctrns. Co., Watchung, N.J.
Memodyne Corp., Newton Upper Falls, Ma.
NES, Inc., Itasca, Ill.
Nuclear Data, Palatine, Ill.
Oxford Instr. Corp., Annapolis, Md.
Plessey Enviromental Sys., San Diego, Cal.
RCA Corp., Camden, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Remex, Santa Ana, Cal.
RIL Elctrns., Inc., Southampton, Pa.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Telectro Sys. Corp., Corona, N.Y.
3M Co., St. Paul, Minn.
Transducer Controls Corp., Covina, Calif.
Video Research Corp., Gaithersburg, Md.

Recorders, Polar

B & K Instrs., Inc., Cleveland, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Recorder Systems Div., E. Greenwich, R.I.
Scientific-Atlanta, Inc., Atlanta, Ga.

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Recorders, Sound Level

B & K Instrs., Inc., Cleveland, Ohio
Columbia Resch. Labs., Woodlyn, Pa.
General Radio Co., Concord, Mass.
Genisco Tech. Corp., Compton, Cal.
NES, Inc., Itasca, Ill.
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Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Telmar, Inc., Columbus, Ohio

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Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bell & Howell, Bridgeport, Conn.
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
BLH Elctrns., Inc., Waltham, Mass.
Brinkmann Instrs., Inc., Westbury, N.Y.
Bristol Div, Waterbury, Conn
Cole-Parmer Instr. Co., Chicago, Ill.
Coleman Instr. Div., Oak Brook, Ill.
Conklin Instr. Corp., Pleasant Valley, N.Y.
Corning Glass Works, Medfield, Mass.
Digiac Corp., Plainview, N.Y.
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Edo Western Corp., Salt Lake City, Utah
Electric Tachometer Corp., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
General Elec., W. Lynn, Mass.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
General Scanning, Watertown, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Heath Co., Benton Harbor, Mich.
Honeywell, Ft. Washington, Pa.
Honeywell, Denver, Colo.
Impact-O-Graph Corp., Bedford, Ohio
IMPACT-O-GRAPH Div., Bedford, Ohio
Keithley Instrs., Inç., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Laboratory Data Control, Riviera Beach, Fla.
Leeds & Northrup Corp., No. Wales, Pa.
LFE Corp., Waltham,, Mass.
Linear Instrs. Corp., Costa Mesa, Cal.
London Co., Cleveland, Ohio
Matheson Gas Products, East Rutherford, N.J.
McKee-Pedersen Instrs., Danville, Calif.
NES, Inc., Itasca, Ill.
Photron Instr. Co., Cleveland, Ohio
Robertshaw Controls Co., Richmond, Va.
Rohde & Schwarz Sls., Passaic, N.J.
Recorder Systems Div., E. Greenwich, R.I.
Sensotec, Inc., Columbus, Ohio
Siemens Corp., Iselin, N.J.
Sigma Instrs., Inc., Braintree, Mass.
Sloan Technology Corp., Santa Barbara, Calif.
Soltec Corp., No. Hollywood, Cal.
Standard Controls, Seattle, Wash.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Telmar, Inc., Columbus, Ohio
Test & Measuring Instrs. Inc., Hicksville, N.Y.
Texas Instruments, Inc., Houston, Tex.
Tracor, Inc., Austin, Tex.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
VirTis Co., Gardiner, N.Y.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
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Engdahl Enterprises, Costa Mesa, Cal.
Hathaway Instruments, Inc., Denver, Colo.
Kenton Engrg. Corp., Skokie, Ill.
Lecroy Resch. Sys. Corp., West Nyack, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Westronics, Inc., Ft. Worth, Tex.
Zonic Tech. Labs., Cincinnati, Ohio

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Bell & Howell Co., Pasadena, Calif.
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General Radio Co., Concord, Mass.
Honeywell, Denver, Colo.
Robertshaw Controls Co., Richmond, Va.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Teledyne Geotech, Dallas, Tex.
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Edo Western Corp., Salt Lake City, Utah
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
McDonnell Douglas Electronics Co., St. Charles, Mo.
RCA Corp., Camden, N.J.
R.C.A. Electromagnetic & Aviation Sys. Div., Van Nuys, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Telectro Sys. Corp., Corona, N.Y.
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Video Research Corp., Gaithersburg, Md.

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Bristol Div, Waterbury, Conn
California Computer Prods., Anaheim, Cal
Data General Corp. (E), Southboro, Ma.
Dohrmann Div., Mountain View, Cal.
Fisher Sci. Co., Pittsburgh, Pa.
Gamma Sci., San Diego, Cal.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Laboratory Data Control, Riviera Beach, Fla.
Larson Aero Dev., Concord, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
Linear Instrs. Corp., Costa Mesa, Cal.
McKee-Pedersen Instrs., Danville, Calif.
Rohde & Schwarz Sls., Passaic, N.J.
Scientific-Atlanta, Inc., Atlanta, Ga.
Siemens Corp., Iselin, N.J.
Simpson Elec. Co., Chicago, Ill.
Soltec Corp., No. Hollywood, Cal.
Tech Serv., Inc., Fogelsville, Pa.
Texas Instruments, Inc., Houston, Tex.
Tucker Electronics Co., Garland, Tex.
Varian Assocs., Palo Alto, Cal.
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Records, Frequency Test

CBS Laboratories, Stamford, Conn.
Components Corp., Denville, N.J.
GC Electronics, Rockford, Ill.
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Alpha Components Corp., El Segundo, Cal.
Amperex Electronic Corp., Hicksville, N.Y.
Edal Inds., Inc., E. Haven, Conn.
Elctrn. Devices, Yonkers, N.Y.
AFI Industries Inc., Long Branch, N. J.
FMC Corp., Homer City, Pa.
Ledex, Inc., Dayton, Ohio
Motorola Semiconductor Prods., Phoenix, Ariz.
Opad Elec. Co., Inc., New York, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Texas Instruments, Dallas, Tex.
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Fluke, John Mfg. Co., Inc., Seattle, Wash.
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American Elctrns., Inc., Fullerton, Cal.
American Time Products, Woodside, N.Y.
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Adams & Westlake, Elkhart, Ind.
Allen-Bradley Co., Milwaukee, Wisc.
Allied Control Co., Plantsville, Conn.
AMF Electical Prods., Alexandria, Va.
Amp Inc., Harrisburg, Pa.
Arrow-Hart, Inc., Hartford, Conn.
Artisan Elctrns. Corp., Parsippany, N.J.
Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
Bell Industries, Compton, Cal.
Branson Corp., Denville, N.J.
Chicago Dynamic Inds., Chicago, Ill.
Computer Prods., Ft. Lauderdale, Fla.
Controls Div., Elizabeth, N.J.
Cutler-Hammer, Milwaukee, Wisc.
Davis Elec. Co., Cape Girardeau, Mo.
Deltrol Controls, Milwaukee, Wisc.
Douglas Randall Div., Pawcatuck, Conn.
Eagle Signal, Davenport, Iowa
Electronic Specialty Div., Portland, Ore
Essex International, Inc., Logansport, Ind.
Furnas Elec. Co., Batavia, Ill.
General Automatic Corp., Bayonne, N.J.
General Elec. Company, Providence, R.I.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
GTE Automatic Elec., Northlake, Ill.
Guardian California, Culver City, Cal.
H-B Instr. Co., Phila., Pa.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Ingraham Inds., Controls Div., Elizabethtown, Ky.
Jaidinger Mfg. Co., Inc., Chicago, Ill.
Kratos Precision Prods., Los Angeles, Cal.
Landis & Gyr, Inc., Elmsford, N.Y.
Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Littelfuse, Inc., Des Plaines, Ill.
Mack Elec. Devices, Wyncote, Pa.
Master Elctrn. Controls, Santa Monica, Cal.
Micro Switch, Freeport, Ill.
Oak Inds. Inc., Crystal Lake, Ill.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Stevens-Arnold, Inc., So. Boston, Mass.
Syracuse Elctrns. Corp., Syracuse, N.Y.
Triac Elctrn. Sys., Forest Hills, N. Y.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
WABCO Aerospace Dept., Pittsburgh, Pa.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Welch Relay Division, Los Angeles, Calif.
Weston Instruments, Inc., Newark, N.J.
Wheelock Signals, Long Branch, N.J.
Yaskawa Elec. America, Inc., Oak Brook, Ill.

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AMF Electical Prods., Alexandria, Va.
Arrow-Hart, Inc., Hartford, Conn.
Babcock Control Prods., Costa Mesa, Calif.
Beckman Instrs., Cedar Grove, N.J.
Cober Elctrns., Inc., Stamford, Conn.
Computer Comps., Jamaica, N.Y.
Coto-Coil Co., Inc., Providence, R.I.
Cutler-Hammer, Milwaukee, Wisc.
Del Electronics Corp., Mt. Vernon, N.Y.
Elec-Trol, Inc., Saugus, Cal.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Guardian Elec. Mfg. Co., Chicago, Ill.
H-B Instr. Co., Phila., Pa.
Hartman Electrical Mfg., Mansfield, Ohio
Hi-G, Windsor Locks, Conn.
Hipotronics, Inc., Brewster, N.Y.
Jaidinger Mfg. Co., Inc., Chicago, Ill.
James Elctrns., Inc., Chicago, Ill.
Kilovolt Corp., Hackensack, N.J.
Mack Elec. Devices, Wyncote, Pa.
Megavolt, Inc., New York, N.Y.
Micro Switch, Freeport, Ill.
Midtex/Aemco, Mankato, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
North American Philips Controls Corp., Cheshire, Conn.
North American Philips Controls, Frederick, Md.
Peschel Instrs., Cape Coral, Fla.
Potter & Brumfield, Princeton, Ind.
Relay Specialties Inc., Fair Lawn, N.J.
Schrack Elec. Sls., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Solid State Elctrns. Corp., Sepulveda, Cal.
Struthers-Dunn, Inc., Pitman, N.J.
Texas Instruments, Attleboro, Mass.
Torr Labs., Los Angeles, Cal.
Triridge Corp., Pittsburgh, Pa.
Universal Relay Corp., New York, N.Y.

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ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Ledex, Inc., Dayton, Ohio
Sigma Instrs., Inc., Braintree, Mass.
Texas Instruments, Dallas, Tex.
Vanguard Relay Corp., Lindenhurst, N.Y.

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Relays, Latching

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A. D. Data Sys., Inc., Rochester, N.Y.
Adams & Westlake, Elkhart, Ind.
Allied Control Co., Plantsville, Conn.
AMF Electical Prods., Alexandria, Va.
Babcock Control Prods., Costa Mesa, Calif.
Bell Industries, Compton, Cal.
Branson Corp., Denville, N.J.
Controls Div., Elizabeth, N.J.
Cutler-Hammer, Milwaukee, Wisc.
Deltrol Controls, Milwaukee, Wisc.
Eagle Signal, Davenport, Iowa
Elec-Trol, Inc., Saugus, Cal.
Elctrn. Applications, S. El Monte, Cal.
Elctrn. Instr. & Specialty, Stoneham, Mass.
Fifth Dimension, Princeton, N.J.
GTE Automatic Elec., Northlake, Ill.
Hamlin, Inc., Lake Mills, Wisc.
Hartman Electrical Mfg., Mansfield, Ohio
Ingraham Inds., Controls Div., Elizabethtown, Ky.
ITT Jennings, San Jose, Cal
Liberty Controls, Inc., Shorewood, Ill.
Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
The Maxi-Switch Co., Minneapolis, Minn.
Micro Switch, Freeport, Ill.
Midtex/Aemco, Mankato, Minn.
New Prod. Engrg., Wabash, Ind.
North American Philips Controls Corp., Cheshire, Conn.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
Schrack Elec. Sls., New York, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Square D Co., Park Ridge, Ill.
Teledyne Relays, Hawthorne, Cal.
Texas Instruments, Attleboro, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Triridge Corp., Pittsburgh, Pa.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.

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Adams & Westlake, Elkhart, Ind.
H-B Instr. Co., Phila., Pa.
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Kahl Scientific Instr. Corp., El Cajon, Calif.
Milli-Switch Corp., Gladwyne, Pa.
Struthers-Dunn, Inc., Pitman, N.J.
Universal Relay Corp., New York, N.Y.

Relays, Mercury-Wetted Contacts

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New Prod. Engrg., Wabash, Ind. Vol 2•840
Potter & Brumfield, Princeton, Ind. Vol 2•865,866
Adams & Westlake, Elkhart, Ind.
AMF Electical Prods., Alexandria, Va.
Computer Prods., Ft. Lauderdale, Fla.
Cosar Corp., Garland, Texas
Elctrn. Applications, S. El Monte, Cal.
Electronic Specialty Div., Portland, Ore
Fifth Dimension, Princeton, N.J.
Gordos Corp., Bloomfield, N.J.
GTE Automatic Elec., Northlake, Ill.
H-B Instr. Co., Phila., Pa.
James Elctrns., Inc., Chicago, Ill.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Kratos Precision Prods., Los Angeles, Cal.
Matrix Systems Corp., Chatsworth, Calif.
MKC Elctrns. Corp., Kansas City, Kans.
North American Philips Controls Corp., Cheshire, Conn.
North American Philips Controls, Frederick, Md.
Relay Specialties Inc., Fair Lawn, N.J.
Struthers-Dunn, Inc., Pitman, N.J.
Triridge Corp., Pittsburgh, Pa.
Trompeter Elctrns., Chatsworth, Cal.
Universal Relay Corp., New York, N.Y.

Relays, Meter

Beede Electrical Instr. Co., Inc., Penacook, N.H. Vol 1•395
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Larson Instr. Co., Inc., Orangeburg, N.Y. Vol 1•477
Simpson Elec. Co., Chicago, Ill. Vol 1•502
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AMF Electical Prods., Alexandria, Va.
Cutler-Hammer, Milwaukee, Wisc.
Elctrn. Applications, S. El Monte, Cal.
Essex Int'l., Logansport, Ind.
General Elec., W. Lynn, Mass.
Int'l. Instrs., Orange, Conn.
Jewell Electrical Instrs., Manchester, N.H.
LFE Corp., Waltham,, Mass.
Modutec, Inc., Norwalk, Conn.
Q.V.S., Inc., East Orange, N.J.
Sigma Instrs., Inc., Braintree, Mass.
Universal Relay Corp., New York, N.Y.
Weston Instruments, Inc., Newark, N.J.

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Elmwood Sensors, Inc., Cranston, R.I.
Essex International, Inc., Logansport, Ind.
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Pitman, N.J.
Triac Elctrn. Sys., Forest Hills, N. Y.

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AMF Electical Prods., Alexandria, Va.
Arrow-Hart, Inc., Hartford, Conn.
Autronics Corp., Pasadena, Calif.
Basler Elec. Co., Highland, Ill.
Bell Industries, Compton, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Electro-Module, Inc., Pomona, Cal.
Elctrn. Applications, S. El Monte, Cal.
Electronic Resch. Assocs., Moonachie, N.J.
Electronic Specialty Div., Portland, Ore
Flight Sys., Inc., Mechanicsburg, Pa.
Furnas Elec. Co., Batavia, Ill.
General Automatic Corp., Bayonne, N.J.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
Hoagland Instr., Dayton, N.J.
Jewell Electrical Instrs., Manchester, N.H.
Landis & Gyr, Inc., Elmsford, N.Y.
Logitek, Inc., Farmingdale, N.Y.
Magnecraft Elec., Chicago, Ill.
Potter & Brumfield, Princeton, Ind.
Relay Specialties Inc., Fair Lawn, N.J.
Ross Engrg. Corp., Campbell, Cal.
Sensor Corp., Scottsdale, Pa.
Sigma Instrs., Inc., Braintree, Mass.
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Pitman, N.J.
Teledyne Kinetics, Solana Beach, Cal.
Teledyne Relays, Hawthorne, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Universal Relay Corp., New York, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Warren G-V Communications, Livingston, N.J.
Westinghouse Elec., Buffalo, N. Y.
Weston Instruments, Inc., Newark, N.J.
Wilmar Elctrns. Inc., Torrance, Cal.

Relays, Phase-Sensing

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Allen-Bradley Co., Milwaukee, Wisc.
Autronics Corp., Pasadena, Calif.
Avtron Mfg., Inc., Cleveland, Ohio
Babcock Control Prods., Costa Mesa, Calif.
Bell Industries, Compton, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Electro-Module, Inc., Pomona, Cal.
Guardian California, Culver City, Cal.
Hartman Electrical Mfg., Mansfield, Ohio
Hi-G, Windsor Locks, Conn.
Jewell Electrical Instrs., Manchester, N.H.
Lear Siegler, Inc., Santa Monica, Calif.
Logitek, Inc., Farmingdale, N.Y.
Magnecraft Elec., Chicago, Ill.
Potter & Brumfield, Princeton, Ind.
Relay Specialties Inc., Fair Lawn, N.J.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
Wilmar Elctrns. Inc., Torrance, Cal.

Relays, Plate Circuit

Guardian Elec. Mfg. Co., Chicago, Ill. Vol 2•776
Magnecraft Elec., Chicago, Ill. Vol 2•822
American Zettler, Irvine, Ca.
Artisan Elctrns. Corp., Parsippany, N.J.
Computer Comps., Jamaica, N.Y.
Couch S.H. Div., Boston, Mass.
Dale Elctrns., Inc., Yankton, S.D.
Davis Elec. Co., Cape Girardeau, Mo.
Deltrol Controls, Milwaukee, Wisc.
Elctrn. Applications, S. El Monte, Cal.
Essex International, Inc., Logansport, Ind.
Essex Int'l., Logansport, Ind.
General Automatic Corp., Bayonne, N.J.
Guardian California, Culver City, Cal.
Hi-G, Windsor Locks, Conn.
Jaidinger Mfg. Co., Inc., Chicago, Ill.
Liberty Controls, Inc., Shorewood, Ill.
Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Midtex/Aemco, Mankato, Minn.
North American Philips Controls, Frederick, Md.
Ohmite Mfg. Co., Skokie, Ill.
Omega Electric, Chicago, Ill.
Potter & Brumfield, Princeton, Ind.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
Schrack Elec. Sls., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Struthers-Dunn, Inc., Pitman, N.J.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.

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Adams & Westlake, Elkhart, Ind.
Babcock Control Prods., Costa Mesa, Calif.
Barber-Colman Co., Motor Div., Rockford, Ill.
Branson Corp., Denville, N.J.
Clare, C.P. & Co., Chicago, Ill.
Computer Comps., Jamaica, N.Y.
Cook Elec. Co., Morton Grove, Ill.
Coto-Coil Co., Inc., Providence, R.I.
Deltrol Controls, Milwaukee, Wisc.
Douglas Randall Div., Pawcatuck, Conn.
Elctrn. Applications, S. El Monte, Cal.
Elctrn. Instr. & Specialty, Stoneham, Mass.
Fifth Dimension, Princeton, N.J.
Flight Sys., Inc., Mechanicsburg, Pa.
General Automatic Corp., Bayonne, N.J.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
GTE Automatic Elec., Northlake, Ill.
Hartman Electrical Mfg., Mansfield, Ohio
ITT Jennings, San Jose, Cal
Jewell Electrical Instrs., Manchester, N.H.
Liberty Controls, Inc., Shorewood, Ill.
Magnecraft Elec., Chicago, Ill.
Midtex/Aemco, Mankato, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
North American Philips Controls, Frederick, Md.
Potter & Brumfield, Princeton, Ind.
Printact Relay Div., Long Island City, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Struthers-Dunn, Inc., Pitman, N.J.
T-Bar Inc., Wilton, Conn.
Triac Elctrn. Sys., Forest Hills, N. Y.
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Adams & Westlake, Elkhart, Ind.
Allen-Bradley Co., Milwaukee, Wisc.
American Zettler, Irvine, Ca.
AMF Electical Prods., Alexandria, Va.
Arrow-Hart, Inc., Hartford, Conn.
Artisan Elctrns. Corp., Parsippany, N.J.
ATR Elctrns., Inc., St. Paul, Minn.
Basler Elec. Co., Highland, Ill.
Cutler-Hammer, Milwaukee, Wisc.
Davis Elec. Co., Cape Girardeau, Mo.
Deltrol Controls, Milwaukee, Wisc.
Dynamic Controls Corp., S. Windsor, Conn.
Elmwood Sensors, Inc., Cranston, R.I.
Essex International, Inc., Logansport, Ind.
Gems Sensors Div., Farmington, Conn.
General Automatic Corp., Bayonne, N.J.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
GTE Automatic Elec., Northlake, Ill.
Guardian California, Culver City, Cal.
H-B Instr. Co., Phila., Pa.
Hartman Electrical Mfg., Mansfield, Ohio
Hi-G, Windsor Locks, Conn.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Ingraham Inds., Controls Div., Elizabethtown, Ky.
International Rectifier, El Segundo, Cal.
James Elctrns., Inc., Chicago, Ill.
Jewell Electrical Instrs., Manchester, N.H.
Johnson E. F. Co., Waseca, Minn.
Lear Siegler, Inc., Santa Monica, Calif.
Ledex, Inc., Dayton, Ohio
Liberty Controls, Inc., Shorewood, Ill.
Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Littelfuse, Inc., Des Plaines, Ill.
Mack Elec. Devices, Wyncote, Pa.
Nanotron Relay Co., Burbank, Cal.
North American Philips Controls, Frederick, Md.
Oak Inds. Inc., Crystal Lake, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
Solid State Elctrns. Corp., Sepulveda, Cal.
Square D Co., Park Ridge, Ill.
T-Bar Inc., Wilton, Conn.
Texas Instruments, Attleboro, Mass.
Torr Labs., Los Angeles, Cal.
Triac Elctrn. Sys., Forest Hills, N. Y.
Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Weston Instruments, Inc., Newark, N.J.
Yaskawa Elec. America, Inc., Oak Brook, Ill.
Zenith Controls Inc., Chicago, Ill.

Relays, Programmable

Matrix Systems Corp., Chatsworth, Calif. Vol 2•835

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Amphenol RF Div., Danbury, Conn. Vol 2•1002
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. Vol 2•1002
Daico Inds. Inc., Compton, Cal. Vol 2•610
Elctrn. Instr. & Specialty, Stoneham, Mass. Vol 2•743
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Hi-G, Windsor Locks, Conn. Vol 2•789
ITT Jennings, San Jose, Cal. Vol 2•1071
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal. Vol 2•798,799
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Magnecraft Elec., Chicago, Ill. Vol 2•830
Matrix Systems Corp., Chatsworth, Calif. Vol 2•835
Potter & Brumfield, Princeton, Ind. Vol 2•856,859
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Allied Control Co., Plantsville, Conn.
American Zettler, Irvine, Ca.
Babcock Control Prods., Costa Mesa, Calif.
CES Elctrns., Brooklyn, N.Y.
Clare, C.P. & Co., Chicago, Ill.
Collins Radio Co., Dallas, Tex.
Computer Comps., Jamaica, N.Y.
Cosar Corp., Garland, Texas
E & M Laboratories, Inc., Westlake Village, Cal.
Elctrn. Applications, S. El Monte, Cal.
Fifth Dimension, Princeton, N.J.
Grigsby-Barton, Inc., Rolling Meadows, Ill.
Kratos Precision Prods., Los Angeles, Cal.
Midtex/Aemco, Mankato, Minn.
Norsal Industries, Inc., Brentwood, N.Y.
Printact Relay Div., Long Island City, N.Y.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Struthers-Dunn, Inc., Pitman, N.J.
Teledyne Relays, Hawthorne, Cal.
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Automatic Timing & Controls, Inc., King of Prussia, Pa.
Babcock Control Prods., Costa Mesa, Calif.
Barber-Colman Co., Motor Div., Rockford, Ill.
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Cornell-Dubilier Elctrns., Newark, N.J.
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Coto-Coil Co., Inc., Providence, R.I.
Couch S.H. Div., Boston, Mass.
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Edison, Instr. Div., W. Orange, N.J.
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Hartman Electrical Mfg., Mansfield, Ohio
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Master Elctrn. Controls, Santa Monica, Cal.
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Universal Relay Corp., New York, N.Y.
Vanguard Relay Corp., Lindenhurst, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
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Nanotron Relay Co., Burbank, Cal.
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Grigsby-Barton, Inc., Rolling Meadows, Ill.
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Jettron Prods., Hanover, N.J.
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Mack Elec. Devices, Wyncote, Pa.
Magnecraft Elec., Chicago, Ill.
Struthers-Dunn, Inc., Pitman, N.J.
Torr Labs., Los Angeles, Cal.
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ADC Prods., Minneapolis, Minn.
Allen-Bradley Co., Milwaukee, Wisc.
ATR Elctrns., Inc., St. Paul, Minn.
Biddle, James G., Plymouth Meeting, Pa.
Bramco Controls, Piqua, Ohio
Douglas Randall Div., Pawcatuck, Conn.
GTE Automatic Elec., Northlake, Ill.
J-B-T Instrs., Inc., New Haven, Conn.
Magnecraft Elec., Chicago, Ill.
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General Radio Co., Concord, Mass.
Metavac, Inc., Flushing, N.Y.
Mini-Systems, Inc, North Attleboro, Mass.
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Carbone Corp., Boonton, N.J.
Consolidated Resistance Amer., Yonkers, N.Y.
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E-Systems, Inc., Memcor Div., Huntington, Ind.
Edison Elctrns. Div., Manchester, N.H.
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Elctrn. Precision Comps., Mt. Vernon, N.Y.
General Resistance, Inc., Mt. Vernon, N.Y.
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Kelvin, Van Nuys, Cal.
KRL Electronics, Manchester, N.H.
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Ohmite Mfg. Co., Skokie, Ill.
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Shigoto Inds., Ltd., New York, N.Y.
Sprague Elec. Co., No. Adams, Mass.
Square D Co., Park Ridge, Ill.
Stackpole Carbon Co., Elctrn. Comp. Div.-Soft Ferrites/Special Resistors, St. Marys, Pa.
Ultronix, Inc., Grand Junction, Colo.
United Mineral & Chem. Corp., New York, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.

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Bourns, Inc., Instr. Div., Riverside, Calif.

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Allen-Bradley Co., Milwaukee, Wisc.
Astro Elctrns., Inc., Fullerton, Calif.

Beckman Instrs., Helipot Div., Fullerton, Cal.
Bourns, Inc., Instr. Div., Riverside, Calif.
Carbone Corp., Boonton, N.J.
Carter Mfg. Corp., Hudson, Mass.
Computer Instrs., Hempstead, N.Y.
Dale Elctrns., Inc., Columbus, Neb.
Diplohmatic Div., Seattle, Wash.
E-Systems, Inc., Memcor Div., Huntington, Ind.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
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Litton Inds., Mt. Vernon, N.Y.
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Litton Inds., Mt. Vernon, N.Y.
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Pyrofilm Corp., Whippany, N.J.
RCL Elctrns., Inc., Irvington, N.J.
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United Mineral & Chem. Corp., New York, N.Y.
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Carborundum Co., Niagara Falls, N.Y.
CW Industries, Warminster, Pa.
Dale Elctrns., Inc., Columbus, Neb.
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Beman Mfg., Inc., New Cumberland, Pa.
Carborundum Co., Niagara Falls, N.Y.
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Clarostat Mfg. Co., Inc., Dover, N.H.
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Constanta Co. of Can., Montreal, Can.
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E-Systems, Inc., Memcor Div., Huntington, Ind.
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Lectrohm Div. of Capco, Inc., Grand Junction, Col.
Litton Inds., Mt. Vernon, N.Y.
Mallory Controls, Frankfort, Ind.
Marstan Resistor, Orange, N.J.
Nytronics Inc., Darlington, S.C.
Precision Resistor Co., Hillside, N.J.
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Samarius, Inc., Derby, Conn.
Seacor, Inc., Norwood, N.J.
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Sprague Elec. Co., No. Adams, Mass.
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United Mineral & Chem. Corp., New York, N.Y.
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E & M Laboratories, Inc., Westlake Village, Cal.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
MCL, Inc., La Grange, Ill.
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Acme Model Engrg. Co., Ridgefield, N.J.
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Retainers, Relay

American Zettler, Irvine, Ca.
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Retainers, Transistor & Diode

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Gibson/Egan Co., Arcadia, Calif.
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Jettron Prods., Hanover, N.J.
Keystone Elctrns. Corp., New York, N.Y.
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CW Industries, Warminster, Pa.
Duncan Elctrns., Costa Mesa, Cal.
Edison Elctrns. Div., Manchester, N.H.
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Mallory Controls, Frankfort, Ind.
Maurey Instrument Corp., Chicago, Ill.
Reon Resistor Corp., Frazer, Pa.
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Shigoto Inds., Ltd., New York, N.Y.
Tech Labs., Inc., Palisades Pk., N.J.
Techno-Comps. Corp., Van Nuys, Cal.
Triac Elctrn. Sys., Forest Hills, N. Y.
United Mineral & Chem. Corp., New York, N.Y.
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Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
GC Electronics, Rockford, Ill.
PIC Design Division, Ridgefield,, Conn.
Sterling Instr., New Hyde Pk., NY
Superior Carbon Prods., Inc., Cleveland, Ohio
Templeman, D.R. Co., Plainville, Conn.
Tridair Inds., Torrance, Calif.
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APM-Hexseal, Englewood, N.J.
Cherry Rivet & Boots Nut Divs., Santa Ana, Calif.
Circon Corp., Santa Barbara, Ca.
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Gries Reproducer Co., New Rochelle, N.Y.
Ico/Rally, Palo Alto, Cal.
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Milford Rivet & Mach., Milford, Conn.
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Pylon Co., Inc., Attleboro, Mass.
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Agnew-Higgins, Inc., Garden Grove, Calif.
Baker Co., Inc., Sanford, Me.
Clean Room Prods., Farmingdale, N.Y.
Merix Chem. Co., Chicago, Ill.

Standard Environmental Systems, Inc., Totowa, N.J.
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Minnesota Rubber Co., Minneapolis, Minn.
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Sapphire Parts

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Amtron Inc., Midlothian, Ill.
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Nuclear Data, Palatine, Ill.
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Ormond Inc., Santa Fe Springs, Cal.
Packard Instrument Co., Inc., Downers Grove, Ill.
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Mechanical Engraving Co., Inc., Bronx, N.Y.
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General Scanning, Watertown, Mass.
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Syntronic Instrs., Inc., Addison, Ill.

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Conklin Instr. Corp., Pleasant Valley, N.Y.
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Data Specialties Inc., Highland Park, Ill.
Doric Sci. Corp., San Diego, Calif.
Fifth Dimension, Princeton, N.J.
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Jonard Inds. Corp., Bronx, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
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Gardner-Denver Co., Quincy, Ill.
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Hunter Tools, El Monte, Calif
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Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Moody Tools, Inc., Providence, R.I.
Neuses, P.K., Inc., Arlington Hgts., Ill.
Norelcom Inds., Inc., Farmingdale, N.Y.
Skyo Industries Inc., Deer Park, N.Y.
Standard Pneumatic Motor Co., Reno, Nev.
Techni-Tool, Inc., Philadelphia, Pa.
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X-Acto, Long Island City, N.Y.
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Electro-Science Labs., Pennsauken, N. J.
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Statham Instrs., Inc., Oxnard, Cal.
Tekform Prods. Co., Anaheim, Cal.
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Anchor Alloys, Inc., Brooklyn, N.Y.
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Ceramaseal, Inc., New Lebanon Center, N.Y.
Composite Microcircuits, Waltham, Mass.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Electrical Inds., Murray Hill, N.J.
Electro-Science Labs., Pennsauken, N. J.
Elctrn. Seals, Van Nuys, Cal.
Fredericks Co., Huntingdon Valley, Pa.
General Elec. Co., Waterford, N.Y.
GTI Corp. (E), Pittsburgh, Pa.

Gulton Inds., Newport Bch., Cal.
Hermetic Seal Corp., Rosemead, Cal.
High Voltage Engrg. Corp., Burlington, Mass.
Latronics Corp., Latrobe, Pa.
Malco, A Microdot Co., Inc., Chicago, Ill.
National Beryllia Corp., Haskell, N.J.
Statham Instrs., Inc., Oxnard, Cal.
Tekform Prods. Co., Anaheim, Cal.
Thermal Amer. Fused Quartz, Montville, N.J.
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Ceramaseal, Inc., New Lebanon Center, N.Y.
Composite Microcircuits, Waltham, Mass.
Coors Porcelain Co., Golden, Colo.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
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Eimac, San Carlos, Calif.
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Electro-Science Labs., Pennsauken, N. J.
Elctrn. Seals, Van Nuys, Cal.
Fansteel Inc., N Chicago, Ill.
General Lab. Assocs., Norwich, N.Y.
GTI Corp. (E), Pittsburgh, Pa..
Hermetic Seal Corp., Rosemead, Cal.
Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y.
Latronics Corp., Latrobe, Pa.
Malco, A Microdot Co., Inc., Chicago, Ill.
Metal Bellows Corp., Sharon, Mass.
National Beryllia Corp., Haskell, N.J.
Parker Seal Co., Culver City, Calif.
Plessey Ceramic Div., Frenchtown, N.J.
Singer Co., Little Falls, N.J.
Solid State Equipment Corp., Fort Washington, Pa.
Tekform Prods. Co., Anaheim, Cal.
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Armstrong Cork Co., Lancaster, Pa.
Associate General Labs., Inc., Brookfield, Ill.
Ceramaseal, Inc., New Lebanon Center, N.Y.
Chemetron Corp., Chicago, Ill.
Electro-Science Labs., Pennsauken, N. J.
Fansteel Inc., N Chicago, Ill.
General Elec. Co., Waterford, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
Latronics Corp., Latrobe, Pa.
Omega Engrg., Inc., Stamford, Conn.
Parker Seal Co., Culver City, Calif.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
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Chemplast, Inc., Wayne, N.J.
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Dixon Corp., Bristol, R.I.
Lake Chemical Co., Chicago, Ill.
Paul, F.H. & Stein Bros., New York, N.Y.
Penn Fibre & Specialty, Phila., Pa.
Press-On Prods., Addison, Ill.
Rogers Corp., Rogers, Conn.
Zippertubing Co., Los Angeles, Calif.

Seals, Rubber

Adhesive Prods. Corp., Bronx, N.Y.
APM-Hexseal, Englewood, N.J.
Armstrong Cork Co., Lancaster, Pa.
Bacon Inds., Watertown, Mass.
Edwards High Vacuum, Grand Island, N.Y.
General Elec. Co., Waterford, N.Y.
Hardman Inc., Belleville, N.J.
Minnesota Rubber Co., Minneapolis, Minn.
Parker Seal Co., Culver City, Calif.
Paul, F.H. & Stein Bros., New York, N.Y.
Press-On Prods., Addison, Ill.
Rogers Corp., Rogers, Conn.
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Seals, Rubber To Metal

Adhesive Prods. Corp., Bronx, N.Y.
APM-Hexseal, Englewood, N.J.
General Elec. Co., Waterford, N.Y.
Hardman Inc., Belleville, N.J.
High Voltage Engrg. Corp., Burlington, Mass.
Minnesota Rubber Co., Minneapolis, Minn.
Parker Seal Co., Culver City, Calif.
Rogers Corp., Rogers, Conn.
Vacuum Resch. Mfg., San Ramon, Cal.

Seals, Waveguide

Chomerics, Inc., Woburn, Mass.
Parker Seal Co., Culver City, Calif.
Systron-Donner Microwave Div., Van Nuys, Cal.
Waveline, Inc., W. Caldwell, N.J.

Search Unit, Magnetic Tape—See Tape Search Equipment

Self-Lubricating Materials—See Materials, Self-Lubricating

Selsyns—See Motors, Synchronous

Semiconductor Material—See Crystals, Semiconductor

Semiconductor Wafer Fabrication, Artwork (Precision)

Illumination Inds., Inc., Sunnyvale, Cal. Vol 2•682
Cal-Tex Semiconductor, Santa Clara, Cal.
Texas Instruments, Dallas, Tex.

Semiconductor Wafer Fabrication, Assembling (Packaging)

Cal-Tex Semiconductor, Santa Clara, Cal.
Texas Instruments, Dallas, Tex.
Wentworth Labs, Inc., Broadfield, Conn.

Semiconductor Wafer Fabrication, Designing (Topological)

Cal-Tex Semiconductor, Santa Clara, Cal.
Laser Technology, Inc., N. Hollywood, Calif.
Lithic Systems, Inc., Cupertino, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
National Semiconductor, Santa Clara, Cal.
Precision Monolithics Inc., Santa Clara, Cal.
Texas Instruments, Dallas, Tex.

Semiconductor Wafer Fabrication, Maskmaking (Tooling)

Illumination Inds., Inc., Sunnyvale, Cal. Vol 2•682
Cal-Tex Semiconductor, Santa Clara, Cal.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Texas Instruments, Dallas, Tex.

Semiconductor Wafer Fabrication, Processing

Cal-Tex Semiconductor, Santa Clara, Cal.
Cincinnati Milacron, Lebanon, Ohio
Materials Resch. Corp., Orangeburg, N.Y.
National Beryllia Corp., Haskell, N.J.
Philadelphia Quartz Co., Phila., Pa.
Precision Monolithics Inc., Santa Clara, Cal.
Research Devices, Berkeley Heights, N.J.
Texas Instruments, Dallas, Tex.
Union Carbide, San Diego, Cal.
Varadyne Capacitors, Santa Monica, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Semiconductor Wafer Fabrication, Testing

Cal-Tex Semiconductor, Santa Clara, Cal.
Comaltest, Danbury, Conn.
Hacker Instrs., Inc., Fairfield, N.J.
Laser Technology, Inc., N. Hollywood, Calif.
Lithic Systems, Inc., Cupertino, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
Precision Monolithics Inc., Santa Clara, Cal.
Research Devices, Berkeley Heights, N.J.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Dallas, Tex.
Transitron Elctrn. Corp., Wakefield, Mass.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
Wentworth Labs, Inc., Broadfield, Conn.

Semiconductors—See Diodes; Rectifiers; Transistors

Sensors—See Tranducer Listings

Sensors, Temperature—See Bolometers; Thermistors; Transducers

Services, Assembly & Fabrication

Amphenol Cadre Div., Endicott, N.Y. Vol 3•1091
Peerless Radio Corp., Lynbrook, N.Y. Vol 3•1089
ABA Industries, Inc., Pinellas Pk., Fla.
Abrams Instr., Lansing, Mich.
Accurate Elctrns. Corp., Elyria, Ohio
American Elctrn. Labs., Inc., Lansdale, Pa.
Amphenol Sams Div., Chatsworth, Cal.
Applied Control Co., Fairfield, N.J.
BECO, Inc., Salem, Va.
Bendix Corp, Towson, Md.
Bud Radio, Willoughby, Ohio
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Elctrn. Molding Corp., Woonsocket, R.I.
Elgin Elctrns. Inc., Waterford, Pa.
Estes Engrg. Co., Gardena, Calif.
GRM Corp., Medford, N.J.
Hybrid-Technology Corp., Arlington, Tex.
IEC Electronics Corp., E. Rochester, N.Y.
Inservco, Inc., La Grange, Ohio
Kates Scientific Instrs., Inc., Watertown, Mass.
Kinetron Corp., Asbury Park, N.J.
Mag-Con, Inc., New Brighton, Minn.
Matrix Engineering Corp., Gardena, Calif.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Midland Standard Inc., Elgin, Ill.
Mobil Elctrns., Inc., Anderson, Ind.
National Metal Crafters Inc., Phila., Pa.
New Era Products, Cleveland, Ohio
Norelcom Inds., Inc., Farmingdale, N.Y.
Pioneer/Instrumentation, Cleveland, Ohio
Plastiglide Mfg. Corp., Santa Monica, Cal.
Projects Unlimited, Inc., Dayton, Ohio
Proto Matic Co., Cincinnati,, Ohio
RCA Service Co., Camden, N.J.
3M Co., St. Paul, Minn.
Viking Inds., Inc., Chatsworth, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

Services, Backplane Wiring

Amphenol Cadre Div., Endicott, N.Y. Vol 3•647
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. ..... Vol 3•647
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
IFE Div., E. Providence, R. I.
Malco, A Microdot Co., Inc., Chicago, Ill.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Vero Electronics, Inc., Hauppauge, N.Y.
Zonic Tech. Labs., Cincinnati, Ohio

Services, Calibration & Instrument Repair

AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
American Elctrn. Labs., Inc., Lansdale, Pa.
BECO, Inc., Salem, Va.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Biddle, James G., Plymouth Meeting, Pa.
BLH Elctrns., Inc., Waltham, Mass.
Columbia Resch. Labs., Woodlyn, Pa.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electrical Testing Labs., Inc., New York, N.Y.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Gen'l. Environments Corp., Morton Grove, Ill.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Honeywell, Minneapolis, Minn.
Honeywell, Denver, Colo.
Lear Siegler, Inc., Santa Monica, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
Main Elctrns., Inc., Wichita, Kans.
Marlin Mfg. Corp., Cleveland, Ohio
Maury Microwave Corp., Cucamonga, Calif.
Milletron, Inc., Pittsburgh, Pa.
New Era Products, Cleveland, Ohio
N.Y. Testing Labs., Inc., Westbury, N.Y.
Ormond Inc., Santa Fe Springs, Cal.
Photo Resch. Corp., Burbank, Calif.
Pioneer/Instrumentation, Cleveland, Ohio
Polarad Elctrn. Instrs., Lake Success, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Inc., Beaverton, Ore.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Transducers, Inc., Whittier, Ca.
Tucker Electronics Co., Garland, Tex.
Victoreen Instr., Cleveland, Ohio
Westinghouse Elec. Corp., Industry Srvcs. Div., Pittsburgh, Pa.
Weston Instruments, Inc., Newark, N.J.
Westronics, Inc., Ft. Worth, Tex.

Services, Coating (All-Types)

Alpha Metals, Inc., Jersey City, N.J.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Atlantic Instrs. Corp., Watertown, Mass.
Chemplast, Inc., Wayne, N.J.
Collins Radio Co., Dallas, Tex.
Hardman Inc., Belleville, N.J.
High Voltage Engrg. Corp., Burlington, Mass.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Materials Resch. Corp., Orangeburg, N.Y.
Metavac, Inc., Flushing, N.Y.
Mid-West Metal Prods., Inc., Kansas City, Kans.
National Beryllia Corp., Haskell, N.J.
Natvar Corp., Rahway, N.J.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Press-On Prods., Addison, Ill.
Sifco Metachemical, Cleveland, Ohio
Spectra-Physics, Inc., Mountain View, Calif.
Tempil Div., So. Plainfield, N.J.
Thin Film Services, Gile, Wisc.
Union Carbide, San Diego, Cal.
Union Carbide, Indpls., Ind.
Valpey Corp., Holliston, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Services, Computer-Aided Design (CAD)

Design Automation, Inc., Lexington, Mass.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Scanbe Mfg. Corp., El Monte, Cal.

Services, Crimping

Amphenol Cadre Div., Endicott, N.Y.

Services Custom Molding, Plastics

Accurate Elctrns. Corp., Elyria, Ohio
Barker Prods. Co., Saugus, Mass.
Central Plastics Dists., Chicago, Ill.
Chemplast, Inc., Wayne, N.J.
Communications Technology Corp., Los Angeles, Cal.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
GTE Sylvania Inc., Warren, Pa.

GTI Corp. (E), Pittsburgh, Pa.
Harbison Ind'l. Prods., Inc., Levittown, Pa.
Haysite Div., Erie, Pa.
IFE Div., E. Providence, R. I.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Kurz-Kasch Incorporated, Dayton, Ohio
Molex Inc., Lisle, Ill.
Nat'l. Wire & Cable, Los Angeles, Cal.
NVF Co., Yorklyn, Del.
Panta-Pak Packaging Div., Passaic, N.J.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Precision Paper Tube Co., Wheeling, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Rostone Corp., Lafayette, Ind.
Stevens Prods., Inc., E. Orange, N.J.
Textool Prods., Inc., Irving, Tex.
Vichek Plastics Co., Middlefield, Ohio
Westinghouse Elec., W. Mifflin, Pa.
Whittaker Corp., Los Angeles, Cal.

Services, Decapsulation

Amphenol Cadre Div., Endicott, N.Y. Vol 3•1090
Amphenol Comps. Grp. Mktg., Oak Brook, Ill.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Amphenol Sams Div., Chatsworth, Cal.

Services, Electrical Measurement & Test

Amphenol Cadre Div., Endicott, N.Y. Vol 3•647
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. ..... Vol 3•647
Cornell-Dubilier Elctrns., Newark, N.J. Vol 2•559
Hopkins Engrg., San Fernando, Cal. Vol 2•569
AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
All-Tronics Inc., Westbury, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amphenol Sams Div., Chatsworth, Cal.
Biddle, James G., Plymouth Meeting, Pa.
Comaltest, Danbury, Conn.
Dielectric Instr. Corp., Pittsburgh, Pa.
Dynamic Measurements Corp., Winchester, Ma.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Electrical Testing Labs., Inc., New York, N.Y.
Electro-Mechanics Co., Austin, Tex.
Erie Technological Prods. (EEM), Erie, Pa.
Esterline Angus Div., Indianapolis, Ind.
Gen'l. Environments Corp., Morton Grove, Ill.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Honeywell, Denver, Colo.
HRB-Singer, Inc., State College, Pa.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
LFE Corp., Waltham,, Mass.
Lockheed Elctrns. Co., Watchung, N.J.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Melpar, Falls Church, Va.
New Era Products, Cleveland, Ohio
Parks Laboratory Henry Francis, Seattle, Wash.
Proto Matic Co., Cincinnati,, Ohio
RCA Service Co., Camden, N.J.
Ross Engrg. Corp., Campbell, Cal.
Rowe Inds., Div., Toledo, Ohio
Sanders Assocs., Nashua, N.H.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Solar Elctrns. Co., Hollywood, Cal.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Tech-Etch, Inc., Hingham, Mass.
Technical Research & Mfg. Co., Manchester, N.H.
Teledyne Micronetics, San Diego, Calif.
Westinghouse Elec. Corp., Industry Srvcs. Div., Pittsburgh, Pa.

Services, Encapsulation

Airflyte Elctrns. Co., Bayonne, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amphenol Cadre Div., Endicott, N.Y.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Amphenol Sams Div., Chatsworth, Cal.
Anchor Alloys, Inc., Brooklyn, N.Y.
Atlantic Instrs. Corp., Watertown, Mass.
Automation Services Div., Windsor, N. Y.
Bacon Inds., Watertown, Mass.
Beman Mfg., Inc., New Cumberland, Pa.
Bendix Corp., Sturbridge, Mass.
Cable Sys. & Assembly Co., Inc., Everett, Mass.
Conap, Inc., Allegany, N.Y.
Dynamic Measurements Corp., Winchester, Ma.
Eastern Delta Corp., Fair Lawn, N.J.
Electrical Plastics Corp., Long Branch, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Emerson & Cuming, Inc., Canton, Mass.
Endicott Coil Co., Binghamton, N.Y.
Estes Engrg. Co., Gardena, Calif.
Grayhill Inc., LaGrange, Ill.
Hardman Inc., Belleville, N.J.
Hightemp Resins, Inc., Stamford, Conn.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Kates Scientific Instrs., Inc., Watertown, Mass.
Manger Elec. Co., Inc., Stamford, Conn.
National Beryllia Corp., Haskell, N.J.
Paraplegics Mfg., Bensenville, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Q.V.S., Inc., East Orange, N.J.
Robinson-Nugent, New Albany, Ind.
Rowe Inds., Div., Toledo, Ohio
Semicon Assoc., Inc., Lexington, Ky.
U.S. Elctrns., Long Branch, N.J.

Services, Environmental Testing

Abrams Instr., Lansing, Mich.
American Elctrn. Labs., Inc., Lansdale, Pa.
Atlas Electric Devices, Chicago, Ill.
Baganoff Assocs., Inc., St. Louis, Mo.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Beukers Labs., Inc., Hauppauge, N.Y.
Burlington Opers. Div., Burlington, Mass.
Dow Chemical Co., Midland, Mich.
Electrical Testing Labs., Inc., New York, N.Y.
Electro-Mechanics Co., Austin, Tex.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Fairchild Space & Defense Sys., Syosset, N.Y.
Fisher Sci. Co., Pittsburgh, Pa.
General Elec., Baltimore, Md.
General Elec., Phila., Pa.
Gen'l. Environments Corp., Morton Grove, Ill.
Grayhill Inc., LaGrange, Ill.
GRM Corp., Medford, N.J.
HRB-Singer, Inc., State College, Pa.
Hughes Aircraft Co, Ground Sys. Grp., Fullerton, Cal.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Kaman Sciences Corp., Colorado Springs, Colo.
L.A.B. Corp., Skaneateles, N.Y.
Lear Siegler, Inc., Elyria, Ohio
Lockheed Elctrns. Co., Watchung, N.J.
Melcor Elctrns. Corp., Farmingdale, N.Y.
N.Y. Testing Labs., Inc., Westbury, N.Y.
Q.V.S., Inc., East Orange, N.J.
RCA Service Co., Camden, N.J.
Rowe Inds., Div., Toledo, Ohio
Sloan Technology Corp., Santa Barbara, Calif.
Torwico Elctrns., Inc., Lakewood, N.J.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Varian Assocs., Vacuum Div., Palo Alto, Cal.
Vibration Instrs. Co., Anaheim, Cal.
Webber Mfg. Co., Inc., Indianapolis, Ind.
Westinghouse Elec., Elmira, N.Y.
Westinghouse Elec. Corp., Industry Srvcs. Div., Pittsburgh, Pa.
Whittaker Corp., Los Angeles, Cal.

Services, Glass Blowing & Fabrication

Bendix Corp., Sturbridge, Mass.
Fredericks Co., Huntingdon Valley, Pa.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
Kahl Scientific Instr. Corp., El Cajon, Calif.
Latronics Corp., Latrobe, Pa.
Valpey Corp., Holliston, Mass.

Services, Hermetic Sealing

Alberox Corp., New Bedford, Mass.
Associate General Labs., Inc., Brookfield, Ill.
Basic Ceramics Inc., Hawthorne, N.J.
Bendix Corp., Sturbridge, Mass.
Bendix, Franklin, Ind.
Ceramaseal, Inc., New Lebanon Center, N.Y.
Composite Microcircuits, Waltham, Mass.
Electrical Inds., Murray Hill, N.J.
Elctrn. Seals, Van Nuys, Cal.
Fansteel Inc., N Chicago, Ill.
Glass Beads Co., Latrobe, Pa.
GTI Corp. (E), Pittsburgh, Pa.
Gulton Inds., Newport Bch., Cal.
Hermetic Seal Corp., Rosemead, Cal.
Kinetron Corp., Asbury Park, N.J.
Latronics Corp., Latrobe, Pa.
Mann, David W. Co., Burlington, Mass.
Solid State Equipment Corp., Fort Washington, Pa.
Tekform Prods. Co., Anaheim, Cal.
Texas Instruments, Attleboro, Mass.

Services, High Vacuum

Bemco, Inc., Pacoima, Cal.
Eastern Delta Corp., Fair Lawn, N.J.
Evaporated Coatings, Inc., Huntingdon Valley, Pa.
Fredericks Co., Huntingdon Valley, Pa.
Gen'l. Environments Corp., Morton Grove, Ill.
High Voltage Engrg. Corp., Burlington, Mass.
Materials Resch. Corp., Orangeburg, N.Y.
Metavac, Inc., Flushing, N.Y.
N.Y. Testing Labs., Inc., Westbury, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Thin Film Services, Gile, Wisc.
Vacumetrics Inc., Waltham, Mass.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Services, Mask Making

Buckbee-Mears Co., St. Paul, Minn.
Conforming Matrix Corp., Toledo, Ohio
Mann, David W. Co., Burlington, Mass.
Photronic Labs., Danbury, Conn.
Press-On Prods., Addison, Ill.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Tech-Etch, Inc., Hingham, Mass.

Services, Metal Etching, Engraving

Buckbee-Mears Co., St. Paul, Minn.
Hamilton Technology, Inc., Lancaster, Pa.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Tech-Etch, Inc., Hingham, Mass.
Thin Film Services, Gile, Wisc.

Services, Metal Parts Fabrication

Abrams Instr., Lansing, Mich.
Acme Model Engrg. Co., Ridgefield, N.J.
American Elctrn. Labs., Inc., Lansdale, Pa.
Automation Services Div., Windsor, N. Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Buckbee-Mears Co., St. Paul, Minn.
Bud Radio, Willoughby, Ohio
Conklin Instr. Corp., Pleasant Valley, N.Y.
Electronic Enclosures, Los Angeles, Cal.
Evans, George Corp., Moline, Ill.
Falstrom Co., Passaic, N.J.
GTE Sylvania Inc., Warren, Pa.
GTI Corp. (E), Pittsburgh, Pa.
Hamilton Technology, Inc., Lancaster, Pa.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Jade Corp., Huntingdon Valley, Pa.
Kates Scientific Instrs., Inc., Watertown, Mass.
Kinetron Corp., Asbury Park, N.J.
Lear Siegler, Inc., Elyria, Ohio
Luminator Div., Plano, Tex.
Matrix Engineering Corp., Gardena, Calif.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Micrite Metal Mfg., Inc., Canoga Park, Cal.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mobil Elctrns., Inc., Anderson, Ind.
Modpak, Waltham, Mass.
Nanotron Relay Co., Burbank, Cal.
National Metal Crafters Inc., Phila., Pa.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Semicon Assoc., Inc., Lexington, Ky.
Servotronics, Inc., Buffalo, N.Y.
South River Metal Prods. Co., South River, N.J.
South Shore Metal Prods., Inc., Farmingdale, N.Y.
Staver Co., Inc., Bay Shore, N.Y.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Titchener, E.H. & Co., Binghamton, N.Y.
W.L.S. Stamping Co., Cleveland, Ohio
Zenrad Controls Co., Santa Barbara, Ca.
Zero Mfg. Co., Burbank, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Services, Metallizing (Including Electroforming)

Alberox Corp., New Bedford, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Basic Ceramics Inc., Hawthorne, N.J.
Buckbee-Mears Co., St. Paul, Minn.
Ceramaseal, Inc., New Lebanon Center, N.Y.
Craig Sys. Corp., Lawrence, Mass.
Eastern Delta Corp., Fair Lawn, N.J.
Electro-Science Labs., Pennsauken, N. J.
Evaporated Coatings, Inc., Huntingdon Valley, Pa.
Fredericks Co., Huntingdon Valley, Pa.
Hermetic Seal Corp., Rosemead, Cal.
HRB-Singer, Inc., State College, Pa.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Latronics Corp., Latrobe, Pa.
Materials Resch. Corp., Orangeburg, N.Y.
Metalized Ceramics, Providence, R.I.
Metavac, Inc., Flushing, N.Y.
Schweitzer, Peter J. Div., Lee, Mass.
Servometer Corp., Clifton, N.J.
Statek Corp., Orange, Cal.
Thin Film Services, Gile, Wisc.
Union Carbide, San Diego, Cal.
Union Carbide, Indpls., Ind.
Varian Assocs., Palo Alto, Cal.
Zenrad Controls Co., Santa Barbara, Ca.

Services, Molding

Amphenol Cadre Div., Endicott, N.Y. Vol 3•646
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. ..... Vol 3•646
ITT Thermotech, Hopkins, Minn. Vol 3•1014,1015
Nat'l. Wire & Cable, Los Angeles, Cal. Vol 3•1406
Atlantic Optical Moulding Co., Dudley, Mass.
Automation Services Div., Windsor, N. Y.
Beman Mfg., Inc., New Cumberland, Pa.
Cable Sys. & Assembly Co., Inc., Everett, Mass.
Capsonic Group, Inc., Elgin, Ill.
Central Plastics Dists., Chicago, Ill.
Communications Technology Corp., Los Angeles, Cal.
Elctrn. Molding Corp., Woonsocket, R.I.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
Hardman Inc., Belleville, N.J.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Jewell Electrical Instrs., Manchester, N.H.
Kates Scientific Instrs., Inc., Watertown, Mass.
Minnesota Rubber Co., Minneapolis, Minn.
Molex Inc., Lisle, Ill.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Precision Paper Tube Co., Wheeling, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Robinson-Nugent, New Albany, Ind.
Rostone Corp., Lafayette, Ind.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
Useco Div., Van Nuys, Cal.
Westinghouse Elec., W. Mifflin, Pa.
Westmoreland Plastics Co., Latrobe, Pa.

Services, Packaging

Composite Microcircuits, Waltham, Mass.
GTE Sylvania, Muncy, Pa.
Kates Scientific Instrs., Inc., Watertown, Mass.
Modpak, Waltham, Mass.
Solid State Equipment Corp., Fort Washington, Pa.
Zero Mfg. Co., Burbank, Cal.

Services, Plastics Fabrication

Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Ace Plastic Co., Inc., Jamacia, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
Amphenol Cadre Div., Endicott, N.Y.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Anchor Specialty Mfg., Teterboro, N.J.
Apahouser Corp. of N.E., Boston, Mass.
Aubin, A.E. Co., Glastonbury, Conn.
Bell Co., Inc., Trussville, Ala.
Budd Co., Bridgeport, Pa.
Cadilac Plastics & Chems., Detroit, Mich.
Central Plastics Dists., Chicago, Ill.
Chemplast, Inc., Wayne, N.J.
Comco Plastics, Inc., Richmond Hill, N.Y.
Communications Technology Corp., Los Angeles, Cal.
Conap, Inc., Allegany, N.Y.
Devco Engrg., W. Caldwell, N.J.
Dura Plastics N.Y., Inc., Westport, Conn.
Electronic Hardware Corp., Jamaica, N.Y.
Emerson & Cuming, Inc., Canton, Mass.
Estes Engrg. Co., Gardena, Calif.
Globe Plastics, Pomona, Cal.
Grayhill Inc., LaGrange, Ill.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
GTE Sylvania Inc., Warren, Pa.
Harbison Ind'l. Prods., Inc., Levittown, Pa.
Hermes Plastics, Inc., New York, N.Y.
Hoagland Instr., Dayton, N.J.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Jonard Inds. Corp., Bronx, N.Y.
Kates Scientific Instrs., Inc., Watertown, Mass.
Keystone Elctrns. Corp., New York, N.Y.
Laminated Fabricators, San Bruno, Calif.
Lear Siegler, Inc., Santa Monica, Calif.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Minnesota Rubber Co., Minneapolis, Minn.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
N.Y. Testing Labs., Inc., Westbury, N.Y.
Norelcom Inds., Inc., Farmingdale, N.Y.
NVF Co., Yorklyn, Del.
Panelgraphic Corp., Caldwell, N.J.
Parabam, Inc., Compton, Cal.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Precision Paper Tube Co., Wheeling, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Quartzite Processing, Inc., Malden, Mass.
Reynolds Inds., Inc., Marina Del Rey, Cal.
Robinson-Nugent, New Albany, Ind.
Rogers Corp., Rogers, Conn.
Rostone Corp., Lafayette, Ind.
Shigoto Inds., Ltd., New York, N.Y.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
Spaulding Fibre Co., Inc., Tonawanda, N.Y.
Textool Prods., Inc., Irving, Tex.
Transcon Mfg. Co., Dallas, Tex.
Western Coil & Elec. Co., Racine, Wisc.

Services, Plating

CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y. ..... Vol 3•1092
American Elctrn. Labs., Inc., Lansdale, Pa.
Berg Electronics, New Cumberland, Pa.
Buckbee-Mears Co., St. Paul, Minn.
Flexible Circuits, Inc., Warrington, Pa.
GAF Corp., New York, N.Y.
Hughes Aircraft Co., Ground Systems Grp., Fullerton, Cal.
Kawecki Berylco Inds., Inc., New York, N.Y.
Materials Technology, Inc., Somerset, N.J.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Sifco Metachemical, Cleveland, Ohio
Tekform Prods. Co., Anaheim, Cal.
Thin Film Services, Gile, Wisc.
Union Carbide, San Diego, Cal.
Union Carbide, Indpls., Ind.
Viking Inds., Inc., Chatsworth, Calif.
Zenrad Controls Co., Santa Barbara, Ca.

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Ampex Corp., Redwood City, Calif.
Continental Rentals Div., Bedford, Mass.
Sprague Elec. Co., No. Adams, Mass.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Tektronix, Inc., Beaverton, Ore.
3M Co., St. Paul, Minn.
Tucker Electronics Co., Garland, Tex.
Westronics, Inc., Ft. Worth, Tex.
Wiltron Co., Palo Alto, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

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Services, Silk Screening

Accurate Elctrns. Corp., Elyria, Ohio
Acme Model Engrg. Co., Ridgefield, N.J.
Allied Systems Corp., Greensboro, N.C.
American Elctrn. Labs., Inc., Lansdale, Pa.
Apahouser Corp. of N.E., Boston, Mass.
BECO, Inc., Salem, Va.
Bell Co., Inc., Trussville, Ala.
Decalcraft Corp., Hatfield, Pa.
Devco Engrg., W. Caldwell, N.J.
Douglas Electronics, Inc., San Leandro, Cal.
Dura Plastics N.Y., Inc., Westport, Conn.
Electro-Science Labs., Pennsauken, N. J.
Elgin Elctrns. Inc., Waterford, Pa.
Flexible Circuits, Inc., Warrington, Pa.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Mac Panel Co., High Pt., N.C.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mobil Elctrns., Inc., Anderson, Ind.
National Metal Crafters Inc., Phila., Pa.
Panelgraphic Corp., Caldwell, N.J.
Photo Chemical Prods. Cal., Santa Monica, Cal.
Stacoswitch, Inc., Costa Mesa, Cal.
Virginia Panel Corp., Waynesboro, Va.
Western Coil & Elec. Co., Racine, Wisc.
Wire Cloth Enterprises, Inc., Pittsburgh, Pa.
Zenrad Controls Co., Santa Barbara, Ca.
Zero Mfg. Co., Burbank, Cal.

Services, Vibration Surveys

American Elctrn. Labs., Inc., Lansdale, Pa.
Dytronics Co., Columbus, Ohio
Gen'l. Environments Corp., Morton Grove, Ill.
N.Y. Testing Labs., Inc., Westbury, N.Y.
Teledyne Geotech, Dallas, Tex.
Torwico Elctrns., Inc., Lakewood, N.J.
Westinghouse Elec. Corp., Industry Srvcs. Div., Pittsburgh, Pa.

Services, Waveform Analysis

Federal Sci. Corp., New York, N.Y.
Petty Geophysical Engrg., San Antonio, Tex.
Vibration Instrs. Co., Anaheim, Cal.
Weston Instruments, Inc., Newark, N.J.

Services, Wire Cutting & Stripping

Acme Model Engrg. Co., Ridgefield, N.J.
Alpha Wire Corp., Elizabeth, N.J.
Amphenol Cadre Div., Endicott, N.Y.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Automation Services Div., Windsor, N. Y.
BECO, Inc., Salem, Va.
Beman Mfg., Inc., New Cumberland, Pa.
Cable Sys. & Assembly Co., Inc., Everett, Mass.
Cambridge Thermionic, Cambridge, Mass
Cole Instrument Corp., Costa Mesa, Cal.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Drake Mfg., Harwood Hgts., Ill.
Electronic Coil Corp., Plainville, Conn.
Eraser Co., Syracuse, N.Y.
Estes Engrg. Co., Gardena, Calif.
Excel Specialty Corp., Chicago, Ill.
Halmar Elctrns., Inc., Columbus, Ohio
IEC Electronics Corp., E. Rochester, N.Y.
Kates Scientific Instrs., Inc., Watertown, Mass.
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
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Meson Electronics Co. Inc., Rochester, N. Y.
Mid-West Metal Prods., Inc., Kansas City, Kans.
Mupac Corp., Brockton, Mass.
National Tel-Tronics, Meadville, Pa.
Nat'l. Wire & Cable, Los Angeles, Cal.
Paraplegics Mfg., Bensenville, Ill.
Phoenix Wire, Inc., S. Hero, Vt.
Storm Products Co., Los Angeles, Ca.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
Whitmor Wire & Cable, No. Hollywood, Cal.

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Clifton Precision, Clifton Hgts., Pa.
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Control Data Corp., Minneapolis, Minn.
Datron Systems, Chatsworth, Cal.
Digiac Corp., Plainview, N.Y.
Dynamic Instr. Corp., Plainview, N. Y.
Farrand Controls, Inc., Valhalla, N.Y.
Gap Instr. Corp., Hauppauge, N.Y.
Geo Space Sys., Tampa, Fla.
Henschel Corp., Amesbury, Mass.
H H Controls Co., Inc., Arlington, Mass.
Hybrid Sys. Corp., Burlington, Mass.
IMC Magnetics Corp., Maywood, Cal.
Jordan Controls, Milwaukee, Wisc.
Kollsman Instr. Co., Syosset, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Luft Instrs., Inc., Lincoln, Mass.
McFadden Elctrns. Co., South Gate, Calif.
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Orbit Instr. Corp., Syosset, N.Y.
Parabam, Inc., Compton, Cal.
Perfect Gear & Instr. Corp., Northridge, Calif.
Planet Instr., Gardena, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Co., Little Falls, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Sterling Instr., New Hyde Pk., NY
Stock Drive Prods., New Hyde Pk., N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
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Rowe Inds., Div., Toledo, Ohio

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Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
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Victor Wire & Cable, L.A., Cal.
Zippertubing Co., Los Angeles, Calif.

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Magnetic Metals Co., Camden, N.J.
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Co-Operative Inds., Inc., Chester, N.J.
Collins Radio Co., Dallas, Tex.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
GTE Sylvania Inc., Warren, Pa.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
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Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
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GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
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Premier Microwave, Port Chester, N.Y.
Raytheon Co., Waltham, Mass.
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TRG Prods., E. Boston, Mass.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
UTE Microwave, Asbury Park, N.J.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.
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General Microwave Corp., Farmingdale, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Keithley Instrs., Inc., Cleveland, Ohio
Merrimac Inds., Inc., West Caldwell, N.J.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Narda Microwave Corp., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Premier Microwave, Port Chester, N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.
Waveline, Inc., W. Caldwell, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

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Dranetz Engrg. Labs., So. Plainfield, N.J.
Dytronics Co., Columbus, Ohio
Ind'l. Control Co., Farmingdale, N.Y.
Ind'l. Test Equip., Clifton, NJ
NH Research, Inc., Santa Ana, Calif.
North Atlantic Inds., Plainview, N.Y.
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y.
Singer Co., Little Falls, N.J.
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Bell & Howell Co., Pasadena, Calif.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
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Data-Control Systems, Danbury, Conn.
Doric Sci. Corp., San Diego, Calif.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Dynamic Measurements Corp., Winchester, Ma.
Elcor Prods. Welex Elctrns., Silver Spring, Md.
Electronic Modules, Inc., Pasadena, Cal.
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Foxboro Co., Foxboro, Mass.
General Devices, Inc., Princeton, N.J.
General Radio Co., Concord, Mass.
Gould, Inc., Cleveland, Ohio
Hawkeye Instrus., Inc., Marion, Iowa
Honeywell, Denver, Colo.
Hybrid Sys. Corp., Burlington, Mass.
Inservco, Inc., La Grange, Ohio
Ithaco, Inc., Ithaca, N.Y.
James Elctrns., Inc., Chicago, Ill.
Lear Siegler, Inc., Santa Monica, Calif.
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McDonnell Douglas Electronics Co., St. Charles, Mo.
Minnetech Labs, Minneapolis, Minn.
Monitor Systems, Ft. Washington, Pa
Multimetric Industries, Richmond Hill, N.Y.
Newport Labs., Inc., Santa Ana, Cal.
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Princeton Applied Resch. Corp., Princeton, N.J.
Reliance Elec. Co., Cleveland, Ohio
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RCA Missile & Surface Radar Div., Moorestown, N.J.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Tasker Systems, Chatsworth, Cal.
Varian, Beverly, Mass.
Whittaker Corp., Los Angeles, Cal.

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Techni-Tool, Inc., Philadelphia, Pa.

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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Ingersoll Prods., Chicago, Ill.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Lambda Elctrns., Melville, N.Y.
Optima Enclosures, Tucker, Ga.
Par-Metal Prods. Div., Brooklyn, N.Y.
Plastiglide Mfg. Corp., Santa Monica, Cal.
South River Metal Prods. Co., South River, N.J.
Vent-Rak, Indianapolis, Ind.
Zero Mfg. Co., Burbank, Cal.

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Aircom, Inc., Union, N.H.
Alford Mfg. Co., Winchester, Mass.
CES Elctrns., Brooklyn, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
RF Systems, Inc., Cohasset, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
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Poly-Scientific, Blacksburg, Va.
Superior Carbon Prods., Inc., Cleveland, Ohio
Teledyne Kinetics, Solana Beach, Cal.

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General Microwave Corp., Farmingdale, N.Y.
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Narda Microwave Corp., Plainview, N.Y.
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PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
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Wiltron Co., Palo Alto, Calif.

Smith Chart Impedance Plotters, Automatic

Alford Mfg. Co., Winchester, Mass.
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Master Elctrn. Controls, Santa Monica, Cal.
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Micro Instr. Co., Hawthorne, Cal.
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Mupac Corp., Brockton, Mass.
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Augat Inc., Attleboro, Mass.
Chicago Miniature Lamp Works, Chicago, Ill.
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Circon Corp., Santa Barbara, Ca.
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Control Switch, Inc., Folcroft, Pa.
Data Display Products, Los Angeles, Cal.
Flex-Link Products, Inc., San Fernando, Cal.
General Elec. Company, Providence, R.I.
Genisco Technology Corp., Eldema Div., Compton, Cal.
GTE Sylvania Inc., Danvers, Mass.
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Kulka Elec. Corp., Mt. Vernon, N.Y.
Ledex, Inc., Dayton, Ohio
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Molex Inc., Lisle, Ill.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Paraplegics Mfg., Bensenville, Ill.
Philips Elmet Corp., Lewiston, Me.
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TEC, Inc., Tucson, Ariz.
Underwriters Safety Device Co., Chicago, Ill.
Welch Allyn, Inc., Skaneateles Falls, N.Y.
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Custom Connector Corp., Cleveland, Ohio
Elco, Willow Grove, Pa.
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K-Tech., Inc., Framingham, Mass.
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Dunton, M.W. Co., Providence, R.I.
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Precision Elec. Co., Kezar Falls, Me.
Sta-Warm Elec. Co., Ravenna, Ohio
Techni-Tool, Inc., Philadelphia, Pa.
Zeva Elec. Corp., Hanover, N.J.

Solder Preforms (Including Rings)-Also See Preforms,Precious Metal

CRM, Div. Consolidated Refining Co., Mamaroneck, N.Y. Vol 3•1092
Alpha Metals, Inc., Jersey City, N.J.
Anchor Alloys, Inc., Brooklyn, N.Y.
Bow Solder Products, Newark, N.J.
Circon Corp., Santa Barbara, Ca.
Gardiner Solder Co., Chicago, Ill.
Goldsmith Precious Metals Div., Chicago, Ill.
Kester Solder Co, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Multicore Sales Corp., Westbury, N.Y.
NL Inds., Inc., Metal Div., New York, N.Y.

Soldering Accessories

Caig Labs., Inc., Westbury, N.Y. Vol 4•324,558*
Enterprise Development Corp., Indianapolis, Ind. Vol 3•1236
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 3•1237
Hexacon Elec. Co., Roselle Park, N.J. Vol 3•1238,1239
Wall-Lenk Mfg. Co., Kinston, N.C. Vol 3•1243
Air-O-Tronics Prods., Morrisville, N.Y.
Air-Vac Engrg. Co., Milford, Conn.
Alpha Metals, Inc., Jersey City, N.J.
American Elec. Heater, Detroit, Mich.
Anchor Alloys, Inc., Brooklyn, N.Y.
Chemetron Corp., Chicago, Ill.
Circon Corp., Santa Barbara, Ca.
Edsyn, Inc., Van Nuys, Cal.
Electric Soldering Iron Co., Inc., Deep River, Conn.
Engineering & Elctrn. Devices, Inc., Los Angeles, Calif.
Erikson Specialized Tool Co., Pico-Rivera, Cal.
GC Electronics, Rockford, Ill.
General Electric, Shelbyville, Ind.
Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
Hunter Tools, El Monte, Calif
Kester Solder Co, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Matrix Engineering Corp., Gardena, Calif.
Miller, L.C. Co., Monterey Park, Calif.
Precision Elec. Co., Kezar Falls, Me.
Superior Flux & Mfg., Cleveland, Ohio
Techni-Tool, Inc., Philadelphia, Pa.
Telvac Instr. Co., Van Nuys, Cal.
Titchener, E.H. & Co., Binghamton, N.Y.
UNGAR, Compton, Calif.
Union Carbide, Linde Div., New York, N. Y.
Zeva Elec. Corp., Hanover, N.J.

Soldering Equip., Induction Heating

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 3•1237
Cycle-Dyne, Inc., Jamaica, N.Y.
Electrovert, Mt. Vernon, N.Y.
Gardiner Solder Co., Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Miller, L.C. Co., Monterey Park, Calif.
Taylor-Winfield Corp., Warren, Ohio
Techni-Tool, Inc., Philadelphia, Pa.

Soldering Equip., Printed Circuit

Caig Labs., Inc., Westbury, N.Y. Vol 4•558*
Enterprise Development Corp., Indianapolis, Ind. Vol 3•1236
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 3•1237
Wall-Lenk Mfg. Co., Kinston, N.C. Vol 3•1243
Air-Vac Engrg. Co., Milford, Conn.
American Elec. Heater, Detroit, Mich.
Anchor Alloys, Inc., Brooklyn, N.Y.
Atlantic Instrs. Corp., Watertown, Mass.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Electrovert, Mt. Vernon, N.Y.
Gardiner Solder Co., Chicago, Ill.
Hexacon Elec. Co., Roselle Park, N.J.
Hollis Engrg., Inc., Nashua, N.H.
Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Matrix Engineering Corp., Gardena, Calif.
OAL Assocs., Inc., Westbury, N.Y.
Precision Elec. Co., Kezar Falls, Me.
Ragen Precision Inds., Inc., N. Arlington, N.J.
Selectrons, Ltd., New York, N.Y.
Superior Flux & Mfg., Cleveland, Ohio
Techni-Tool, Inc., Philadelphia, Pa.
Tech. Devices Co., Culver City, Calif.
UNGAR, Compton, Calif.
Zeva Elec. Corp., Hanover, N.J.

Soldering Equip., Reflow

Atlantic Instrs. Corp., Watertown, Mass.
Casso-Solar Inc., Kew Gardens, N.Y.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Electrovert, Mt. Vernon, N.Y.
Ewald Instrs. Corp., Kent, Conn.
Hollis Engrg., Inc., Nashua, N.H.
Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
Lear Siegler, Inc., Santa Monica, Calif.
MacDonald & Co., Glendale, Calif.
OAL Assocs., Inc., Westbury, N.Y.
Precision Elec. Co., Kezar Falls, Me.

Soldering Equip., Resistance

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 3•1237
American Elec. Heater, Detroit, Mich.
Americon Microwave Inds., Inc., Waltham, Mass.
Ewald Instrs. Corp., Kent, Conn.
Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
Ideal Industries, Inc., Sycamore, Ill.
MacDonald & Co., Glendale, Calif.
Solid State Equipment Corp., Fort Washington, Pa.
Taylor-Winfield Corp., Warren, Ohio
Techni-Tool, Inc., Philadelphia, Pa.
Wall-Lenk Mfg. Co., Kinston, N.C.

Soldering Systems, Temperature Controlled

Caig Labs., Inc., Westbury, N.Y. Vol 4•558*
Hexacon Elec. Co., Roselle Park, N.J. Vol 3•1238
Anchor Alloys, Inc., Brooklyn, N.Y.
Chemical Etching Equip. & Supply, Alexandria, Va.
Circon Corp., Santa Barbara, Ca.
Cooper Group, Apex, N.C.
Edsyn, Inc., Van Nuys, Cal.
Electrovert, Mt. Vernon, N.Y.
Gardiner Solder Co., Chicago, Ill.
General Electric, Shelbyville, Ind.
Hollis Engrg., Inc., Nashua, N.H.
MacDonald & Co., Glendale, Calif.
OAL Assocs., Inc., Westbury, N.Y.
Tech. Devices Co., Culver City, Calif.

Soldering Equip., Ultrasonic

Enterprise Development Corp., Indianapolis, Ind. Vol 3•1236
Anchor Alloys, Inc., Brooklyn, N.Y.
Electrovert, Mt. Vernon, N.Y.
Norelcom Inds., Inc., Farmingdale, N.Y.
Sonobond Corp., West Chester, Pa.

Soldering Flux—See Flux, Brazing & Soldering Materials

Soldering Guns, Irons & Desoldering Tools

GC Electronics, Rockford, Ill. Vol 3•679
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 3•1237
Hexacon Elec. Co., Roselle Park, N.J. Vol 3•1238
Wall-Lenk Mfg. Co., Kinston, N.C. Vol 3•1243
Air-Vac Engrg. Co., Milford, Conn.
Allied Elctrns., Chicago, Ill.
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Chemetron Corp., Chicago, Ill.
Circon Corp., Santa Barbara, Ca.
Cooper Group, Apex, N.C.
Edsyn, Inc., Van Nuys, Cal.
Electric Soldering Iron Co., Inc., Deep River, Conn.
Enterprise Development Corp., Indianapolis, Ind.
Gardiner Solder Co., Chicago, Ill.
General Electric, Shelbyville, Ind.
Hollis Engrg., Inc., Nashua, N.H.
Hunter Tools, El Monte, Calif
MacDonald & Co., Glendale, Calif.
Precision Elec. Co., Kezar Falls, Me.
Solder Removal Co., Covina, Cal.
Union Carbide, Linde Div., New York, N. Y.
Wen Prods., Inc., Chicago, Ill.
Zeva Elec. Corp., Hanover, N.J.

Solenoid Drivers, Solid-State

Artisan Elctrns. Corp., Parsippany, N.J.
Coil Co. of Amer., Northvale, N.J.
Controlcraft Corp., West Chicago, Ill.
Cutler-Hammer, Milwaukee, Wisc.
Fork Standards, W. Chicago, Ill.
Guardian California, Culver City, Cal.
Ledex, Inc., Dayton, Ohio
Tech Serv., Inc., Fogelsville, Pa.
Triac Elctrn. Sys., Forest Hills, N. Y.
Voltex Co., Inc., Farmingdale, N.Y.
Warner Elec. Brake & Clutch Co., Beloit, Wisc.

Solenoids, Linear

Guardian Elec. Mfg. Co., Chicago, Ill. Vol 2•768-773
Hi-G, Windsor Locks, Conn. Vol 2•785
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Oak Inds. Inc., Crystal Lake, Ill. Vol 2•1125
Allen-Bradley Co., Milwaukee, Wisc.
American Zettler, Irvine, Ca.
Artisan Elctrns. Corp., Parsippany, N.J.
Barber Corp., Waynesville, Ohio
Bicron Elctrns. Co., Canaan, Conn.
Coil Co. of Amer., Northvale, N.J.
Component Specialties, Temple City, Cal.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Deltrol Controls, Milwaukee, Wisc.
Dormeyer Inds., Chicago, Ill.
Electro-Mechanisms, Inc., Azusa, Cal.
Endicott Coil Co., Binghamton, N.Y.
General Valve Corp., E. Hanover, N.J.
Hartman Electrical Mfg., Mansfield, Ohio
IMC Magnetics Corp., Westbury, N.Y.
IMC Magnetics Corp., Rochester, N.H.
IMC Magnetics Corp., Maywood, Cal.
Ingraham Inds., Controls Div., Elizabethtown, Ky.
James Elctrns., Inc., Chicago, Ill.
Lisk, G.W. Co., Clifton Springs, N.Y.
Mark Specialties, Costa Mesa, Cal.
Meltronics Inc., Leeds, Ala.
Omega Electric, Chicago, Ill.
Servotronics, Inc., Buffalo, N.Y.
Synchro-Start Prods., Skokie, Ill.
Triac Elctrn. Sys., Forest Hills, N. Y.
Universal Relay Corp., New York, N.Y.
U.S. Elctrns., Long Branch, N.J.

Solenoids, Rotary

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Oak Inds. Inc., Crystal Lake, Ill. Vol 2•1125
Barber Corp., Waynesville, Ohio
Clifton Precision, Clifton Hgts., Pa.
Daco Instr. Co., Milford, Conn.
IMC Magnetics Corp., Maywood, Cal.
Lisk, G.W. Co., Clifton Springs, N.Y.
Universal Relay Corp., New York, N.Y.

Solvents—See Cleaners & Solvents

Sonic Analyzers—See Analyzers, Sonic & Subsonic

Sound Absorbing Materials

Anchor Alloys, Inc., Brooklyn, N.Y.
Dow Chemical Co., Midland, Mich.
3M Co., St. Paul, Minn.
Tracor, Inc., Austin, Tex.
Zippertubing Co., Los Angeles, Calif.

Sound Level Indicators—See Meters, Audio Level

Sound Recording Equip.—See Microphones; Recorders; etc.

Sources, Light, Radioactive

3M Co., St. Paul, Minn.

Sources, Light, Stroboscopic —See Lights, Stroboscopic Source

Spacers

Bivar, Inc., Santa Ana, Cal. Vol 3•1070,1071; Vol 4•311*
Concord Elctrns., New York, N.Y. Vol 3•655
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Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•820,821
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Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Birnbach Co., Inc., Freeport, N.Y.
Control Inds. Inc., Inwood, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Delbert Blinn. Co., Pomona, Calif.
Edal Inds., Inc., E. Haven, Conn.
Elctrn. Molding Corp., Woonsocket, R.I.
Fischer Special Mfg. Co., Cincinnati, Ohio
General Mfg. Co., Glendale, Calif.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Johnson E. F. Co., Waseca, Minn.
Keystone Elctrns. Corp., New York, N.Y.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
PIC Design Division, Ridgefield,, Conn.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Plessey Ceramic Div., Frenchtown, N.J.
Positronic Inds., Springfield, Mo.
Resdel Corp., Rio Grande, N.J.
Sealectro Corp., Mamaroneck, N.Y.
Sterling Instr., New Hyde Pk., NY
3M Co., St. Paul, Minn.
Useco Div., Van Nuys, Cal.

Vero Electronics, Inc., Hauppauge, N.Y.
Weckesser Co., Inc., Chicago, Ill.

Spaghetti—See Tubing, Spaghetti

Spark Gaps

Kilovolt Corp., Hackensack, N.J. Vol 1•757
Radio Materials Co., Chicago, Ill. Vol 3•494
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Signalite, Neptune, N.J. Vol 2•1134,1135
Amperex Electronic Corp., Hicksville, N.Y.
Bel Fuse, Inc., Jersey City, N.J.
Calvert Elctrns., Inc., New York, N.Y.
Dale Elctrns., Inc., Yankton, S.D.
EG & G, Inc., Salem, Mass.
Electrons Co., Fairfield, N.J.
Energy Systems, Palo Alto, Cal.
General Lab. Assocs., Norwich, N.Y.
ITT Electron Tube, Easton, Pa.
Joslyn Elctrn. Sys., Goleta, Cal.
Maxwell Labs., Inc., San Diego, Calif.
Megavolt, Inc., New York, N.Y.
Murata Mfg. Co. Ltd., Kyoto, Japan
Raytheon Co., Quincy, Mass.
Tobe Deutschmann Labs., Inc., Canton, Mass.
Varian Assocs., Palo Alto, Cal.
Victoreen Instr., Cleveland, Ohio

Speaker Drivers—See Drivers, Speaker

Speaker Systems

CTS Corp, Elkhart, Ind..... Vol 1•310,311
Altec Div., Anaheim, Calif.
Amperex Electronic Corp., Hicksville, N.Y.
Argos Prods. Co., Inc., Genoa, Ill.
Atlas Sound Div., Parsippany, N.J.
Bell P/A Prods. Corp., Columbus, Ohio
Bogen Div., Paramus, N.J.
Collins Radio Co., Dallas, Tex.
Dukane Corp., St. Charles, Ill.
Dynaco, Inc., Philadelphia, Pa.
Electro-Voice, Inc., Buchanan, Mich.
Electronic Resch. Assocs., Moonachie, N.J.
Era Acoustics, Moonachie, N.J.
Executone, Inc., Long Island City, N.Y.
Jensen Sound Labs., Schiller Park, Ill.
Knowles Elctrns., Inc., Franklin Park, Ill.
Magitran Co., Moonachie, N.J.
Mobil Elctrns., Inc., Anderson, Ind.
Oaktron Inds., Monroe, Wisc.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
University Sound, Anaheim, Cal.
Utah Elctrns., Huntington, Ind.
Webster Elec. Co., Inc., Racine, Wisc.

Speakers, Dynamic

Amperex Electronic Corp., Hicksville, N.Y. ..... Vol 1•308
CTS Corp, Elkhart, Ind..... Vol 1•310,311
Oaktron Inds., Monroe, Wisc. Vol 4•310*
Atlas Sound Div., Parsippany, N.J.
Components Specialties, Freeport, N.Y.
Electro-Voice, Inc., Buchanan, Mich.
Era Acoustics, Moonachie, N.J.
Gotham Audio Corp., New York, N.Y.
Jensen Sound Labs., Schiller Park, Ill.
Magitran Co., Moonachie, N.J.
National Tel-Tronics, Meadville, Pa.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Rola-Jenson Div./Pemcor, Inc., Cleveland, Ohio
Shigoto Inds., Ltd., New York, N.Y.
Utah Elctrns., Huntington, Ind.

Speakers, Explosion & Flame Proof

Atlas Sound Div., Parsippany, N.J.
Electronic Resch. Assocs., Moonachie, N.J.
Executone, Inc., Long Island City, N.Y.
Oaktron Inds., Monroe, Wisc.
University Sound, Anaheim, Cal.

Speakers, Horn

Allied Elctrns., Chicago, Ill.
Altec Div., Anaheim, Calif.
Atlas Sound Div., Parsippany, N.J.
Bogen Div., Paramus, N.J.
Components Specialties, Freeport, N.Y.
Dukane Corp., St. Charles, Ill.
Electro-Voice, Inc., Buchanan, Mich.
Electronic Resch. Assocs., Moonachie, N.J.
Executone, Inc., Long Island City, N.Y.
Jensen Sound Labs., Schiller Park, Ill.
Rola-Jenson Div./Pemcor, Inc., Cleveland, Ohio
Shigoto Inds., Ltd., New York, N.Y.
University Sound, Anaheim, Cal.
Utah Elctrns., Huntington, Ind.

Speakers, Pillow

Components Specialties, Freeport, N.Y.
Saxton Prods., Congers, N.Y.

Speakers, Submergence-Proof

Electronic Resch. Assocs., Moonachie, N.J.
Era Acoustics, Moonachie, N.J.
Magitran Co., Moonachie, N.J.
Shigoto Inds., Ltd., New York, N.Y.
University Sound, Anaheim, Cal.

Speakers, Weatherproof

CTS Corp, Elkhart, Ind..... Vol 1•310,311
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Altec Div., Anaheim, Calif.
Atlas Sound Div., Parsippany, N.J.
Bogen Div., Paramus, N.J.
Components Specialties, Freeport, N.Y.
Dukane Corp., St. Charles, Ill.
Electro-Voice, Inc., Buchanan, Mich.
Electronic Resch. Assocs., Moonachie, N.J.
Era Acoustics, Moonachie, N.J.
Executone, Inc., Long Island City, N.Y.
Jensen Sound Labs., Schiller Park, Ill.
Magitran Co., Moonachie, N.J.
RCA, Mobile Communications Sys., Meadow Lands, Pa.
Sennheiser Elctrn. Corp., New York, NY
Shigoto Inds., Ltd., New York, N.Y.
University Sound, Anaheim, Cal.
Utah Elctrns., Huntington, Ind.

Spectrometers

Coleman Instr. Div., Oak Brook, Ill.
Edwards High Vacuum, Grand Island, N.Y.
Vacumetrics Inc., Waltham, Mass.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Spectrum Analyzers—See Analyzers, Spectrum

Speed Drives, Motor—See Controls, Motor Speed

Spiral Wrap—See Tubing, Spiral Wrap

Splicers, Coaxial Cable

Amp Inc., Harrisburg, Pa.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Communications Technology Corp., Los Angeles, Cal.
Jonard Inds. Corp., Bronx, N.Y.
Phelps Dodge Comm., North Haven, Conn.
Sealectro Corp., Mamaroneck, N.Y.
Thomas & Betts Co., Elizabeth, N.J.

Splicers, Wire (Including Butt & Cap Types)

ETC, Div. ITT, Cleveland, Ohio Vol 3•664
Panduit Corp., Tinley Pk., Ill. Vol 3•1409; Vol 4•571*
Amp Inc., Harrisburg, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Burndy Corp., Norwalk, Conn.
Communications Technology Corp., Los Angeles, Cal.
Jonard Inds. Corp., Bronx, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Sonobond Corp., West Chester, Pa.
Thomas & Betts Co., Elizabeth, N.J.
3M Co., St. Paul, Minn.
Waldom Elctrns., Inc., Chicago, Ill.

Splicing Equipment, Magnetic Tape

Ampex Corp., Redwood City, Calif.
Communications Technology Corp., Los Angeles, Cal.
GC Electronics, Rockford, Ill.
Jonard Inds. Corp., Bronx, N.Y.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
3M Co., St. Paul, Minn.

Splicing Equipment, Paper Tape

Brady, W.H. Co., Milwaukee, Wisc.
Data Specialties Inc., Highland Park, Ill.
Jonard Inds. Corp., Bronx, N.Y.

Spoolers, Punched Tape—See Readers, Punched Tape

Springs (All Types)

Instrument Specialties, Little Falls, N.J. Vol 3•1016,1017
Acme Model Engrg. Co., Ridgefield, N.J.
Amersil, Inc., Hillside, N.J.
Bram Metallurgical-Chem. Co., Phila., Pa.
Chatillon John & Sons, Kew Gardens, N.Y.
Dzus Fastener Co., Inc., West Islip, N.Y.
Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
GC Electronics, Rockford, Ill.
Helical Prods. Co., Inc., Hermosa Beach, Cal.
Helix Spring Corp., Long Island City, N.Y.
Hunter Spring, Hatfield, Pa.
PIC Design Division, Ridgefield,, Conn.
Potter & Brumfield, Princeton, Ind.
Suffolk Etched Prods., Inc., Riverhead, N.Y.
Templeman, D.R. Co., Plainville, Conn.

Sputtering Equipment

CCA Elctrns. Corp., Gloucester, N.J.
Edwards High Vacuum, Grand Island, N.Y.
High Voltage Engrg. Corp., Burlington, Mass.
Inficon Inc., E. Syracuse, N.Y.
Lepel High Frequency Labs., Maspeth, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Perkin-Elmer Ultek Inc., Palo Alto, Calif.
Sloan Technology Corp., Santa Barbara, Calif.
Thin Film Services, Gile, Wisc.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Stabilizers, Line Impedance

Geo Space, Houston, Tex.
Gerator Corporation, Manassas, Va.
NH Research, Inc., Santa Ana, Calif.
Power-Matic, Inc., San Diego, Cal.
Sola Elec. Div., Elk Grove Village, Ill.

Stabilizers, Voltage—See Regulators & Stabilizers, Voltage-Also See Transformers, Voltage Regulating

Stalos—See Oscillators, Microwave

Stamped Circuit Boards—See Circuit Boards, Stamped

Standards, Atomic Beam

Frequency Elctrns., New Hyde Pk., N.Y.
Tracor, Inc., Austin, Tex.

Standards, Capacitance

ARCO Elctrns., Inc., Great Neck, N.Y.
Beckman Instrs., Cedar Grove, N.J.
Boonton Elctrns., Parsippany, N.J.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Electro Sci. Inds., Portland, Ore.
Elctrn. Assocs., W. Long Branch, N.J.
General Radio Co., Concord, Mass.
Guildline Instrs., Inc., Larchmont, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Rohde & Schwarz Sls., Passaic, N.J.

Standards, Current

Electronic Dev. Corp., Boston, Mass. Vol 1•428,429
RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
CEA, San Luis Obispo, Cal.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
General Resistance, Inc., Mt. Vernon, N.Y.
Glentronics, Div. Sawyer Inds., Glendora, Cal.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Julie Research Lab., New York, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimation, Inc., Chatsworth, Cal.
Sawyer Inds., Arcadia, Cal.
Weston Instruments, Inc., Newark, N.J.

Standards, Delay Line

Kappa Networks, Inc., Carteret, N.J.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Standards, Frequency

Greenray Inds., Inc., Mechanicsburg, Pa. ..... Vol 2•415
Monitor Prods., S. Pasadena, Cal. Vol 2•430
Accutronics, Geneva, Ill.
Advanced Energy Conversion, Belmont, Cal.
American Time Products, Woodside, N.Y.
AMF Electical Prods., Alexandria, Va.
Austron, Inc., Austin, Tex.
Beukers Labs., Inc., Hauppauge, N.Y.
Bramco Controls, Piqua, Ohio
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Connor-Winfield Corp., West Chicago, Ill.
Cox & Co., Inc., New York, N.Y.
CTS Corp, Elkhart, Ind.
Esterline Angus Div., Indianapolis, Ind.
Fairchild Space & Defense Sys., Syosset, N.Y.
Ferwalt, W.H., Inc., Lapwai, Idaho
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Fork Standards, W. Chicago, Ill.
Frequency Elctrns., New Hyde Pk., N.Y.
Ind'l. Test Equip., Clifton, NJ
ITT Mackay Marine, Elizabeth, N.J.
Meloy Laboratories Inc., Springfield, Va.
Microlab/FXR, Livingston, N.J.
NH Research, Inc., Santa Ana, Calif.
Ovenaire, Charlottesville, Va.
Palomar Engrs., Escondido, Cal.
Philamon, Inc., Westbury, N.Y.
PPM, Inc., Bedford, Ohio
Riverbank Labs., Geneva, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
T-F Electronics, Inc., Austin, Tex.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tracor, Inc., Austin, Tex.
Vectron Labs., Inc., Norwalk, Conn.

Standards, Inductance

Dietz Design, Inc., Belton, Mo.
General Radio Co., Concord, Mass.
North Hills Elctrns., Inc., Glen Cove, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.

Standards, Noise

AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Quan-Tech, Whippany, N.J.

Standards, Phase

Dytronics Co., Columbus, Ohio Vol 1•422
Dranetz Engrg. Labs., So. Plainfield, N.J.
Ind'l. Test Equip., Clifton, NJ
North Atlantic Inds., Plainview, N.Y.
Optimation, Inc., Chatsworth, Cal.
Theta Instr. Corp., Fairfield, N.J.

Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Standards, Resistance

Biddle, James G., Plymouth Meeting, Pa. ..... Vol 1•399
Beckman Instrs., Cedar Grove, N.J.
Electro Sci. Inds., Portland, Ore.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Leeds & Northrup Corp., No. Wales, Pa.
Penn Airborne Prods., Southampton, Pa.
Precision Resistor Co., Hillside, N.J.
RFL Inds., Instr. Div., Boonton, N.J.
Shallcross, Selma, N.C.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Thermal Sys., Los Angeles, Cal.
Vishay Resistor Prod. Div., Malvern, Pa.

Standards, Synchro & Resolver

Astrosystems, Inc., Lake Success, N.Y.
C & A Products, Inc., Woodside, N. Y.
North Atlantic Inds., Plainview, N.Y.
Singer Co., Little Falls, N.J.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Theta Instr. Corp., Fairfield, N.J.

Standards, Temperature

Barnes Engrg. Co., Stamford, Conn.
Cox & Co., Inc., New York, N.Y.
Fisher Sci. Co., Pittsburgh, Pa.
Guildline Instrs., Inc., Larchmont, N.Y.
H-B Instr. Co., Phila., Pa.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Harrel, Inc., E. Norwalk, Conn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
Oven Industries, Inc., Mechanicsburg, Pa.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Riverbank Labs., Geneva, Ill.
Rosemount Inc., Minneapolis, Minn.
Trans-Sonics, Inc., Lexington, Mass.

Standards, Time

Chrono-log Corp., Broomall, Pa. Vol 1•333
American Time Products, Woodside, N.Y.
Austron, Inc., Austin, Tex.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Cognitronics Corp., Stamford, Conn.
Connor-Winfield Corp., West Chicago, Ill.
Ferwalt, W.H., Inc., Lapwai, Idaho
Fork Standards, W. Chicago, Ill.
Hathaway Instruments, Inc., Denver, Colo.
Phelps Dodge Comm., North Haven, Conn.
PPM, Inc., Bedford, Ohio
Riverbank Labs., Geneva, Ill.
Rohde & Schwarz Sls., Passaic, N.J.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Tracor, Inc., Austin, Tex.

Standards, Voltage

Connor-Winfield Corp., West Chicago, Ill. ..... Vol 2•401
Electronic Dev. Corp., Boston, Mass. Vol 1•428,429
Greenray Inds., Inc., Mechanicsburg, Pa. ..... Vol 2•415
Julie Research Lab., New York, N.Y. Vol 1•469
RFL Inds., Instr. Div., Boonton, N.J. Vol 1•497
AMF Electical Prods., Alexandria, Va.
AUL Instrs., Inc., Flushng, N.Y.
Ballantine Laboratories, Inc., Boonton,, N. J.
Beckman Instrs., (AISSD), Fullerton, Cal.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
CEA, San Luis Obispo, Cal.
Computer Diode, Fair Lawn, N.J.
Dynage, Bloomfield, Conn.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Esterline Angus Div., Indianapolis, Ind.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Fork Standards, W. Chicago, Ill.
General Microwave Corp., Farmingdale, N.Y.
General Rand Corp., Edison, N.J.
General Resistance, Inc., Mt. Vernon, N.Y.
Glentronics, Div. Sawyer Inds., Glendora, Cal.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Ind'l. Test Equip., Clifton, NJ
Kepco, Inc., Flushing, N.Y.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
NH Research, Inc., Santa Ana, Calif.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimation, Inc., Chatsworth, Cal.
Power Designs, Westbury, N.Y.
Precision Standards Corp., Santa Ana, Cal.
Sawyer Inds., Arcadia, Cal.
Simpson Elec. Co., Chicago, Ill.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Velonex, Santa Clara, Calif.
Weston Instruments, Inc., Newark, N.J.
Zi-Tech Div., Palo Alto, Cal.

Standards, Voltage Ratio

Collins, G.L. Corp., Long Beach, Calif.
Electro Sci. Inds., Portland, Ore.
General Resistance, Inc., Mt. Vernon, N.Y.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Julie Research Lab., New York, N.Y.
North Atlantic Inds., Plainview, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Wiltron Co., Palo Alto, Calif.

Standing Wave Detectors—

See Detectors, Standing Wave

Standoffs—

See Bushings, Glass, Plastic, Metal, etc.

Stators, Motor & Generator—

See Motor & Generator Armatures,Rotors, Stators

—Status Displays -- See Displays, Status

Stools—

See Benches, Consoles, Stools, Tables (Lab & Shop)

Stops, Limit—

See Limit Stops, Mechanical

Staighteners, Tube Pin—

See Pin Straighteners, Tube

Strain Gauges—

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Strain Indicators—

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Strain Reliefs, Cable & Wire

Amphenol Connector Div., Broadview, Ill. ..... Vol 3•565
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. ..... Vol 3•565
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•812
Amphenol Cadre Div., Endicott, N.Y.
Amphenol Ind'l. Div., Chicago, Ill.
Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
GC Electronics, Rockford, Ill.
Heyman Mfg. Co., Kenilworth, N.J.
Molex Inc., Lisle, Ill.
Richco Plastic Co., Chicago, Ill.
Rowe Inds., Div., Toledo, Ohio
Sjoberg, C. & Son, Inc., Cranston, R.I.
Thomas & Betts Co., Elizabeth, N.J.
Transcon Mfg. Co., Dallas, Tex.
Waldom Elctrns., Inc., Chicago, Ill.
Zippertubing Co., Los Angeles, Calif.

Stretchers, Microwave—

See Microwave Line Stretchers

Strip-Line Components, Microwave

Aertech Inds., Sunnyvale, Calif.
Airtron, Morris Plains, N.J.
Alford Mfg. Co., Winchester, Mass.
American Tech. Ceramics, Huntington Sta., N.Y.
Americon Microwave Inds., Inc., Waltham, Mass.
Anaren Microwave, Inc., Syracuse, N.Y.
Arra Inc., Bay Shore, N.Y.
Avantek, Inc., Santa Clara, Cal.
Bendix, Franklin, Ind.
Dynalab Corp., Van Nuys, Cal.
E & M Laboratories, Inc., Westlake Village, Cal.
EMC Technology Inc, Cherry Hill, N.J.
Environmental Communications Inc., Santa Ana, Cal.
Lorch Elctrns. Corp., Englewood, N.J.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Merrimac Inds., Inc., West Caldwell, N.J.
Metavac, Inc., Flushing, N.Y.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Prods., Inc., Chatsworth, Cal.
Modpak, Waltham, Mass.
Narda Microwave Corp., Plainview, N.Y.
Norsal Industries, Inc., Brentwood, N.Y.
Premier Microwave, Port Chester, N.Y.
Scientific Communications, Garland, Tex.
Sealectro Corp., Mamaroneck, N.Y.
Solitron/Microwave, Port Salerno, Fla.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Research & Mfg. Co., Manchester, N.H.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Vector Industries, Palo Alto, Cal.
Wiltron Co., Palo Alto, Calif.

Strippers & Twisters, Wire—

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Strippers, Wire, Chemical—

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Strips, Ground

Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Chem Aero, Inc., Wilmington, Cal.
Christiansen Radio Inc., Laguna Beach, Cal.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Jettron Prods., Hanover, N.J.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Strips, Marker & Fanning

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Hathaway Industries Inc., Tulsa, Okla. Vol 3•686
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Accurate Elctrns. Corp., Elyria, Ohio
EI Instruments, Derby, Conn.
ETC, Div. ITT, Cleveland, Ohio
Kulka Elec. Corp., Mt. Vernon, N.Y.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Thomas & Betts Co., Elizabeth, N.J.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Zippertubing Co., Los Angeles, Calif.

Strips, Terminal

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Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•817
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Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Acme Model Engrg. Co., Ridgefield, N.J.
ADC Prods., Minneapolis, Minn.
Advanced Circuitry Div., Springfield, Mo.
Aeronautical Elec. Co., Inc., Chicago, Ill.
Alco Elctrn. Prods., North Andover, Mass.
Apahouser Corp. of N.E., Boston, Mass.
A P Products, Inc., Painesville, Ohio
Ark-Les Switch Corp., Watertown, Mass.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Buchanan Elec. Prods., Union, N.J.
Burndy Corp., Norwalk, Conn.
Christiansen Radio Inc., Laguna Beach, Cal.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Custom Connector Corp., Cleveland, Ohio
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
De Soto Elec. Prods., De Soto, Mo.
Electrical Plastics Corp., Long Branch, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Electrovert, Mt. Vernon, N.Y.
GC Electronics, Rockford, Ill.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Magnum Elec. Corp., Erie, Mich.
Mechanical Engraving Co., Inc., Bronx, N.Y.
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Shigoto Inds., Ltd., New York, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Square D Co., Park Ridge, Ill.
Texas Instruments, Attleboro, Mass.
3M Co., St. Paul, Minn.
Useco Div., Van Nuys, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Stroboscopes—

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Styli, Marking & Engraving-Also See Engraving & Profiling Equip.

Bird, Richard H. & Co., Inc., Waltham, Mass.
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General Elec., W. Lynn, Mass.

Substrates, Ceramic

American Lava Corp., Chattanooga, Tenn. ..... Vol 3•1074
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Radio Materials Co., Chicago, Ill. Vol 3•494
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Aremco Prods., Inc., Briarcliff Manor, N.Y.
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Bram Metallurgical-Chem. Co., Phila., Pa.
Carborundum Co., Niagara Falls, N.Y.
Ceramic Magnetics, Inc., Fairfield, N.J.
Coors Porcelain Co., Golden, Colo.
Electro-Science Labs., Pennsauken, N. J.
Emerson & Cuming, Inc., Canton, Mass.
Erie Technological Prods. (EEM), Erie, Pa.

Film Microelectronics, Inc., Burlington, Mass
Gte Sylvania Inc., Belmont, Cal.
Honeywell, Minneapolis, Minn.
Materials Resch. Corp., Orangeburg, N.Y.
Mepco/Electra, Substrate Div., San Diego, Cal.
Metalized Ceramics, Providence, R.I.
National Beryllia Corp., Haskell, N.J.
Statek Corp., Orange, Cal.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
3M Co., St. Paul, Minn.
Trans-Tech, Gaithersburg, Md.
Union Carbide, San Diego, Cal.
Valpey Corp., Holliston, Mass.

Substrates, Flexible

Emerson & Cuming, Inc., Canton, Mass.
Flexible Circuits, Inc., Warrington, Pa.
GTE Sylvania Inc., Newark, N.J.
Schjeldahl, G.T. Co., Northfield, Minn.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Westinghouse Elec., W. Mifflin, Pa.

Substrates, Glass

Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371
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Atlantic Optical Moulding Co., Dudley, Mass.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Statek Corp., Orange, Cal.

Superconducting Magnets—

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Suppressors, Arc

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Basic Ceramics Inc., Hawthorne, N.J.
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Eastern Delta Corp., Fair Lawn, N.J.
Edal Inds., Inc., E. Haven, Conn.
Joslyn Elctrn. Sys., Goleta, Cal.
Ledex, Inc., Dayton, Ohio
Presin Co., Inc., Shelton, Conn.
RtroN Corp., Skokie, Ill.
Sarkes Tarzian, Inc., Bloomington, Ind.
Sprague Elec. Co., No. Adams, Mass.
Standard Condenser Corp., Chicago, Ill.
Transtector Systems, Monterey Park, Cal.

Suppressors, Noise

Computer Diode, Fair Lawn, N.J.
Corcom Inc., Chicago, Ill.
CW Industries, Warminster, Pa.
Erie Technological Prods. (EEM), Erie, Pa.
Estes Engrg. Co., Gardena, Calif.
GC Electronics, Rockford, Ill.
Genisco Tech. Corp., Genistron Div., Compton, Cal.
Hopkins Engrg., San Fernando, Cal.
Maury Microwave Corp., Cucamonga, Calif.
Narda Microwave Corp., Plainview, N.Y.
RtroN Corp., Skokie, Ill.
Smith, Herman H., Inc., Bklyn., N.Y.
Standard Condenser Corp., Chicago, Ill.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
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Suppressors, Transient Voltage (All Types)

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Elgar Corp., San Diego, Cal.
Elin Div., San Diego, Cal.
FMC Corp., Homer City, Pa.
General Semiconductor Inds., Tempe, Ariz.
Integrated Systems, Inc., Norcross, Ga.
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Microsemiconductor Corp., Culver City, Cal.
Motorola Semiconductor Prods., Phoenix, Ariz.
Power Conversion Prods. Inc., Crystal Lake, Ill.
Sanford-Miller Corp., Brooklyn, N.Y.
Sarkes Tarzian, Inc., Bloomington, Ind.
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Alco Elctrn. Prods., North Andover, Mass.
APM-Hexseal, Englewood, N.J.
Arcolectric Switch Corp., No. Hollywood, Cal.

Switch Mounting Plates

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Leviton Mfg. Co., Inc., Brooklyn, N.Y.
Square D Co., Park Ridge, Ill.
Waldom Elctrns., Inc., Chicago, Ill.

Switchboards

Amtron Inc., Midlothian, Ill.
Anchor Specialty Mfg., Teterboro, N.J.
Basler Elec. Co., Highland, Ill.
Clare-Pendar Co., Post Falls, Idaho
Cutler-Hammer, Milwaukee, Wisc.
Devco Engrg., W. Caldwell, N.J.
Electrospace Systems Inc., Richardson, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Key Tronic Corp., Spokane, Wash.
LVC Inds. Inc., Flushing, N.Y.
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Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Anderson, W.E., Inc., Kansas City, Mo.
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Cherry Electrical Prods., Waukegan, Ill
Columbus Elec. Mfg. Co., Columbus, Ohio
Cook Elec. Co., Morton Grove, Ill.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Gems Sensors Div., Farmington, Conn.
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Micro Switch, Freeport, Ill.
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Tapeswitch Corp. Amer., Farmingdale, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
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Cole Instrument Corp., Costa Mesa, Cal.
Continental Elctrns. Mfg. Co., Dallas, Tex.
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Fifth Dimension, Princeton, N.J.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Johnson E. F. Co., Waseca, Minn.
Kilovac Corp., Santa Barbara, Cal.
Machine Components Corp., Plainview, N.Y.
Matrix Systems Corp., Chatsworth, Calif.
Mobil Elctrns., Inc., Anderson, Ind.
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Premier Microwave, Port Chester, N.Y.
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R L C Elctrns., Inc., Mt. Kisco, N.Y.
Ross Engrg. Corp., Campbell, Cal.
Sealectro Corp., Mamaroneck, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Teledyne Microwave, Mountain View, Cal.
Torr Labs., Los Angeles, Cal.
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Automatic Timing & Controls, Inc., King of Prussia, Pa.
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Bristol Saybrook Co., Old Saybrook, Conn.
Carter.Mfg. Corp., Hudson, Mass.
Cherry Electrical Prods., Waukegan, Ill
Chicago Lock Co., Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Connector Corp., Chicago, Ill.
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General Control Co., Boston, Mass.
Guardian Elec. Mfg. Co., Chicago, Ill.
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Licon Div., Chicago, Ill.
Maxwell Labs., Inc., San Diego, Calif.
Midtex/Aemco, Mankato, Minn.
Otto Engrg. Inc., Carpentersville, Ill.
Poly-Scientific, Blacksburg, Va.
Relay Service Co., Chicago, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
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Zenith Controls Inc., Chicago, Ill.

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Cole Instrument Corp., Costa Mesa, Cal.
Gibbs Mfg. & Resch., Janesville, Wisc.
Jones Motrola Corp., Stamford, Conn.
Mag-Con, Inc., New Brighton, Minn.
Synchro-Start Prods., Skokie, Ill.

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Barker & Williamson, Inc., Bristol, Pa.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
CES Elctrns., Brooklyn, N.Y.
Collins Radio Co., Dallas, Tex.
E & M Laboratories, Inc., Westlake Village, Cal.
Edison Elctrns. Div., Manchester, N.H.
Elctrn. Instr. & Specialty, Stoneham, Mass.
Fifth Dimension, Princeton, N.J.
General Microwave Corp., Farmingdale, N.Y.
GHZ Devices, Inc., So. Chelmsford, Mass.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Kilovac Corp., Santa Barbara, Cal.
Matrix Systems Corp., Chatsworth, Calif.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Norsal Industries, Inc., Brentwood, N.Y.
Priority Services, Burbank, Cal.
RF Systems, Inc., Cohasset, Mass.
Rohde & Schwarz Sls., Passaic, N.J.
Ross Engrg. Corp., Campbell, Cal.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Microwave, Mountain View, Cal.
Transco Prods., Inc., Venice, Cal.
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Chomerics, Inc., Woburn, Mass.
Cole Instrument Corp., Costa Mesa, Cal.
Counterscan Systems, Sutton, Neb.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Flex Key Corp., Gloucester, Mass.
Grayhill Inc., LaGrange, Ill.
Key Tronic Corp., Spokane, Wash.
LVC Inds. Inc., Flushing, N.Y.
North Electric Co., Galion, Ohio
RCL Elctrns., Inc., Irvington, N.J.
Zippertubing Co., Los Angeles, Calif.

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A. D. Data Sys., Inc., Rochester, N.Y.
Adams-Russell Co., Inc., AR - Waltham Div., Waltham, Mass.
ADC Prods., Minneapolis, Minn.
Amphenol RF Div., Danbury, Conn.
Clare-Pendar Co., Post Falls, Idaho
Dynair Elctrns. Inc., San Diego, Calif.
International Electro Exchange Corp., Eden Prairie, Minn.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
LVC Inds. Inc., Flushing, N.Y.
Matrix Systems Corp., Chatsworth, Calif.
Mechanical Enterprises, Alexandria, Va.
Norsal Industries, Inc., Brentwood, N.Y.
North Electric Co., Galion, Ohio
Priority Services, Burbank, Cal.

Ross Engrg. Corp., Campbell, Cal.
Scientific Communications, Garland, Tex.
Square D Co., Park Ridge, Ill.
T-Bar Inc., Wilton, Conn.
Torr Labs., Los Angeles, Cal.
Universal Relay Corp., New York, N.Y.
Zehntel, Inc., Concord, Cal.

Switches, Data-Sampling

Cunningham, Honeoye Falls, N.Y. Vol 1•337
Matrix Corp., Beech Grove, Ind. Vol 1•355
Trompeter Elctrns., Chatsworth, Cal. Vol 2•1142-1147
A. D. Data Sys., Inc., Rochester, N.Y.
Airflyte Elctrns. Co., Bayonne, N.J.
Amphenol RF Div., Danbury, Conn.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Chicago Dynamic Inds., Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Counterscan Systems, Sutton, Neb.
Datametrics Inc., Wilmington, Mass.
Digitran Co., Pasadena, Cal.
Fifth Dimension, Princeton, N.J.
General Devices, Inc., Princeton, N.J.
Hickok Elect. Instr., Cleveland, Ohio
LVC Inds. Inc., Flushing, N.Y.
Monitor Labs, Inc., San Diego, Cal.
National Semiconductor, Santa Clara, Cal.
NES, Inc., Itasca, Ill.
RCL Elctrns., Inc., Irvington, N.J.
Sealectro Corp., Mamaroneck, N.Y.
T-Bar Inc., Wilton, Conn.
Transco Prods., Inc., Venice, Cal.

Switches, Decade

Chicago Dynamic Inds., Chicago, Ill. Vol 2•1028
Digitran Co., Pasadena, Cal. Vol 2•1048,1049
Durant Digital Instrs., Watertown, Wisc. Vol 2•335
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 2•1052
Amp Inc., Harrisburg, Pa.
Beckman Instrs., Helipot Div., Fullerton, Cal.
Cherry Electrical Prods., Waukegan, Ill
Chicago Lock Co., Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Edison Elctrns. Div., Manchester, N.H.
GTE Automatic Elec., Northlake, Ill.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
International Electro Exchange Corp., Eden Prairie, Minn.
LVC Inds. Inc., Flushing, N.Y.
Oak Inds. Inc., Crystal Lake, Ill.
RCL Elctrns., Inc., Irvington, N.J.
Sealectro Corp., Mamaroneck, N.Y.
Shallcross, Selma, N.C.
Tech Labs., Inc., Palisades Pk., N.J.
Veeder-Root, Hartford, Conn.
Weinschel Engrg. Co., Gaithersburg, Md.

Switches, Foot-Pedal, Mat, Ribbon, etc.

Tapeswitch Corp. Amer., Farmingdale, N.Y. Vol 2•1138
Allen-Bradley Co., Milwaukee, Wisc.
Allied Elctrns., Chicago, Ill.
Allis-Chalmers, Milwaukee, Wisc.
Chicago Switch, Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Flex Key Corp., Gloucester, Mass.
Furnas Elec. Co., Batavia, Ill.
General Control Co., Boston, Mass.
Lektra Labs., Inc., College Point, N.Y.
Line Electric Co. Unit Esterline Corp., Parsippany, N.J.
Linemaster Switch Corp., Woodstock, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Square D Co., Park Ridge, Ill.
Vemaline Prods. Co., Wyckoff, N.J.

Switches, High-Voltage (Over 250 Volts)

Advanced Kinetics, Costa Mesa, Calif.
Allen-Bradley Co., Milwaukee, Wisc.
Beckman Instrs., Cedar Grove, N.J.
Centralab Elctrns Div., Milwaukee, Wisc
Cole Instrument Corp., Costa Mesa, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Del Electronics Corp., Mt. Vernon, N.Y.
Edison Elctrns. Div., Manchester, N.H.
Gordos Corp., Bloomfield, N.J.
Hamlin, Inc., Lake Mills, Wisc.
Hipotronics, Inc., Brewster, N.Y.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Janco Corp., Burbank, Cal.
Kilovac Corp., Santa Barbara, Cal.
Kilovolt Corp., Hackensack, N.J.
Magnecraft Elec., Chicago, Ill.
Maxwell Labs., Inc., San Diego, Calif.
Megavolt, Inc., New York, N.Y.
Millen, James Mfg., Malden, Mass.
Nanotron Relay Co., Burbank, Cal.
Queensboro Transformer & Mach., College Pt., N.Y.
Ross Engrg. Corp., Campbell, Cal.
Sealectro Corp., Mamaroneck, N.Y.
Shallco, Inc., Smithfield, N.C.
Shallcross, Selma, N.C.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Square D Co., Park Ridge, Ill.
Tech Labs., Inc., Palisades Pk., N.J.
Texas Instruments, Attleboro, Mass.
Torr Labs., Los Angeles, Cal.
UID Elctrns. Corp., Hollywood, Fla.
Varian Assocs., Palo Alto, Cal.

Switches, Illuminated

Alco Elctrn. Prods., North Andover, Mass. Vol 2•995,996
American Zettler, Irvine, Ca. Vol 2•1004,1005
Arcolectric Switch Corp., No. Hollywood, Cal. Vol 2•993
Capitol Machine & Switch Co., Danbury, Conn. Vol 2•999
Carling Electric, W. Hartford, Conn. Vol 2•1023
Centralab Elctrns Div., Milwaukee, Wisc Vol 2•1026,1027
Chicago Dynamic Inds., Chicago, Ill. Vol 2•1028
Chicago Switch, Chicago, Ill. Vol 2•1044,1045
Dialight Corp., Brooklyn, N.Y. Vol 2•482
Electro-Mech Comps. Inc., S. El Monte, Cal. Vol 2•1050
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. Vol 2•1052
Grayhill Inc., LaGrange, Ill. Vol 2•1056-1061
Ind'l. Devices, Edgewater, N.J. Vol 2•507
International Electro Exchange Corp., Eden Prairie, Minn. Vol 2•1079-1082
ITT Jennings, San Jose, Cal. Vol 2•1075
Ledex, Inc., Dayton, Ohio Vol 2•1086
Licon Div., Chicago, Ill. Vol 2•1089,1092,1093
Magic Dot, Inc., Minneapolis, Minn. Vol 2•1100
Marco-Oak, Anaheim, Cal. Vol 2•1101
McGill Mfg. Co., Valparaiso, Ind. Vol 4•545*
Micro Switch, Freeport, Ill. Vol 2•1104-1111,1116-1119
Oak Inds. Inc., Crystal Lake, Ill. Vol 2•1124
Seacor, Inc., Norwood, N.J. Vol 2•1132
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan Vol 3•786
Specialties Mfg. Co., Inc., St. Clair Shores, Mich. Vol 4•552*
UID Elctrns. Corp., Hollywood, Fla. Vol 2•1149
Unimax Switch Corp., Wallingford, Conn. Vol 2•1150
Waldom Elctrns., Inc., Chicago, Ill. Vol 2•1151; Vol 4•383*
Wild Rover Corp., Norwood, N.J. Vol 2•1152,1153
Airpax Elctrns., Inc., Cambridge, Md.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Burgess Switch Co., Scarborough, Ont., Can.
Clare, C.P. & Co., Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Cole Instrument Corp., Costa Mesa, Cal.
Control Switch, Inc., Folcroft, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Digitran Co., Pasadena, Cal.
Edison Elctrns. Div., Manchester, N.H.
Electro Switch Corp., Weymouth, Mass.
Elctrn. Engrg. Co. Cal., Santa Ana, Cal.
Flex Key Corp., Gloucester, Mass.
Furnas Elec. Co., Batavia, Ill.
General Automatic Corp., Bayonne, N.J.
General Control Co., Boston, Mass.
General Illumination, Inc., St. Paul, Minn.
Genisco Technology Corp., Eldema Div., Compton, Cal.
Gordos Corp., Bloomfield, N.J.
Guardian Elec. Mfg. Co., Chicago, Ill.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Interswitch, Burlingame, Cal.
Jay-El Prods., Gardena, Calif.
Key Tronic Corp., Spokane, Wash.
Korry Mfg. Co., Seattle, Wash.
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
LVC Inds. Inc., Flushing, N.Y.
Master Specialties, Costa Mesa, Cal.
The Maxi-Switch Co., Minneapolis, Minn.
Molex Inc., Lisle, Ill.
Oshino Electric Lamp Works, Ltd, Shinagawa-ku, Tokyo, Japan
Relay Specialties Inc., Fair Lawn, N.J.
Risk, George, Inds., Inc., Kimball, Neb.
Shigoto Inds., Ltd., New York, N.Y.
Stacoswitch, Inc., Costa Mesa, Cal.
Switchcraft, Inc., Chicago, Ill.
TEC, Inc., Tucson, Ariz.
Vemaline Prods. Co., Wyckoff, N.J.

Switches, Inertia—See Accelerometers

Switches, Joystick

Cole Instrument Corp., Costa Mesa, Cal.
Edison Elctrns. Div., Manchester, N.H.
Machine Components Corp., Plainview, N.Y.
Orbit Instr. Corp., Syosset, N.Y.
Otto Engrg. Inc., Carpentersville, Ill.

Switches, Keyboard

Alco Elctrn. Prods., North Andover, Mass. Vol 2•998
Centralab Elctrns Div., Milwaukee, Wisc Vol 2•1026,1027
Cherry Electrical Prods., Waukegan, Ill Vol 2•1034
Chicago Switch, Chicago, Ill. Vol 2•1040
Hathaway Industries Inc., Tulsa, Okla. Vol 2•1067
Hathaway Instruments, Inc., Denver, Colo. Vol 2•1067
ITT Jennings, San Jose, Cal. Vol 2•1074
Licon Div., Chicago, Ill. Vol 1•354
Magic Dot, Inc., Minneapolis, Minn. Vol 2•1100
The Maxi-Switch Co., Minneapolis, Minn. Vol 2•1102,1103
Micro Switch, Freeport, Ill. Vol 2•1119
Oak Inds. Inc., Crystal Lake, Ill. Vol 2•1124
Raytheon Co., Quincy, Mass. Vol 2•1191
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan Vol 3•786
Wild Rover Corp., Norwood, N.J. Vol 2•1152,1153
Amp Inc., Harrisburg, Pa.
Ark-Les Switch Corp., Watertown, Mass.
Clare, C.P. & Co., Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Dialight Corp., Brooklyn, N.Y.
Elec-Trol, Inc., Saugus, Cal.
Flex Key Corp., Gloucester, Mass.
Gordos Corp., Bloomfield, N.J.
Grayhill Inc., LaGrange, Ill.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
International Electro Exchange Corp., Eden Prairie, Minn.
Key Tronic Corp., Spokane, Wash.
Marco-Oak, Anaheim, Cal.
Mechanical Enterprises, Alexandria, Va.
Risk, George, Inds., Inc., Kimball, Neb.
Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Stackpole Comps. Co., Raleigh, N.C.
Stacoswitch, Inc., Costa Mesa, Cal.
TEC, Inc., Tucson, Ariz.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.

Switches, Key-Lock

Alco Elctrn. Prods., North Andover, Mass. Vol 2•998
Chicago Lock Co., Chicago, Ill. Vol 2•1037
Specialties Mfg. Co., Inc., St. Clair Shores, Mich. Vol 4•555,556*
Trimm, Inc., Libertyville, Ill. Vol 3•944
Allen-Bradley Co., Milwaukee, Wisc.
Ark-Les Switch Corp., Watertown, Mass.
Birnbach Co., Inc., Freeport, N.Y.
Chicago Switch, Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Cole Instrument Corp., Costa Mesa, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Edison Elctrns. Div., Manchester, N.H.
Electro Switch Corp., Weymouth, Mass.
Furnas Elec. Co., Batavia, Ill.
GC Electronics, Rockford, Ill.
General Elec. Company, Providence, R.I.
Grayhill Inc., LaGrange, Ill.
Honeywell, Ft. Washington, Pa.
ITT Jennings, San Jose, Cal
Janco Corp., Burbank, Cal.
Leecraft Mfg. Co., Inc., Long Island City, N.Y.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
McGill Mfg. Co., Valparaiso, Ind.
Micro Switch, Freeport, Ill.
Relay Specialties Inc., Fair Lawn, N.J.
Stettner-Trush Inc., Cazenovia, N.Y.
Unimax Switch Corp., Wallingford, Conn.

Switches, Lever

Alco Elctrn. Prods., North Andover, Mass. Vol 2•997
Arcolectric Switch Corp., No. Hollywood, Cal. Vol 2•993
Capitol Machine & Switch Co., Danbury, Conn. Vol 2•999
Chicago Switch, Chicago, Ill. Vol 2•1042
International Electro Exchange Corp., Eden Prairie, Minn. Vol 2•1082
ITT Jennings, San Jose, Cal. Vol 2•1074
J-B-T Instrs., Inc., New Haven, Conn. Vol 2•1083
Specialties Mfg. Co., Inc., St. Clair Shores, Mich. Vol 4•553,554,556*
Allied Elctrns., Chicago, Ill.
American Switch Corp., Gloucester, Mass.
AMF Electical Prods., Alexandria, Va.
Birnbach Co., Inc., Freeport, N.Y.
C & K Components, Watertown, Mass.
Carling Electric, W. Hartford, Conn.
Centralab Elctrns Div., Milwaukee, Wisc
Cherry Electrical Prods., Waukegan, Ill
Cole Instrument Corp., Costa Mesa, Cal.
Control Switch, Inc., Folcroft, Pa.
Cutler-Hammer, Milwaukee, Wisc.
Denison, R.B., Inc., Bedford, Ohio
Digitran Co., Pasadena, Cal.
Edison Elctrns. Div., Manchester, N.H.
Furnas Elec. Co., Batavia, Ill.
General Control Co., Boston, Mass.
GTE Automatic Elec., Northlake, Ill.
Guardian Elec. Mfg. Co., Chicago, Ill.
Haydon Switch & Instr., Waterbury, Conn.
Licon Div., Chicago, Ill.
Mallory Controls, Frankfort, Ind.
McGill Mfg. Co., Valparaiso, Ind.
Micro Switch, Freeport, Ill.
Milli-Switch Corp., Gladwyne, Pa.
Oak Inds. Inc., Crystal Lake, Ill.
Otto Engrg. Inc., Carpentersville, Ill.
Potter & Brumfield, Princeton, Ind.
Reed Switch Dev. Co., Greenwich, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Robertshaw Controls, Columbus, Ohio
Seacor, Inc., Norwood, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Signet Scientific Co., Burbank, Cal.
Singer Co., Schiller Park, Ill.
Smith, Herman H., Inc., Bklyn., N.Y.
Square D Co., Park Ridge, Ill.
Switchcraft, Inc., Chicago, Ill.
T-Bar Inc., Wilton, Conn.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Unimax Switch Corp., Wallingford, Conn.

Switches, Limit

Licon Div., Chicago, Ill... Vol 2•1090,1091
Precision Mechanisms Corp., Westbury, N.Y. ..... Vol 2•990
Alco Elctrn. Prods., North Andover, Mass.
Allen-Bradley Co., Milwaukee, Wisc.
Allis-Chalmers, Milwaukee, Wisc.
AMF Electical Prods., Alexandria, Va.
Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Arrow-Hart, Inc., Hartford, Conn.
Astrosystems, Inc., Lake Success, N.Y.
Birnbach Co., Inc., Freeport, N.Y.
Burgess Switch Co., Scarborough, Ont., Can.
Chatham Controls Corp., Chatham, N.J.
Cole Instrument Corp., Costa Mesa, Cal.
Control Switch, Inc., Folcroft, Pa.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Denison, R.B., Inc., Bedford, Ohio
Dillon, W.C. & Co., Van Nuys 340, Calif.
Douglas Randall Div., Pawcatuck, Conn.
Fifth Dimension, Princeton, N.J.
Flex Key Corp., Gloucester, Mass.
Furnas Elec. Co., Batavia, Ill.
General Control Co., Boston, Mass.
General Electric, Shelbyville, Ind.
Gordos Corp., Bloomfield, N.J.
Grayhill Inc., LaGrange, Ill.
GTE Automatic Elec., Northlake, Ill.
Haydon Switch & Instr., Waterbury, Conn.
Janco Corp., Burbank, Cal.
Machine Components Corp., Plainview, N.Y.
McGill Mfg. Co., Valparaiso, Ind.
Metrix Instr. Co., Houston, Tex.
Micro Switch, Freeport, Ill.
Otto Engrg. Inc., Carpentersville, Ill.
PECO Corp., Milpitas, Cal.
Photobell Co., Inc., New York, N.Y.
Reed Switch Dev. Co., Greenwich, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Risk, George, Inds., Inc., Kimball, Neb.
Robertshaw Controls, Columbus, Ohio
Signet Scientific Co., Burbank, Cal.
Singer Co., Schiller Park, Ill.
Skan-A-Matic Corp., Elbridge, N. Y.
Smith, Herman H., Inc., Bklyn., N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Specialties Mfg. Co., Inc., St. Clair Shores, Mich.
Square D Co., Park Ridge, Ill.
Sterling Instr., New Hyde Pk., NY
Tapeswitch Corp. Amer., Farmingdale, N.Y.
Teledyne Kinetics, Solana Beach, Cal.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Unimax Switch Corp., Wallingford, Conn.
Westinghouse Elec., Buffalo, N. Y.
Wild Rover Corp., Norwood, N.J.

Switches, Liquid Level/Pressure

AMF Electical Prods., Alexandria, Va.
Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Bourns, Inc., Instr. Div., Riverside, Calif.
Bristol Div, Waterbury, Conn
Computer Instrs., Hempstead, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Cook Elec. Co., Morton Grove, Ill.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Cutler-Hammer, Milwaukee, Wisc.
Delavan Electronics, Scottsdale, Ariz.
Dietz, Henry G. Co., Inc., Long Island City, N.Y.
Fifth Dimension, Princeton, N.J.
Furnas Elec. Co., Batavia, Ill.
Gagne Assocs., Inc., Binghamton, N.Y.
Gems Sensors Div., Farmington, Conn.
Gordos Corp., Bloomfield, N.J.
Harwil Co., Santa Monica, Calif.
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Kratos, Pasadena, Cal
Landis & Gyr, Inc., Elmsford, N.Y.
National Sonics, Farmingdale, N.Y.
Photobell Co., Inc., New York, N.Y.
Revere Elctrn. Div., Wallingford, Conn.
Robertshaw Controls Co., Richmond, Va.
Scientific Technology, Mountain View, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Square D Co., Park Ridge, Ill.
Statham Instrs., Inc., Oxnard, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
Trans-Sonics, Inc., Lexington, Mass.
Triac Elctrn. Sys., Forest Hills, N. Y.
United Elec. Controls Co., Watertown, Mass.
Wild Rover Corp., Norwood, N.J.
Zi-Tech Div., Palo Alto, Cal.

Switches, Lock—See Switches, Key-Lock

Switches, Magnetic Reed

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Coto-Coil Co., Inc., Providence, R.I. Vol 2•720
Cunningham, Honeoye Falls, N.Y. Vol 1•337; Vol 4•331,332*
Hamlin, Inc., Lake Mills, Wisc. Vol 2•1069; Vol 4•543*
Trompeter Elctrns., Chatsworth, Cal. Vol 2•1142-1147
Allen-Bradley Co., Milwaukee, Wisc.
Amperex Electronic Corp., Hicksville, N.Y.
Clare, C.P. & Co., Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Cole Instrument Corp., Costa Mesa, Cal.
Cutler-Hammer, Milwaukee, Wisc.
Denison, R.B., Inc., Bedford, Ohio
Disc Instruments, Inc., Costa Mesa, Ca.
Douglas Randall Div., Pawcatuck, Conn.
Gordos Corp., Bloomfield, N.J.
GTE Automatic Elec., Northlake, Ill.
ITT Jennings, San Jose, Cal
Kahl Scientific Instr. Corp., El Cajon, Calif.
Key Tronic Corp., Spokane, Wash.
Magnecraft Elec., Chicago, Ill.
Marco-Oak, Anaheim, Cal.
Matrix Systems Corp., Chatsworth, Calif.
The Maxi-Switch Co., Minneapolis, Minn.
Micro Switch, Freeport, Ill.
New Prod. Engrg., Wabash, Ind.
Potter & Brumfield, Princeton, Ind.
Risk, George, Inds., Inc., Kimball, Neb.
Ross Engrg. Corp., Campbell, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Sigma Instrs., Inc., Braintree, Mass.
TEC, Inc., Tucson, Ariz.
Tech Labs., Inc., Palisades Pk., N.J.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Torr Labs., Los Angeles, Cal.
Transco Prods., Inc., Venice, Cal.

Switches, Magnetically Actuated

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Hamlin, Inc., Lake Mills, Wisc. Vol 4•543*
Ross Engrg. Corp., Campbell, Cal. Vol 2•871
Adams & Westlake, Elkhart, Ind.
Airpax Elctrns., Inc., Cambridge, Md.
Allen-Bradley Co., Milwaukee, Wisc.
Allis-Chalmers, Milwaukee, Wisc.
Arrow-Hart, Inc., Hartford, Conn.
Artisan Elctrns. Corp., Parsippany, N.J.
Birnbach Co., Inc., Freeport, N.Y.
Clare, C.P. & Co., Chicago, Ill.
Clare-Pendar Co., Post Falls, Idaho
Cole Instrument Corp., Costa Mesa, Cal.
Coto-Coil Co., Inc., Providence, R.I.
Cutler-Hammer, Milwaukee, Wisc.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Denison, R.B., Inc., Bedford, Ohio
Douglas Randall Div., Pawcatuck, Conn.
Electro-Mechanisms, Inc., Azusa, Cal.
Fifth Dimension, Princeton, N.J.
Furnas Elec. Co., Batavia, Ill.
Gems Sensors Div., Farmington, Conn.
General Electric, Shelbyville, Ind.
Gordos Corp., Bloomfield, N.J.
GTE Automatic Elec., Northlake, Ill.
GTE Sylvania Inc., Danvers, Mass.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
H-B Instr. Co., Phila., Pa.
Information Transfer, Inc., Holcomb, N.Y.
ITT Jennings, San Jose, Cal
Jaidinger Mfg. Co., Inc., Chicago, Ill.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Key Tronic Corp., Spokane, Wash.
Kilovac Corp., Santa Barbara, Cal.
Leece-Neville Co., Cleveland, Ohio
Liberty Controls, Inc., Shorewood, Ill.
Licon Div., Chicago, Ill.
Magnecraft Elec., Chicago, Ill.
The Maxi-Switch Co., Minneapolis, Minn.
Micro Switch, Freeport, Ill.
Ohmite Mfg. Co., Skokie, Ill.
Potter & Brumfield, Princeton, Ind.
Reed Devices, Inc., Glen Ellyn, Ill.
Reed Switch Dev. Co., Greenwich, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Risk, George, Inds., Inc., Kimball, Neb.
Signet Scientific Co., Burbank, Cal.
Sprague Elec. Co., No. Adams, Mass.
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Pitman, N.J.
TEC, Inc., Tucson, Ariz.
Teledyne Kinetics, Solana Beach, Cal.
Texas Instruments, Attleboro, Mass.
Trompeter Elctrns., Chatsworth, Cal.
Veeder-Root, Hartford, Conn.
Yaskawa Elec. America, Inc., Oak Brook, Ill.

Switches, Matrix—See Switches, Crossbar; Switches, Reed; Boards, Programming

Switches, Mercury Displacement

Gordos Corp., Bloomfield, N.J. Vol 2•1053
Adams & Westlake, Elkhart, Ind.
Beltone Electronics Corp., Chicago, Ill.
H-B Instr. Co., Phila., Pa.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Leviton Mfg. Co., Inc., Brooklyn, N.Y.
Mack Elec. Devices, Wyncote, Pa.
Magnecraft Elec., Chicago, Ill.
Mechanical Enterprises, Alexandria, Va.
Micro Switch, Freeport, Ill.
Risk, George, Inds., Inc., Kimball, Neb.

Switches, Mercury Wetted Contacts

Hamlin, Inc., Lake Mills, Wisc. Vol 2•1068,1069
Trompeter Elctrns., Chatsworth, Cal. Vol 2•1142-1147
Adams & Westlake, Elkhart, Ind.
AMF Electical Prods., Alexandria, Va.
Clare, C.P. & Co., Chicago, Ill.
Disc Instruments, Inc., Costa Mesa, Ca.
Douglas Randall Div., Pawcatuck, Conn.
Fifth Dimension, Princeton, N.J.
General Elec. Company, Providence, R.I.
Gordos Corp., Bloomfield, N.J.
H-B Instr. Co., Phila., Pa.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Magnecraft Elec., Chicago, Ill.
Matrix Systems Corp., Chatsworth, Calif.
Micro Switch, Freeport, Ill.
Reed Switch Dev. Co., Greenwich, Conn.

Switches, Microwave—See Switches, Coaxial Cable; Switches, Waveguide

Switches, Motor-Driven

Precision Mechanisms Corp., Westbury, N.Y. ..... Vol 2•990
Sealectro Corp., Mamaroneck, N.Y. Vol 2•1133
Tech Labs., Inc., Palisades Pk., N.J. Vol 2•1140
Airflyte Elctrns. Co., Bayonne, N.J.
Arra Inc., Bay Shore, N.Y.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Saybrook Co., Old Saybrook, Conn.
Chicago Dynamic Inds., Chicago, Ill.
Chicago Switch, Chicago, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Consolidated Controls Corp., Bethel, Conn.
Edison Elctrns. Div., Manchester, N.H.
Electro Switch Corp., Weymouth, Mass.
Fifth Dimension, Princeton, N.J.
Furnas Elec. Co., Batavia, Ill.
General Devices, Inc., Princeton, N.J.
General Elec. Company, Providence, R.I.
Hickok Elect. Instr., Cleveland, Ohio
Ingraham Inds., Controls Div., Elizabethtown, Ky.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Janco Corp., Burbank, Cal.
Maurey Instrument Corp., Chicago, Ill.
Midtex/Aemco, Mankato, Minn.
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Ark-Les Switch Corp., Watertown, Mass.
Arrow-Hart, Inc., Hartford, Conn.
Birnbach Co., Inc., Freeport, N.Y.
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Kulka Elec. Corp., Mt. Vernon, N.Y.
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Master Specialties, Costa Mesa, Cal.
Milli-Switch Corp., Gladwyne, Pa.
Mitsumi Elec. Co., Ltd., Kitatamagun, Tokyo, Japan
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Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Singer Co., Schiller Park, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
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Chicago Switch, Chicago, Ill.
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Gordos Corp., Bloomfield, N.J.
Janco Corp., Burbank, Cal.
Johnson E. F. Co., Waseca, Minn.
Kilovac Corp., Santa Barbara, Cal.
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Norsal Industries, Inc., Brentwood, N.Y.
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H-B Instr. Co., Phila., Pa.
Hamlin, Inc., Lake Mills, Wisc.
ITT Jennings, Vacuum Elctrn. Prods., San Jose, Cal.
Kilovac Corp., Santa Barbara, Cal.
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Amphenol RF Div., Danbury, Conn.
Arra Inc., Bay Shore, N.Y.
E & M Laboratories, Inc., Westlake Village, Cal.
Fifth Dimension, Princeton, N.J.
General Microwave Corp., Farmingdale, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Norsal Industries, Inc., Brentwood, N.Y.
Nurad, Inc., Baltimore, Md.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
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Teledyne Microwave, Mountain View, Cal.
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Astrosystems, Inc., Lake Success, N.Y.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
C & A Products, Inc., Woodside, N. Y.
Computer Conversions Corp., East Northport, N.Y.
Control Technology Co., L.I.C., N.Y.
General Magnetics, Bloomfield, N.J.
ILC Data Device Corp., Hicksville, N.Y.
Ind'l. Control Co., Farmingdale, N.Y.
Natel Engrg. Co., Canoga Pk., Cal.
North Atlantic Inds., Plainview, N.Y.
Republic Advanced System Technology Group, Chatsworth, Calif.
Singer Co., Little Falls, N.J.

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Frequency Engrg. Labs., Farmingdale, N.J.
Microwave/Sys., Inc., E. Syracuse, N.Y.
Polarad Elctrn. Instrs., Lake Success, N.Y.
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Vernitron Control Comps., Torrance, Cal. ..... Vol 2•992
American Elctrns., Inc., Fullerton, Cal.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Clifton Precision, Clifton Hgts., Pa.
Electric Indicator Co., Inc., Norwalk, Conn.
Harowe Servo Controls, W. Chester, Pa.
Henschel Corp., Amesbury, Mass.
IMC Magnetics Corp., Westbury, N.Y.
IMC Magnetics Corp., Maywood, Cal.
Singer Co., Little Falls, N.J.
Transicoil, Inc., Worcester, Pa.

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A.R.F. Products, Inc., Boulder, Colo.
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Damon Corp., Westwood, Mass.
Dana Labs., Inc., Irvine, Calif.
Digitech Data Inds., Inc., Ridgefield, Conn.
Epsco, Inc., Westwood, Mass.
Fluke, John Mfg. Co., Inc., Seattle, Wash.
Frederick Electronics Corp., Frederick, Md.
Frequency Elctrns., New Hyde Pk., N.Y.
Frequency Engrg. Labs., Farmingdale, N.J.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
General Radio Co., Concord, Mass.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
HRB-Singer, Inc., State College, Pa.
ITT Mackay Marine, Elizabeth, N.J.
Logimetrics, Inc., Greenvale, N.Y.
Lorch Elctrns. Corp., Englewood, N.J.
Melpar, Falls Church, Va.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
Oeco Corp., Portland, Ore.
Omni-Spectra, Inc., Tempe, Ariz.
Pacific Meas., Inc., Palo Alto, Calif.
PRD Elctrns., Inc., Westbury, N.Y.
Resdel Engrg. Corp., Arcadia, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Sierra Sys., Mountain View, Cal.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Technical Mat'l., Mamaroneck, N.Y.
Vibration Instrs. Co., Anaheim, Cal.
Watkins Johnson Co., Palo Alto, Cal.

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Wavetek, San Diego, Cal. ..... Vol 1•532
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Exact Elctrns., Inc., Hillsboro, Ore.
NH Research, Inc., Santa Ana, Calif.

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Electronic Research Co., Shawnee Mission, Kan. ..... Vol 1•431
Ailtech, City of Industry, Cal.
Airpax Elctrns., Ft. Lauderdale, Fla.
Avtron Mfg., Inc., Cleveland, Ohio
Baldwin Elctrns., Little Rock, Ark.
Bendix Corp., Sidney, N.Y.
Controlcraft Corp., West Chicago, Ill.
Electro Corp., Sarasota, Fla.
Faria, Thomas G. Corp., Uncasville, Conn.
Mag-Con, Inc., New Brighton, Minn.
Metrix Instr. Co., Houston, Tex.
New Era Products, Cleveland, Ohio
Parametrics, Inc., Orange, Conn.
PECO Corp., Milpitas, Cal.
Pioneer Elec. & Resch. Corp., Forest Park, Ill.
Sensor Corp., Scottsdale, Pa.
Sequential Information Systems, Elmsford, N.Y.
Solid State Elctrns. Corp., Sepulveda, Cal.
Speed Detectors, Bedford, Ohio
Trump-Ross Ind'l. Controls, Inc., Billerica, Mass.

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Eastern Air Devices, Inc., Dover, N.H. Vol 2•640
Hathaway Industries Inc., Tulsa, Okla. Vol 1•451
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Electric Tachometer Corp., Philadelphia, Pa.
Electro-Craft Corp, Hopkins, Minn
Esterline Angus Div., Indianapolis, Ind.
Georator Corporation, Manassas, Va.
Harowe Servo Controls, W. Chester, Pa.
Indiana Gen'l. Div., Oglesby, Ill.
Kollsman Instr. Co., Syosset, N.Y.
Magnedyne Inc., Carlsbad, Calif.
Norden Div., Norwalk, Conn.
Parametrics, Inc., Orange, Conn.
Renco Corp., Goleta, Cal.
Sequential Information Systems, Elmsford, N.Y.
Singer Co., Little Falls, N.J.
Sticht, Herman H. Co., Inc., New York, N.Y.
Superior Elec., Bristol, Conn.
Torque Systems, Waltham, Mass.
Triplett Corp., Bluffton, Ohio
TRW/Globe Motors, Dayton, Ohio
Vibrac Corp., Chelmsford, Mass.

Tachometers, Stroboscopic

Slaughter Co., Ardmore, Okla. Vol 1•504
General Radio Co., Concord, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Pioneer Elec. & Resch. Corp., Forest Park, Ill.
Power Instrs., Skokie, Ill.
Sticht, Herman H. Co., Inc., New York, N.Y.
U.S. Scientific Instrs., Watertown, Mass.
Waters Mfg., Inc., Wayland, Mass.

Tape Decks—See Tape Transports

Tape Duplicators—See Duplicators, Magnetic Tape; Perforators,Paper Tape

Tape Editing Equipment—See Editing Equipment, Tape

Tape Erasers, Magnetic—See Erasers, Magnetic Tape (Bulk)

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Tape Recording Accessories

Int'l. Electro-Magnetics, Palatine, Ill. Vol 1•313
Ampex Corp., Redwood City, Calif.
Audio Devices, Inc., Glenbrook, Conn.
Bell & Howell Co., Pasadena, Calif.
Calico Div., San Diego, Cal.
California Instrs. Co., San Diego, Cal.
Concord Communications Sys., Farmingdale, N.Y.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Cramer Division, Old Saybrook, Conn.
Datum, Inc., Anaheim, Calif.
Electro-Voice, Inc., Buchanan, Mich.
GC Electronics, Rockford, Ill.
Honeywell, Denver, Colo.
Instrumentation Prods., Camarillo, Cal.
Int'l. Computer Prods., Dallas, Tex.
Kenton Engrg. Corp., Skokie, Ill.
Laminated Shim Co., Inc., Glenbrook, Conn.
Mac Panel Co., High Pt., N.C.
Raymond Engrg. Inc., Middletown, Conn.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
TDK Elctrns. Corp., Long Island City, N.Y.
Telectro Sys. Corp., Corona, N.Y.
Telex Comm. Div., Minneapolis, Minn.
3M Co., St. Paul, Minn.
Video Research Corp., Gaithersburg, Md.

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Tape Search Equipment

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Datatron, Inc., Santa Ana, Cal Vol 1•338
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Ampex Corp., Redwood City, Calif.
Collins Radio Co., Dallas, Tex.
Cramer Division, Old Saybrook, Conn.
Datametrics Inc., Wilmington, Mass.
Geo Space Sys., Tampa, Fla.
Int'l. Computer Prods., Dallas, Tex.
Kyros Corp., Madison, Wisc.
Metric Sys., Ft. Walton Beach, Fla.
RCA Corp., Camden, N.J.
Redactron Corp., Hauppauge, N.Y.
Remex, Santa Ana, Cal.
SRC Div., Newport Bch., Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Telectro Sys. Corp., Corona, N.Y.
Video Research Corp., Gaithersburg, Md.
Voiceprint Laboratories Corp., Somerville, N. J.

Tape Transports, Computer

Almond Instrs. Co., Covina, Cal Vol 1•935
Burroughs Corp., Pasadena, Cal. Vol 1•330
MFE Corporation, Salem, N.H. Vol 1•358
Ampex Corp., Redwood City, Calif.
Bell & Howell Co., Pasadena, Calif.
California Computer Prods., Anaheim, Cal
Cramer Division, Old Saybrook, Conn.
Crown Int'l., Elkhart, Ind.
Data Disc, Inc., Sunnyvale, Cal.
Data Recording Sys., Sunnyvale, Cal.
Data Specialties Inc., Highland Park, Ill.
Datacom, Inc., Ft. Walton Bch., Fla.
Datum, Inc., Anaheim, Calif.
Digital Equip. Corp., Maynard, Mass.
Elctrn. Memories, Hawthorne, Cal.
GRI Computer Corporation, Newton, Mass.
Interdyne, Van Nuys, Cal.
Int'l. Computer Prods., Dallas, Tex.
Int'l. Electro-Magnetics, Palatine, Ill.
KYBE Corp., Waltham, Mass.
Memodyne Corp., Newton Upper Falls, Ma.
PSC Technology Inc., Glendale, Cal.
Raymond Engrg. Inc., Middletown, Conn.
Remex, Santa Ana, Cal.
Telectro Sys. Corp., Corona, N.Y.
Telex Comm. Div., Minneapolis, Minn.
Texas Instruments, Inc., Houston, Tex.
Video Research Corp., Gaithersburg, Md.
Xerox Data Sys., El Segundo, Cal

Tape Winders

Data Specialties Inc., Highland Park, Ill.
Remex, Santa Ana, Cal.
Telectro Sys. Corp., Corona, N.Y.
3M Co., St. Paul, Minn.

Tapes, Electrical Insulation

3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn. ..... Vol 3•1078-1082
Birnbach Co., Inc., Freeport, N.Y.
Brady, W.H. Co., Milwaukee, Wisc.
Brand Dielectrics, Inc., N. Windham, Conn.
Burlington Opers. Div., Burlington, Mass.
Cadilac Plastics & Chems., Detroit, Mich.
Chemical Etching Equip. & Supply, Alexandria, Va.
Chemplast, Inc., Wayne, N.J.
Cole-Flex Corp., W. Babylon, N.Y.
Dixon Corp., Bristol, R.I.
General Elec., Insulating Matl's., Schenectady, N.Y.
General Elec. Company, Providence, R.I.
IE Mfg. Co., Chicago, Ill.
Markel, L. Frank & Sons, Norristown, Pa.
Mystik Tape, Div. Borden Chem., Winnetka, Ill.
Natvar Corp., Rahway, N.J.
Norton Coated Abrasive & Tape Divs., Troy, N.Y.
Okonite Co., Ramsey, N.J.
Plymouth Rubber Co., Inc., Canton, Mass.
Press-On Prods., Addison, Ill.
Russell Inds., Inc., Lynbrook, N.Y.
Schjeldahl, G.T. Co., Northfield, Minn.
Tensolite, Tarrytown, N.Y.
3M Co., St. Paul, Minn.
Transcon Mfg. Co., Dallas, Tex.
Union Carbide, Carbon Prods. Div., New York, N.Y.
United Mineral & Chem. Corp., New York, N.Y.
Westinghouse Elec., W. Mifflin, Pa.

Tapes, Films & Foils, Pressure Sensitive

Bishop Graphics, No. Hollywood, Cal.
Brady, W.H. Co., Milwaukee, Wisc.
Centron Engrg., Torrance, Cal.
Chartpak, Leeds, Mass.
Chemical Etching Equip. & Supply, Alexandria, Va.
Chemplast, Inc., Wayne, N.J.
Circuit-Stik, Inc., Torrance, Cal.
Cole-Flex Corp., W. Babylon, N.Y.
Fitchburg Coated Products, Scranton, Pa.
Freudenberg, B., Inc., New York, N.Y.
Labelon Corp., Canandaigua, N.Y.
Morgan Adhesives Co., Stow, Ohio
Mystik Tape, Div. Borden Chem., Winnetka, Ill.
Norton Coated Abrasive & Tape Divs., Troy, N.Y.
Plymouth Rubber Co., Inc., Canton, Mass.
Press-On Prods., Addison, Ill.
Schjeldahl, G.T. Co., Northfield, Minn.
Schweitzer, Peter J. Div., Lee, Mass.
Tapecon, Inc., Rochester, N.Y.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
Topflight Corp., York, Pa.
Union Carbide, Carbon Prods. Div., New York, N.Y.
United Mineral & Chem. Corp., New York, N.Y.
Westinghouse Elec., W. Mifflin, Pa.
Zippertubing Co., Los Angeles, Calif.

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Tapes, Paper, Plastic, etc. (For Punching)

Chemplast, Inc., Wayne, N.J.
Data Specialties Inc., Highland Park, Ill.
New England Laminates Co., Inc., Glenbrook, Conn.
Tapecon, Inc., Rochester, N.Y.
3M Co., St. Paul, Minn.
3M Co., Dielectric Materials & Sys. Div., St. Paul, Minn.
United Mineral & Chem. Corp., New York, N.Y.

Tapes, Recording, Magnetic (All Types)

Sangamo Elec. Co., Springfield, Ill. Vol 1•371
AGFA-Gevaert, Inc., Teterboro, N.J.
Allied Elctrns., Chicago, Ill.
Amperex Electronic Corp., Hicksville, N.Y.
Ampex Corp., Redwood City, Calif.
Audio Devices, Inc., Glenbrook, Conn.
Automedia, Inc., Sunnyvale, Cal.
Bell & Howell Co., Pasadena, Calif.
Concord Communications Sys., Farmingdale, N.Y.
Infodex, Inc., Waterbury, Conn.
Int'l. Computer Prods., Dallas, Tex.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
Mac Panel Co., High Pt., N.C.
MFE Corporation, Salem, N.H.
RCA Corp., Camden, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Robins Ind's. Corp., Consumer Products Div., Commack, N.Y.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
3M Co., St. Paul, Minn.

Technical Books

Allied Elctrns., Chicago, Ill.
American Radio Relay League, Inc., Newington, Conn.
Barnes & Reinecke, Inc., Chicago, Ill.
Beckman Instrs., (AISSD), Fullerton, Cal.
D.A.T.A. Inc., Orange, N.J.
International Rectifier, El Segundo, Cal.
Johnson Research Corp., Farmingdale, N.Y.
Lockheed Elctrns. Co., Watchung, N.J.
Motorola Semiconductor Prods., Phoenix, Ariz.
RCA Elctrns. Comps., Harrison, N.J.
Sams, Howard W. & Co., Inc., Indianapolis, Ind.
Tektronix, Inc., Beaverton, Ore.

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Alford Mfg. Co., Winchester, Mass.
Americon Microwave Inds., Inc., Waltham, Mass.
Amphenol RF Div., Danbury, Conn.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Arra Inc., Bay Shore, N.Y.
CES Elctrns., Brooklyn, N.Y.
General Radio Co., Concord, Mass.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Norsal Industries, Inc., Brentwood, N.Y.
OMNI Spectra, Farmington, Mich.
Phelps Dodge Comm., North Haven, Conn.
Premier Microwave, Port Chester, N.Y.
Pyrofilm Corp., Whippany, N.J.
RF Systems, Inc., Cohasset, Mass.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Saxton Prods., Congers, N.Y.
Sealectro Corp., Mamaroneck, N.Y.
Sinclair Radio Labs., Maple, Ont., Can.
Telonic Inds., Inc., Laguna Beach, Calif.
Trompeter Elctrns., Chatsworth, Cal.
Vector Industries, Palo Alto, Cal.
Weinschel Engrg. Co., Gaithersburg, Md.

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Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Amphenol RF Div., Danbury, Conn.
Arra Inc., Bay Shore, N.Y.
CES Elctrns., Brooklyn, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Somerset Radiation Lab., Arlington, Va.
Systron-Donner Microwave Div., Van Nuys, Cal.
TRG Prods., E. Boston, Mass.
Vector Industries, Palo Alto, Cal.
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Teleprinters

Design Elements, Columbus, Ohio
Di/An Controls, Inc., Boston, Mass.
E-Systems Inc., Dallas, Tex.
ITT Mackay Marine, Elizabeth, N.J.
Link Communications Inc., New York, N.Y.
NES, Inc., Itasca, Ill.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
Teletype Corp., Skokie, Ill.
Texas Instruments, Inc., Houston, Tex.

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Teletypewriters & Equipment

Data General Corp. (E), Southboro, Ma.
Di/An Controls, Inc., Boston, Mass.
Electrocom Inds., So. Bend, Indiana
ITT Mackay Marine, Elizabeth, N.J.
Link Communications Inc., New York, N.Y.
NES, Inc., Itasca, Ill.
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Copperweld Bimetallics, Glassport, Pa.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RF Systems, Inc., Cohasset, Mass.
Sitco Antennas, Portland, Ore.
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Varian Assocs., Palo Alto, Cal.

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AEL Communications Corp., Sub. of Amer. Elctrn. Labs. Inc., Lansdale, Pa.
Ampex Corp., Redwood City, Calif.
Andersen Labs. Inc., Bloomfield, Conn.
Arvin Sys., Inc., Dayton, Ohio
Audiotronics, N. Hollywood, Cal.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Circon Corp., Santa Barbara, Ca.
Cleveland Elctrns., Inc., Cleveland, Ohio
Collins Radio Co., Dallas, Tex.
Concord Communications Sys., Farmingdale, N.Y.
Cunningham, Honeoye Falls, N.Y.
Data Disc, Inc., Sunnyvale, Cal.
Dynair Elctrns. Inc., San Diego, Calif.
Edo Western Corp., Salt Lake City, Utah
Fairchild Space & Defense Sys., Syosset, N.Y.
General Electrodynamics Corp., Garland, Tex.
General TV Network, Ferndale, Mich.
Hamamatsu Corp. (E), Middlesex, N. J.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Inter-Market, Inc., Glenview, Ill.
ITI Electronics, Inc., Clifton, N.J.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
Jerrold Electronics Corp., Philadelphia, Pa.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Lenox Instr. Co., Philadelphia, Pa.
Marconi Elctrns. Inc., Elmsford, N.Y.
Opto-Metric Tools, Rockleigh, N.J.

RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RCA Service Co., Camden, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Stereotronics Television Co., Sherman Oaks, Cal.
Telectro Sys. Corp., Corona, N.Y.
Teledyne Camera Sys., Arcadia, Cal.
Thomson-CSF Inc., New York, N.Y.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Solid State East Div., Micro-Link Prods., Beverly, Mass
Westinghouse Elec., Elmira, N.Y.
Winegard Co., Burlington, Iowa

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HAPCO, Boulder, Colo.

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Terminal Blocks

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Waldom Elctrns., Inc., Chicago, Ill. Vol 4•383*
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Allied Systems Corp., Greensboro, N.C.
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Controls Div., Elizabeth, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Electrovert, Mt. Vernon, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Laminated Fabricators, San Bruno, Calif.
Methode Elctrns., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
Rostone Corp., Lafayette, Ind.
Shigoto Inds., Ltd., New York, N.Y.
Square D Co., Park Ridge, Ill.
Thomas & Betts Co., Elizabeth, N.J.

Terminal Boards

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Aeronautical Elec. Co., Inc., Chicago, Ill.
Airflyte Elctrns. Co., Bayonne, N.J.
Allied Systems Corp., Greensboro, N.C.
Amphenol Ind'l. Div., Chicago, Ill.
Astrodyne, Inc., Wilmington, Mass.
Buchanan Elec. Prods., Union, N.J.
Christiansen Radio Inc., Laguna Beach, Cal.
Chromalloy-Alcon Inc., Chicago, Ill.
Comco Plastics, Inc., Richmond Hill, N.Y.
Continental Connector, Woodside, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
EI Instruments, Derby, Conn.
Elctrn. Molding Corp., Woonsocket, R.I.
Elgin Elctrns. Inc., Waterford, Pa.
Grayhill Inc., LaGrange, Ill.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Laminated Fabricators, San Bruno, Calif.
Malco, A Microdot Co., Inc., Chicago, Ill.
Mechanical Engraving Co., Inc., Bronx, N.Y.
Meson Electronics Co. Inc., Rochester, N. Y.
Reed Devices, Inc., Glen Ellyn, Ill.
Rostone Corp., Lafayette, Ind.
Shigoto Inds., Ltd., New York, N.Y.
Smith, Herman H., Inc., Bklyn., N.Y.

Terminal Equipment, Digital

Monitor Prods., S. Pasadena, Cal. Vol 2•430,431
AMP Capitron Div./AMP Incorporated, Elizabethtown, Pa.
Applied Digital Data Systems, Inc., Hauppauge, N.Y.
Ark-Les Switch Corp., Watertown, Mass.
Autocon Inds., Inc., Minneapolis, Minn.
Burroughs Corp., Pasadena, Cal.
Clary Corp., San Gabriel, Calif.
Codex Corp., Newton, Mass.
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Control Equip. Corp., Lowell, Mass.
Demex, Inc., Kansas City, Mo.
Design Elements, Columbus, Ohio
Di/An Controls, Inc., Boston, Mass.
Digital Equip. Corp., Maynard, Mass.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitron Corp., Norristown, Pa.
Eldorado Electrodata, Concord, Cal.
Electrocom Inds., So. Bend, Indiana
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Information Displays, Inc., Mt. Kisco, N.Y.
Instrumentation Tech. Corp., Northbridge, Cal.
Int'l. Computer Prods., Dallas, Tex.
Landis & Gyr, Inc., Elmsford, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Lear Siegler, Anaheim, Cal.
Memodyne Corp., Newton Upper Falls, Ma.
NES, Inc., Itasca, Ill.
Pinlites, Fairfield, N.J.
Princeton Elctrn. Prods., New Brunswick, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Re-el Circuits, Inc., Saddle Brook, N.J.
Republic Advanced System Technology Group, Chatsworth, Calif.
Singer - Tele-Signal, Woodbury, N.Y.
TEC, Inc., Tucson, Ariz.
Tektronix, Inc., Beaverton, Ore.
Teletype Corp., Skokie, Ill.
Varian Assocs., Palo Alto, Cal.
Varian Data Machines, Palo Alto, Cal.
Victor Comptometer Corp., Chicago, Ill.
Western Telematic, Inc., Costa Mesa, Cal.
Wyle Computer Prods., Inc., El Segundo, Calif.

Terminal Strips—See Strips, Terminal

Terminals, Data Display

Burroughs Corp., Pasadena, Cal.
CPS, Sunnyvale, Calif.
Digitech Data Inds., Inc., Ridgefield, Conn.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
Infodex, Inc., Waterbury, Conn.
Princeton Elctrn. Prods., New Brunswick, N.J.
Spatial Data Systems, Inc., Goleta, Cal.

Terminals, Feedthru

Concord Elctrns., New York, N.Y. Vol 3•655
Hiram Jones Elctrns., No. Hollywood, Cal. Vol 3•684,685
Precision Metal Prods. Co., Stoneham, Mass. Vol 3•767
Sealectro Corp., Mamaroneck, N.Y. Vol 3•775,776,779,780
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•838-841
Vector Elctrn. Co., Inc., Sylmar, Cal. Vol 3•956,957
Victoreen Instr., Cleveland, Ohio Vol 3•959
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Alberox Corp., New Bedford, Mass.
American Lava Corp., Chattanooga, Tenn.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
Amphenol Sams Div., Chatsworth, Cal.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Atlee Corp., Woburn, Mass.
Augat Inc., Attleboro, Mass.
Basic Ceramics Inc., Hawthorne, N.J.
Beman Mfg., Inc., New Cumberland, Pa.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Cambridge Thermionic, Cambridge, Mass
Ceramaseal, Inc., New Lebanon Center, N.Y.
Coors Porcelain Co., Golden, Colo.
Curtis Dev. & Mfg., Milwaukee, Wisc.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dixon Corp., Bristol, R.I.
Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
Eimac, San Carlos, Calif.
EI Instruments, Derby, Conn.
Elco, Willow Grove, Pa.
Electrical Inds., Murray Hill, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Elctrn. Seals, Van Nuys, Cal.
Flex-Link Products, Inc., San Fernando, Cal.
General Mfg. Co., Glendale, Calif.
Glass Beads Co., Latrobe, Pa.
Goe Engrg. Co., City of Industry, Calif.
GTI Corp. (E), Pittsburgh, Pa.
Hermetic Seal Corp., Rosemead, Cal.
Heyman Mfg. Co., Kenilworth, N.J.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Johnson E. F. Co., Waseca, Minn.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Latronics Corp., Latrobe, Pa.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Positronic Inds., Springfield, Mo.
Pylon Co., Inc., Attleboro, Mass.
Rostone Corp., Lafayette, Ind.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Statham Instrs., Inc., Oxnard, Cal.
Sterling Instr., New Hyde Pk., NY
Taurus Corp., Lambertville, N.J.
Teledyne Positive Connector, Ansonia, Conn.
3M Co., St. Paul, Minn.
Torwico Elctrns., Inc., Lakewood, N.J.
United Prods. Co., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Varian Assocs., Palo Alto, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Ferrule, Cable-End

Glenair, Inc., Glendale, Calif... Vol 4•370*
Amp Inc., Harrisburg, Pa.
Bead Elctrns., Bridgeport, Conn.
Berg Electronics, New Cumberland, Pa.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Eimac, San Carlos, Calif.
Flex-Link Products, Inc., San Fernando, Cal.
Sjoberg, C. & Son, Inc., Cranston, R.I.

Terminals, Lug

Chromalloy-Alcon Inc., Chicago, Ill. Vol 3 •552
Ico/Rally, Palo Alto, Cal. Vol 3•688
Hiram Jones Elctrns., No. Hollywood, Cal. Vol 3•684,685
Panduit Corp., Tinley Pk., Ill. Vol 3•1409; Vol 4•571*
Pomona Elctrns. Co., Inc., Pomona, Cal. Vol 3•717
Precision Metal Prods. Co., Stoneham, Mass. Vol 3•767
Sealectro Corp., Mamaroneck, N.Y. Vol 3•774,775,779,780
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•794
3M Co. Electro Prods. Div., St. Paul, Minn. Vol 3•851
Waldom Elctrns., Inc., Chicago, Ill. Vol 3•965,966,1072,1073; Vol 4•383*
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Acme Model Engrg. Co., Ridgefield, N.J.
Amp Inc., Harrisburg, Pa.
Anchor Alloys, Inc., Brooklyn, N.Y.
Ark-Les Switch Corp., Watertown, Mass.
Augat Inc., Attleboro, Mass.
Beman Mfg., Inc., New Cumberland, Pa.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Circon Corp., Santa Barbara, Ca.
Concord Elctrns., New York, N.Y.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Electrical Inds., Murray Hill, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
ETC, Div. ITT, Cleveland, Ohio
GC Electronics, Rockford, Ill.
General Mfg. Co., Glendale, Calif.
Hoffman Industrial Prods., Farmingdale, N.Y.
Hollingsworth Solderless Terminal, Phoenixville, Pa.
ITT Thermotech, Hopkins, Minn.
Jackson Bros., (London) Ltd., New York, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Malco, A Microdot Co., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Seastrom Mfg. Co., Glendale, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Showa Musen Kogyo Co., Ltd., Shinagawa-Ku Tokyo 141, Japan
Sjoberg, C. & Son, Inc., Cranston, R.I.
Taurus Corp., Lambertville, N.J.
Teledyne Penn-Union Elec., Edinboro, Pa.
Teledyne Positive Connector, Ansonia, Conn.
Thomas & Betts Co., Elizabeth, N.J.
United Prods. Co., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Miniature & Subminiature

Chromalloy-Alcon Inc., Chicago, Ill. Vol 3•552
Concord Elctrns., New York, N.Y. Vol 3•655
Hiram Jones Elctrns., No. Hollywood, Cal. Vol 3•684,685
Precision Metal Prods. Co., Stoneham, Mass. Vol 3•767
Robinson-Nugent, New Albany, Ind. Vol 4•380*
Sealectro Corp., Mamaroneck, N.Y. Vol 3•774-776,779,780
Taurus Corp., Lambertville, N.J. Vol 1•375
Vector Elctrn. Co., Inc., Sylmar, Cal. Vol 3•956,957
Waldom Elctrns., Inc., Chicago, Ill. Vol 3•964-969,971,1072,1073
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
American Lava Corp., Chattanooga, Tenn.
Amp Inc., Harrisburg, Pa.
Amphenol Ind'l. Div., Chicago, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Augat Inc., Attleboro, Mass.

Bead Elctrns., Bridgeport, Conn.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Curtis Dev. & Mfg., Milwaukee, Wisc.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
El Instruments, Derby, Conn.
Elco, Willow Grove, Pa.
Electrical Inds., Murray Hill, N.J.
Elctrn. Molding Corp., Woonsocket, R.I.
Flex-Link Products, Inc., San Fernando, Cal.
GC Electronics, Rockford, Ill.
General Mfg. Co., Glendale, Calif.
Goe Engrg. Co., City of Industry, Calif.
Hathaway Industries Inc., Tulsa, Okla.
Jackson Bros., (London) Ltd., New York, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Malco, A Microdot Co., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Positronic Inds., Springfield, Mo.
Pylon Co., Inc., Attleboro, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Smith, Herman H., Inc., Bklyn., N.Y.
Teledyne Penn-Union Elec., Edinboro, Pa.
Teledyne Positive Connector, Ansonia, Conn.
United Prods. Co., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Printed Circuit Board

Berg Electronics, New Cumberland, Pa. Vol 3•653
Chromalloy-Alcon Inc., Chicago, Ill. Vol 3•552
Concord Elctrns., New York, N.Y. Vol 3•655
Elctrn. Molding Corp., Woonsocket, R.I. Vol 3•666
Hiram Jones Elctrns., No. Hollywood, Cal. ..... Vol 3•684,685
Precision Metal Prods. Co., Stoneham, Mass. ..... Vol 3•767
Reed Devices, Inc., Glen Ellyn, Ill. Vol 3•769
Sealectro Corp., Mamaroneck, N.Y. Vol 3•774-776,779,780
Texas Instruments, Attleboro, Mass. Vol 3•925
Vector Elctrn. Co., Inc., Sylmar, Cal. Vol 3•956,957
Waldom Elctrns., Inc., Chicago, Ill. Vol 3•969,971
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Amp Inc., Harrisburg, Pa.
Amphenol Ind'l. Div., Chicago, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
Bead Elctrns., Bridgeport, Conn.
Beman Mfg., Inc., New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Circon Corp., Santa Barbara, Ca.
Curtis Dev. & Mfg., Milwaukee, Wisc.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
El Instruments, Derby, Conn.
Elco, Willow Grove, Pa.
Flex-Link Products, Inc., San Fernando, Cal.
General Mfg. Co., Glendale, Calif.
Goe Engrg. Co., City of Industry, Calif.
Hathaway Industries Inc., Tulsa, Okla.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Magnum Elec. Corp., Erie, Mich.
Malco, A Microdot Co., Inc., Chicago, Ill.
Methode Elctrns., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Positronic Inds., Springfield, Mo.
Shigoto Inds., Ltd., New York, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Stanford Applied Engrg., Inc., Santa Ana, Cal.
Teledyne Positive Connector, Ansonia, Conn.
Useco Div., Van Nuys, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.
Viking Inds., Inc., Chatsworth, Calif.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Push-On—See Connectors & Terminals, Push-On, Quick Disconnect

Terminals, Solderless

ETC, Div. ITT, Cleveland, Ohio Vol 3•664
GC Electronics, Rockford, Ill. .. Vol 3•679
Ico/Rally, Palo Alto, Cal. ..... Vol 3•688
Panduit Corp., Tinley Pk., Ill. Vol 3•1409; Vol 4•571*
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•814,816
3M Co. Electro Prods. Div., St. Paul, Minn. ..... Vol 3•851
Vaco Prods. Co., Chicago, Ill. Vol 3•952,1242
Waldom Elctrns., Inc., Chicago, Ill. Vol 3•964-966,971; Vol 4•383*
Accurate Elctrns. Corp., Elyria, Ohio
Amp Inc., Harrisburg, Pa.
Amphenol Ind'l. Div., Chicago, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Augat Inc., Attleboro, Mass.
Beman Mfg., Inc., New Cumberland, Pa.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Burndy Corp., Norwalk, Conn.
Bussco Engrg., El Segundo, Cal.
Cambridge Thermionic, Cambridge, Mass
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Circon Corp., Santa Barbara, Ca.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
El Instruments, Derby, Conn.
Elco, Willow Grove, Pa.
Elctrn. Molding Corp., Woonsocket, R.I.
Flex-Link Products, Inc., San Fernando, Cal.
Hathaway Industries Inc., Tulsa, Okla.
Hoffman Industrial Prods., Farmingdale, N.Y.
Hollingsworth Solderless Terminal, Phoenixville, Pa.
ITT Holub Inds., Sycamore, Ill.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
Lance Inds., Sylmar, Calif.
Magnum Elec. Corp., Erie, Mich.
Malco, A Microdot Co., Inc., Chicago, Ill.
Molex Inc., Lisle, Ill.
National Tel-Tronics, Meadville, Pa.
Sealectro Corp., Mamaroneck, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Square D Co., Park Ridge, Ill.
Teledyne Penn-Union Elec., Edinboro, Pa.
Teledyne Positive Connector, Ansonia, Conn.
Thomas & Betts Co., Elizabeth, N.J.
Useco Div., Van Nuys, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Standoff

Concord Elctrns., New York, N.Y. Vol 3•655
Elctrn. Molding Corp., Woonsocket, R.I. Vol 3•666
Hiram Jones Elctrns., No. Hollywood, Cal. ..... Vol 3•684,685
Precision Metal Prods. Co., Stoneham, Mass. ..... Vol 3•767
Sealectro Corp., Mamaroneck, N.Y. Vol 3•774,775,777,779,780
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•809,821,835-838
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Alberox Corp., New Bedford, Mass.
Alco Elctrn. Prods., North Andover, Mass.
American Lava Corp., Chattanooga, Tenn.
Art Wire & Stamping Co., Cedar Knolls, N.J.
Atlee Corp., Woburn, Mass.
Basic Ceramics Inc., Hawthorne, N.J.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Cambridge Thermionic, Cambridge, Mass
Ceramaseal, Inc., New Lebanon Center, N.Y.
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Circon Corp., Santa Barbara, Ca.
Coors Porcelain Co., Golden, Colo.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dixon Corp., Bristol, R.I.
Edal Inds., Inc., E. Haven, Conn.
Elco, Willow Grove, Pa.
Electrical Inds., Murray Hill, N.J.
Flex-Link Products, Inc., San Fernando, Cal.
General Mfg. Co., Glendale, Calif.
Goe Engrg. Co., City of Industry, Calif.
Grayhill Inc., LaGrange, Ill.
Grayhill Moldtronics, Inc., Downers Grove, Ill.
Hermetic Seal Corp., Rosemead, Cal.
Jackson Bros., (London) Ltd., New York, N.Y.
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
Johnson E. F. Co., Waseca, Minn.
Keystone Elctrns. Corp., New York, N.Y.
Latronics Corp., Latrobe, Pa.
Norelcom Inds., Inc., Farmingdale, N.Y.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Positronic Inds., Springfield, Mo.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Sterling Instr., New Hyde Pk., NY
Taurus Corp., Lambertville, N.J.
Teledyne Positive Connector, Ansonia, Conn.
3M Co., St. Paul, Minn.
Torwico Elctrns., Inc., Lakewood, N.J.
United Prods. Co., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Threaded

Hiram Jones Elctrns., No. Hollywood, Cal. ..... Vol 3•684,685
Millen, James Mfg., Malden, Mass. Vol 2•520
Precision Metal Prods. Co., Stoneham, Mass. ..... Vol 3•767
Accurate Elctrns. Corp., Elyria, Ohio
Basic Ceramics Inc., Hawthorne, N.J.
Cambridge Thermionic, Cambridge, Mass
Cinch Connectors, Oper of TRW Elctrn. Comps., Elk Grove Village, Ill.
Concord Elctrns., New York, N.Y.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
Elctrn. Molding Corp., Woonsocket, R.I.
GC Electronics, Rockford, Ill.
General Mfg. Co., Glendale, Calif.
Keystone Elctrns. Corp., New York, N.Y.
Magnum Elec. Corp., Erie, Mich.
National Tel-Tronics, Meadville, Pa.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Positronic Inds., Springfield, Mo.
Sterling Instr., New Hyde Pk., NY
Useco Div., Van Nuys, Cal.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminals, Turret

Elctrn. Molding Corp., Woonsocket, R.I. Vol 3•666
Hiram Jones Elctrns., No. Hollywood, Cal. ..... Vol 3•684,685
Precision Metal Prods. Co., Stoneham, Mass. ..... Vol 3•767
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•818,819
Abacus Elctrns. Corp., Dobbs Ferry, N.Y.
Accurate Elctrns. Corp., Elyria, Ohio
Augat Inc., Attleboro, Mass.
Bead Elctrns., Bridgeport, Conn.
Cambridge Thermionic, Cambridge, Mass
Concord Elctrns., New York, N.Y.
D-Cemco, Inc., Burbank, Calif.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
El Instruments, Derby, Conn.
Electrical Inds., Murray Hill, N.J.
Flex-Link Products, Inc., San Fernando, Cal.
General Mfg. Co., Glendale, Calif.
Johnson E. F. Co., Waseca, Minn.
Keystone Elctrns. Corp., New York, N.Y.
Kulka Elec. Corp., Mt. Vernon, N.Y.
National Tel-Tronics, Meadville, Pa.
Positronic Inds., Springfield, Mo.
Sealectro Corp., Mamaroneck, N.Y.
United Prods. Co., New Hyde Pk., N.Y.
Useco Div., Van Nuys, Cal.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Terminals, Wirewrap

Berg Electronics, New Cumberland, Pa. Vol 3•650
Elctrn. Molding Corp., Woonsocket, R.I. Vol 3•666
Amp Inc., Harrisburg, Pa.
Augat Inc., Attleboro, Mass.
Bussco Engrg., El Segundo, Cal.
Concord Elctrns., New York, N.Y.
Curtis Dev. & Mfg., Milwaukee, Wisc.
General Mfg. Co., Glendale, Calif.
Ico/Rally, Palo Alto, Cal.
IFE Div., E. Providence, R. I.
Mupac Corp., Brockton, Mass.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Viking Inds., Inc., Chatsworth, Calif.
Zierick Mfg. Corp., Mt. Kisco, N.Y.

Terminations, Antenna-Also See Dummy Loads

Bendix, Franklin, Ind. ..... Vol 2•609
Bird Elctrn., Cleveland, Ohio.... Vol 1•397
R L C Elctrns., Inc., Mt. Kisco, N.Y. Vol 2•620
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Barker & Williamson, Inc., Bristol, Pa.
Berg Electronics, New Cumberland, Pa.
Collins Radio Co., Dallas, Tex.
Elcom Sys., Deer Pk., N.Y.
Electro Impulse, Inc., Red Bank, N.J.
EMC Technology Inc, Cherry Hill, N.J.
Engelmann Microwave, Montville, N.J.
Maury Microwave Corp., Cucamonga, Calif.
Microlab/FXR, Livingston, N.J.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Rowe Inds., Div., Toledo, Ohio
Sealectro Corp., Mamaroneck, N.Y.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
Technical Mat'l., Mamaroneck, N.Y.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.

Terminations, High-Voltage (1,000 Volts & Over)

Alberox Corp., New Bedford, Mass.
Amphenol Sams Div., Chatsworth, Cal.
Barth Elctrns., Inc., Cleveland, Ohio
Basic Ceramics Inc., Hawthorne, N.J.
Del Electronics Corp., Mt. Vernon, N.Y.
Deltaray Corp., Woburn, Mass.
Electro Impulse, Inc., Red Bank, N.J.
General Elec., Insulating Matl's., Schenectady, N.Y.
General Lab. Assocs., Norwich, N.Y.
Hathaway Industries Inc., Tulsa, Okla.
Hipotronics, Inc., Brewster, N.Y.
Julie Research Lab., New York, N.Y.
Kilovolt Corp., Hackensack, N.J.
Manger Elec. Co., Inc., Stamford, Conn.
Megavolt, Inc., New York, N.Y.
Narda Microwave Corp., Plainview, N.Y.
Peschel Instrs., Cape Coral, Fla.
Plymouth Rubber Co., Inc., Canton, Mass.
Ross Engrg. Corp., Campbell, Cal.
Rowe Inds., Div., Toledo, Ohio

Universal Voltronics Corp., Mt. Kisco, N.Y.

Terminations, Microwave

Arra Inc., Bay Shore, N.Y. ..... Vol 2•608
Bendix, Franklin, Ind. ..... Vol 2•609
Bird Elctrn., Cleveland, Ohio.... Vol 1•397
Texscan Corp., Indianapolis, Ind. Vol 1•514
Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
Alford Mfg. Co., Winchester, Mass.
American Elctrn. Labs., Inc., Lansdale, Pa.
Americon Microwave Inds., Inc., Waltham, Mass.
Applied Research Inc., Port Washington, N.Y.
Barth Elctrns., Inc., Cleveland, Ohio
Basic Ceramics Inc., Hawthorne, N.J.
CES Elctrns., Brooklyn, N.Y.
Collins Radio Co., Dallas, Tex.
E & M Laboratories, Inc., Westlake Village, Cal.
Elcom Sys., Deer Pk., N.Y.
Electro Impulse, Inc., Red Bank, N.J.
EMC Technology Inc, Cherry Hill, N.J.
Engelmann Microwave, Montville, N.J.
General Radio Co., Concord, Mass.
Manger Elec. Co., Inc., Stamford, Conn.
Maury Microwave Corp., Cucamonga, Calif.
Merrimac Inds., Inc., West Caldwell, N.J.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Microwave Filter Co., Inc., East Syracuse, N.Y.
Narda Microwave Corp., Plainview, N.Y.
OMNI Spectra, Farmington, Mich.
PRD Elctrns., Inc., Westbury, N.Y.
Premier Microwave, Port Chester, N.Y.
Pyrofilm Corp., Whippany, N.J.
Radiation Devices Co., Baltimore, Md.
RF Systems, Inc., Cohasset, Mass.
R L C Elctrns., Inc., Mt. Kisco, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Rowe Inds., Div., Toledo, Ohio
Sealectro Corp., Mamaroneck, N.Y.
Solitron/Microwave, Port Salerno, Fla.
Special Microwave Devices Oper., Waltham, Mass.
Systron-Donner Microwave Div., Van Nuys, Cal.
Telonic Inds., Inc., Laguna Beach, Calif.
Transco Prods., Inc., Venice, Cal.
TRG Prods., E. Boston, Mass.
Varian Assocs., Palo Alto, Cal.
Vector Industries, Palo Alto, Cal.
Waveline, Inc., W. Caldwell, N.J.

Terminations, VHF, Video, Pulse

Bird Elctrn., Cleveland, Ohio.... Vol 1•397
American Elctrn. Labs., Inc., Lansdale, Pa.
Barth Elctrns., Inc., Cleveland, Ohio
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Collins Radio Co., Dallas, Tex.
Elcom Sys., Deer Pk., N.Y.
Electro Impulse, Inc., Red Bank, N.J.
Engelmann Microwave, Montville, N.J.
General Radio Co., Concord, Mass.
Jerrold Electronics Corp., Philadelphia, Pa.
Manger Elec. Co., Inc., Stamford, Conn.
Microlab/FXR, Livingston, N.J.
Narda Microwave Corp., Plainview, N.Y.
OMNI Spectra, Farmington, Mich.
Priority Services, Burbank, Cal.
Radiation Devices Co., Baltimore, Md.
Rohde & Schwarz Sls., Passaic, N.J.
Rowe Inds., Div., Toledo, Ohio
Telonic Inds., Inc., Laguna Beach, Calif.
Texscan Corp., Indianapolis, Ind.
Trompeter Elctrns., Chatsworth, Cal.
Waveline, Inc., W. Caldwell, N.J.
Wide Band Engrg. Co., Phoenix, Ariz.

Test Equipment, Closed Circuit TV-Also See Television Systems & Equipment, Closed-Circuit

Ailtech, City of Industry, Cal.
Colorado Video, Inc., Boulder, Colo.
Kay Elemetrics, Pine Brook, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Tektronix, Inc., Beaverton, Ore.

Test Equipment, Color TV

Dynascan Corp., Chicago, Ill.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
Jerrold Electronics Corp., Philadelphia, Pa.
Kay Elemetrics, Pine Brook, N.J.
Marconi Elctrns. Inc., Elmsford, N.Y.
Marconi Instrs., Englewood, N.J.
Mercury Elctrns. Corp., Mineola, N.Y.
Nelson Ross Elctrns., Lake Success, N.Y.
Nuclear Resch. Corp., Southampton, Pa.
Photo Resch. Corp., Burbank, Calif.
Radio Resch. Co., Rockaway, N.J.
RCA Corp., Camden, N.J.
RCA Elctrns. Comps., Harrison, N.J.
RIL Elctrns., Inc., Southampton, Pa.
Rohde & Schwarz Sls., Passaic, N.J.
Scientronics, Barrington, N.J.
Seco Elctrns. Corp., Hopkins, Minn.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Tektronix, Inc., Beaverton, Ore.
Telectro Sys. Corp., Corona, N.Y.
Telonic Inds., Inc., Laguna Beach, Calif.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Test Equipment, Mechanical Impedance

Bafco, Inc., Warminster, Pa.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Delta Design, San Diego, Cal
Digitech Data Inds., Inc., Ridgefield, Conn.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Endevco, Pasadena, Calif.
New Era Products, Cleveland, Ohio
Quan-Tech, Whippany, N.J.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Universal Ad-Yu Elctrns., Inc., Milwaukee, Wi.

Test Lead Probes—See Probes, Test Lead

Test Leads & Adapters

E-Z Hook, Test Prods., Arcadia, Cal. Vol 3•667-677
Pomona Elctrns. Co., Inc., Pomona, Cal. Vol 3•721,731,732,738,739,751-756, 760-765
Smith, Herman H., Inc., Bklyn., N.Y. Vol 3•798-800,803-805,807,808
Accurate Elctrns. Corp., Elyria, Ohio
Air-O-Tronics Prods., Morrisville, N.Y.
Anchor Specialty Mfg., Teterboro, N.J.
A P Products, Inc., Painesville, Ohio
Birnbach Co., Inc., Freeport, N.Y.
Circon Corp., Santa Barbara, Ca.
Collins Radio Co., Dallas, Tex.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
De Soto Elec. Prods., De Soto, Mo.
Desco Mfg. Co., Glendale, Calif.
Electro Sci. Inds., Portland, Ore.
Excel Specialty Corp., Chicago, Ill.
GC Electronics, Rockford, Ill.
Hickok Elect. Instr., Cleveland, Ohio
Jonard Inds. Corp., Bronx, N.Y.
Lynn Elctrns. Corp., Feasterville, Pa.
McDonnell Douglas Electronics Co., St. Charles, Mo.
National Tel-Tronics, Meadville, Pa.
New Era Products, Cleveland, Ohio
Paraplegics Mfg., Bensenville, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Pylon Co., Inc., Attleboro, Mass.
Rowe Inds., Div., Toledo, Ohio
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Textool Prods., Inc., Irving, Tex.
Vector Elctrn. Co., Inc., Sylmar, Cal.

Test Systems, Automatic D-C

AD Automation, Rochester, N.Y. Vol 1•386
Julie Research Lab., New York, N.Y. Vol 1•466

Testers, Accelerometer—See Calibrators, Accelerometer

Testers, Battery

CML-Macarr, Inc., Edison, N.J. Vol 1•645
Aerotronic Assocs., Inc., Contoocook, N.H.
Altair Resch. & Mfg. Co., Ontario, Calif.
Anchor Specialty Mfg., Teterboro, N.J.
Austin Elctrns., Roselle, N.J.
Christie Elec., Los Angeles, Cal.
Components Specialties, Freeport, N.Y.
Dytro Corp., Hicksville, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Hoyt Elec. Instr. Works, Belmont, Mass.
Kahl Scientific Instr. Corp., El Cajon, Calif.
New Era Products, Cleveland, Ohio
N.Y. Testing Labs., Inc., Westbury, N.Y.
Opad Elec. Co., Inc., New York, N.Y.
Q.V.S., Inc., East Orange, N.J.
Ratelco, Inc., Seattle, Wash.
Schauer Mfg. Corp., Cincinnati, Ohio
Shigoto Inds., Ltd., New York, N.Y.
Simpson Elec. Co., Chicago, Ill.
W-F Products, Inc., Denver, Co.
Western Reserve Elctrns., Twinsburg, Ohio

Testers Burn-In, Aging

Aerotronic Assocs., Inc., Contoocook, N.H.
Applied Control Co., Fairfield, N.J.
Austin Elctrns., Roselle, N.J.
Blue M Engrg. Co., Blue Island, Ill.
CGS Units, Inc., Rochester, N.Y.
Delta Design, San Diego, Cal
EI Instruments, Derby, Conn.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Jettron Prods., Hanover, N.J.
Julie Research Lab., New York, N.Y.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Opad Elec. Co., Inc., New York, N.Y.
PSC Technology Inc., Glendale, Cal.
Slaughter Co., Ardmore, Okla.
Wakefield Engrg., Inc., Systems Div., Wakefield, Mass.

Testers, Cable

Counterscan Systems, Sutton, Neb. Vol 1•417
Slaughter Co., Ardmore, Okla. Vol 1•505
AD Automation, Rochester, N.Y.
A. D. Data Sys., Inc., Rochester, N.Y.
Amprobe Instr., Lynbrook, N.Y.
Anchor Specialty Mfg., Teterboro, N.J.
Associated Resch., Chicago, Ill.
Automatic Production Systems Inc., Pennsauken, N.J.
Automation Dynamics, Northvale, N.J.
Beckman Instrs., Cedar Grove, N.J.
Belden Corp. Elctrn. Div., Richmond, Ind.
Biddle, James G., Plymouth Meeting, Pa.
Cablemaster Div., No. Hollywood, Cal.
Cole Instrument Corp., Costa Mesa, Cal.
Communications Technology Corp., Los Angeles, Cal.
Computer Automation, Inc., Irvine, Cal.
Custom Sci. Instrs., Inc., Whippany, N.J.
Del Electronics Corp., Mt. Vernon, N.Y.
Dit-MCO International, Kansas City, Mo.
General Radio Co., Concord, Mass.
Guildline Instrs., Inc., Larchmont, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Hughes Aircraft Co., Ind'l. Prods. Div. FACT Sys., Los Angeles, Cal.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Jonard Inds. Corp., Bronx, N.Y.
Kilovolt Corp., Hackensack, N.J.
MacDonald & Co., Glendale, Calif.
Megavolt, Inc., New York, N.Y.
Peschel Instrs., Cape Coral, Fla.
PSC Technology Inc., Glendale, Cal.
Railway Comm., Raytown, Mo.
Ross Engrg. Corp., Campbell, Cal.
Shallcross, Selma, N.C.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systems Instrs. Resch., Inc., Atlanta, Ga.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
T-Bar Inc., Wilton, Conn.
Tektronix, Inc., Beaverton, Ore.
Teradyne, Inc., Boston, Mass.
Triplett Corp., Bluffton, Ohio
Universal Voltronics Corp., Mt. Kisco, N.Y.
V. J. Elctrns., Ontario, Cal.

Testers, Capacitor

Beckman Instrs., Cedar Grove, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Clarke - Hess, New York, N.Y.
Davidson Elctrn. Dev. Co., Erie, Pa.
Del Electronics Corp., Mt. Vernon, N.Y.
Dynascan Corp., Chicago, Ill.
Electro Sci. Inds., Portland, Ore.
Freed Transformer Co., Bklyn., N.Y.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
IPT Corp., Sunnyvale, Cal.
Jonard Inds. Corp., Bronx, N.Y.
Kahle Engrg. Co., Union City, N.J.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
Mercury Elctrns. Corp., Mineola, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Optimized Devices Inc., Pleasantville, N.Y.
Peschel Instrs., Cape Coral, Fla.
Sennheiser Elctrn. Corp., New York, NY
Simpson Elec. Co., Chicago, Ill.
Slaughter Co., Ardmore, Okla.
Sprague Elec. Co., No. Adams, Mass.
Teradyne, Inc., Boston, Mass.

Testers, Circuit—See Testers, Signal Tracing

Testers, Coil

AD Automation, Rochester, N.Y. Vol 1•386
Freed Transformer Co., Bklyn., N.Y. Vol 1•446,447
Slaughter Co., Ardmore, Okla. Vol 1•505
Anchor Specialty Mfg., Teterboro, N.J.
Avtron Mfg., Inc., Cleveland, Ohio
Beckman Instrs., Cedar Grove, N.J.
Collins Radio Co., Dallas, Tex.
Counterscan Systems, Sutton, Neb.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Ind'l. Test Equip., Clifton, NJ
J-Omega Co., Mountain View, Calif.
New Prod. Engrg., Wabash, Ind.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Zehntel, Inc., Concord, Cal.

Testers, Component Linearity

Ind'l. Test Equip., Clifton, NJ
IPT Corp., Sunnyvale, Cal.
London Co., Cleveland, Ohio
Microdyne Instruments Inc., Burlington, Mass.
Slaughter Co., Ardmore, Okla.
Solatron Enterprises, Inglewood, Calif.
Teledyne Philbrick, Dedham, Mass.

Testers, Computer Memory

Adar Assocs., Cambridge, Mass.
Chronetics, Inc., Mt. Vernon, N.Y.
Comaltest, Danbury, Conn.
Counterscan Systems, Sutton, Neb.
E-H Resch. Labs., Inc., Oakland, Cal.
Honeywell, Minneapolis, Minn.
Optimized Devices Inc., Pleasantville, N.Y.
Pioneer Magnetics, Santa Monica, Cal.
PSC Technology Inc., Glendale, Cal.
Systron Donner Computer Systems Div., Concord, Cal.
Tau-Tron, Inc., Lowell, Mass.
Zehntel, Inc., Concord, Cal.

Testers, Corona

Associated Resch., Chicago, Ill. Vol 1•388
Biddle, James G., Plymouth Meeting, Pa. ..... Vol 1•399
Bertan Assocs., Inc., Hicksville, N.Y.
Hipotronics, Inc., Brewster, N.Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
Peschel Instrs., Cape Coral, Fla.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Techsonics, El Prado, N.M.
Velonex, Santa Clara, Calif.

Testers, Diode

Kurz-Kasch Incorporated, Dayton, Ohio Vol 1•475; Vol 4•415*
Precision Standards Corp., Santa Ana, Cal. ..... Vol 1•495
Accurate Elctrns. Corp., Elyria, Ohio
Aerotronic Assocs., Inc., Contoocook, N.H.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
American Elctrn. Labs., Inc., Lansdale, Pa.
AMF Electical Prods., Alexandria, Va.
Automated Meas., Oakland, Calif.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Boonton Electronics Corp., Parsippany, N.J.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dynascan Corp., Chicago, Ill.
E-H Resch. Labs., Inc., Oakland, Cal.
Fairchild Sys. Technology, Palo Alto, Cal.
Heath Co., Benton Harbor, Mich.
Hickok Elect. Instr., Cleveland, Ohio
IPT Corp., Sunnyvale, Cal.
J-Omega Co., Mountain View, Calif.
Julie Research Lab., New York, N.Y.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Larson Aero Dev., Concord, Calif.
Luft Instrs., Inc., Lincoln, Mass.
Mastech, Inc., Syracuse, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Peschel Instrs., Cape Coral, Fla.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Tektronix, Inc., Beaverton, Ore.
Telvac Instr. Co., Van Nuys, Cal.
Teradyne, Inc., Boston, Mass.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Velonex, Santa Clara, Calif.

Testers, Electric Power—See Monitors, Power, A-C & D-C

Testers, Encoder

Astrosystems, Inc., Lake Success, N.Y.
Beckman Instrs., Cedar Grove, N.J.
Counterscan Systems, Sutton, Neb.
Fork Standards, W. Chicago, Ill.
NES, Inc., Itasca, Ill.
Norden Div., Norwalk, Conn.
Theta Instr. Corp., Fairfield, N.J.
Zehntel, Inc., Concord, Cal.

Testers, Ground Resistance—See Meters, Ohm

Testers, Hardness

Hacker Instrs., Inc., Fairfield, N.J.
Opto-Metric Tools, Rockleigh, N.J.
Pacific Transducer Corp., Los Angeles, Calif.
Thomas & Betts Co., Elizabeth, N.J.

Testers, Hi-Pot—See Testers, Insulation Breakdown

Testers, Insulation Breakdown

Associated Resch., Chicago, Ill. Vol 1•388
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Freed Transformer Co., Bklyn., N.Y. Vol 1•444,447
Hipotronics, Inc., Brewster, N.Y. Vol 1•454,455
Kilovolt Corp., Hackensack, N.J. Vol 1•756,757
Megavolt, Inc., New York, N.Y. Vol 1•761
Slaughter Co., Ardmore, Okla. Vol 1•504
Advanced Kinetics, Costa Mesa, Calif.
Anchor Specialty Mfg., Teterboro, N.J.
Austin Elctrns., Roselle, N.J.
Automatic Production Systems Inc., Pennsauken, N.J.
Automation Dynamics, Northvale, N.J.
Avtron Mfg., Inc., Cleveland, Ohio
Beckman Instrs., Cedar Grove, N.J.
Bendix Corp., Sidney, N.Y.
Bertan Assocs., Inc., Hicksville, N.Y.
Blue M Engrg. Co., Blue Island, Ill.
Cablemaster Div., No. Hollywood, Cal.
Cincinnati Sub-Zero Prods., Cincinnati, Ohio
Cober Elctrns., Inc., Stamford, Conn.
Cole Instrument Corp., Costa Mesa, Cal.
Davidson Elctrn. Dev. Co., Erie, Pa.
Dielectric Instr. Corp., Pittsburgh, Pa.
Dit-MCO International, Kansas City, Mo.
Energy Systems, Palo Alto, Cal.
GAR Enterprises, Pasadena, Cal.
Grand Transformers, Grand Haven, Mich.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Ind'l. Test Equip., Clifton, NJ
ITT Jennings, Instrus. & Systems, San Jose, Calif.
Janco Corp., Burbank, Cal.
Japanese Prods. Corp., New Rochelle, N. Y.
Kahle Engrg. Co., Union City, N.J.
Opad Elec. Co., Inc., New York, N.Y.
Penn Airborne Prods., Southampton, Pa.
Peschel Instrs., Cape Coral, Fla.
Rohde & Schwarz Sls., Passaic, N.J.
Sotcher Measurement, Cupertino, Cal.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Sticht, Herman H. Co., Inc., New York, N.Y.
T-Bar Inc., Wilton, Conn.
Universal Voltronics Corp., Mt. Kisco, N.Y.
Velonex, Santa Clara, Calif.

Testers, Integrated Circuit (Automatic)

Precision Standards Corp., Santa Ana, Cal. ..... Vol 1•495
Adar Assocs., Cambridge, Mass.
Automated Meas., Oakland, Calif.
Automatic Production Systems Inc., Pennsauken, N.J.
Automedia, Inc., Sunnyvale, Cal.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bulova Watch Co., Valley Stream, N.Y.
CGS Units, Inc., Rochester, N.Y.
Comaltest, Danbury, Conn.
Counterscan Systems, Sutton, Neb.
Datatron, Inc., Santa Ana, Cal
Digital Gen'l. Corp., Cleveland, Ohio
Dit-MCO International, Kansas City, Mo.
E-H Resch. Labs., Inc., Oakland, Cal.
Fairchild Sys. Technology, Palo Alto, Cal.
General Radio Co., Concord, Mass.
General Rand Corp., Edison, N.J.
Headway Research, Inc., Garland, Tex.
IPT Corp., Sunnyvale, Cal.
Julie Research Lab., New York, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Microdyne Instruments Inc., Burlington, Mass.
NES, Inc., Itasca, Ill.
Optimized Devices Inc., Pleasantville, N.Y.
PSC Technology Inc., Glendale, Cal.
Pylon Co., Inc., Attleboro, Mass.
Quan-Tech, Whippany, N.J.
Singer Co., Little Falls, N.J.
Systems Instrs. Resch., Inc., Atlanta, Ga.
Tektronix, Inc., Beaverton, Ore.
Telectro Sys. Corp., Corona, N.Y.
Teledyne Philbrick, Dedham, Mass.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Dallas, Tex.
Texas Instruments, Inc., Houston, Tex.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Zehntel, Inc., Concord, Cal.

Testers, Integrated Circuit (Manual)

Kurz-Kasch Incorporated, Dayton, Ohio Vol 1•475; Vol 4•415*
Adar Assocs., Cambridge, Mass.
Applied Control Co., Fairfield, N.J.
A P Products, Inc., Painesville, Ohio
Automatic Production Systems Inc., Pennsauken, N.J.
Automedia, Inc., Sunnyvale, Cal.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
CGS Units, Inc., Rochester, N.Y.
Circon Corp., Santa Barbara, Ca.
Comaltest, Danbury, Conn.
Dataprobe, Inc., So. Hackensack, N.J.
El Instruments, Derby, Conn.
Fairchild Sys. Technology, Palo Alto, Cal.
General Radio Co., Concord, Mass.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
IPT Corp., Sunnyvale, Cal.
Microdyne Instruments Inc., Burlington, Mass.
Nu-Concept Computer Sys., Norristown, Pa.
Optimized Devices Inc., Pleasantville, N.Y.
Ostby & Barton Co., Providence, R.I.
Precision Standards Corp., Santa Ana, Cal.
Pylon Co., Inc., Attleboro, Mass.
Quan-Tech, Whippany, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Spectrum Dynamics, Inc., Ft. Lauderdale, Fla.
Tektronix, Inc., Beaverton, Ore.
Telectro Sys. Corp., Corona, N.Y.
Teledyne Philbrick, Dedham, Mass.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Dallas, Tex.

Testers, Life, Component

Aerotronic Assocs., Inc., Contoocook, N.H.
Austin Elctrns., Roselle, N.J.
Barnes & Reinecke, Inc., Chicago, Ill.
Blue M Engrg. Co., Blue Island, Ill.
Cole Instrument Corp., Costa Mesa, Cal.
Custom Sci. Instrs., Inc., Whippany, N.J.
Davidson Elctrn. Dev. Co., Erie, Pa.
Delta Design, San Diego, Cal
General Radio Co., Concord, Mass.
Jade Corp., Huntingdon Valley, Pa.
Kilovolt Corp., Hackensack, N.J.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Megavolt, Inc., New York, N.Y.
Micro Instr. Co., Hawthorne, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Solatron Enterprises, Inglewood, Calif.
Wakefield Engrg., Inc., Systems Div., Wakefield, Mass.

Testers, Logic Card

Adar Assocs., Cambridge, Mass.
Alco Elctrn. Prods., North Andover, Mass.
A P Products, Inc., Painesville, Ohio
Austin Elctrns., Roselle, N.J.
Automated Meas., Oakland, Calif.
Automatic Production Systems Inc., Pennsauken, N.J.
Automation Dynamics, Northvale, N.J.
Automedia, Inc., Sunnyvale, Cal.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Comaltest, Danbury, Conn.
Computer Automation, Inc., Irvine, Cal.
Controlcraft Corp., West Chicago, Ill.
Dataprobe, Inc., So. Hackensack, N.J.
Datatron, Inc., Santa Ana, Cal
Davidson Elctrn. Dev. Co., Erie, Pa.
Digital Gen'l. Corp., Cleveland, Ohio
Dit-MCO International, Kansas City, Mo.
Dytro Corp., Hicksville, N.Y.
Epsco, Inc., Westwood, Mass.
Fairchild Sys. Technology, Palo Alto, Cal.
General Radio Co., Concord, Mass.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Marconi Instrs., Englewood, N.J.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Monitor Systems, Ft. Washington, Pa
NES, Inc., Itasca, Ill.
Optimized Devices Inc., Pleasantville, N.Y.
Program Data Co., Carson, Cal.
Proto Matic Co., Cincinnati,, Ohio
PSC Technology Inc., Glendale, Cal.
Systems Instrs. Resch., Inc., Atlanta, Ga.
Tau-Tron, Inc., Lowell, Mass.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Inc., Houston, Tex.
Thermalloy Co., Inc., Dallas, Tex.
Zehntel, Inc., Concord, Cal.

Testers, LSI (Automatic)

AD Automation, Rochester, N.Y. Vol 1•386
Kurz-Kasch Incorporated, Dayton, Ohio Vol 1•475
Adar Assocs., Cambridge, Mass.
Automated Meas., Oakland, Calif.
Comaltest, Danbury, Conn.
Computer Automation, Inc., Irvine, Cal.
Counterscan Systems, Sutton, Neb.
Datatron, Inc., Santa Ana, Cal
Digital Gen'l. Corp., Cleveland, Ohio
E-H Resch. Labs., Inc., Oakland, Cal.
Fairchild Sys. Technology, Palo Alto, Cal.
IPT Corp., Sunnyvale, Cal.
Microdyne Instruments Inc., Burlington, Mass.
NES, Inc., Itasca, Ill.
Optimized Devices Inc., Pleasantville, N.Y.
Proto Matic Co., Cincinnati,, Ohio
PSC Technology Inc., Glendale, Cal.
Systems Instrs. Resch., Inc., Atlanta, Ga.
Tau-Tron, Inc., Lowell, Mass.
Tektronix, Inc., Beaverton, Ore.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Inc., Houston, Tex.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Zehntel, Inc., Concord, Cal.

Testers, Magnetic Core

Chronetics, Inc., Mt. Vernon, N.Y.
E-H Resch. Labs., Inc., Oakland, Cal.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
LDJ Electronics, Troy, Mich.
Magnetic Metals Co., Camden, N.J.
Shallcross, Selma, N.C.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Systron Donner Computer Systems Div., Concord, Cal.

Testers, Magnetron

Cober Elctrns., Inc., Stamford, Conn.
Energy Systems, Palo Alto, Cal.
Henry Prods. Co., Inc., Inwood, N.Y.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.

Testers, Material

Acromag, Inc., Wixom, Mich.
Associated Resch., Chicago, Ill.
Atlas Electric Devices, Chicago, Ill.
Automation Inds., Danbury, Conn.
Beckman Instrs., Cedar Grove, N.J.
Chatillon John & Sons, Kew Gardens, N.Y.
Custom Sci. Instrs., Inc., Whippany, N.J.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Electro Impulse, Inc., Red Bank, N.J.
Honeywell, Ft. Washington, Pa.
Kilovolt Corp., Hackensack, N.J.
LDJ Electronics, Troy, Mich.
Magnaflux Corp., Chicago, Ill.
Megavolt, Inc., New York, N.Y.
Ohio Semitronics, Columbus, Ohio
Peschel Instrs., Cape Coral, Fla.
RFL Inds., Instr. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Schaevitz Engrg., Pennsauken, N.J.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Thwing-Albert Instr. Co., Philadelphia, Pa.
O. S. Walker Co., Worcester, Mass.

Testers, Memory—See Testers, Computer Memory

Testers, Meter

Optimation, Inc., Chatsworth, Cal. Vol 1•492
Automation Dynamics, Northvale, N.J.
Corning Glass Works, Medfield, Mass.
Edison Elctrns. Div., Manchester, N.H.
Electro Sci. Inds., Portland, Ore.
Electronic Dev. Corp., Boston, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Holt Instr. Labs., Oconto, Wisc.
Ind'l. Test Equip., Clifton, NJ
Jewell Electrical Instrs., Manchester, N.H.
Jonard Inds. Corp., Bronx, N.Y.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
North Hills Elctrns., Inc., Glen Cove, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
Simpson Elec. Co., Chicago, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Weston Instruments, Inc., Newark, N.J.
Zehntel, Inc., Concord, Cal.

Testers, Microwave

Waveline, Inc., W. Caldwell, N.J. Vol 2•629
Weinschel Engrg. Co., Gaithersburg, Md. ..... Vol 1•534
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Alford Mfg. Co., Winchester, Mass.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Carco Elctrns., Menlo Park, Calif.
Cober Elctrns., Inc., Stamford, Conn.
Collins Radio Co., Dallas, Tex.
Electro Impulse, Inc., Red Bank, N.J.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
General Radio Co., Concord, Mass.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
Micro-Tel Corp., Baltimore, Md.
Microlab/FXR, Livingston, N.J.
Pacific Meas., Inc., Palo Alto, Calif.
Polarad Elctrn. Instrs., Lake Success, N.Y.
PRD Elctrns., Inc., Westbury, N.Y.
Rantec Div., Calabasas, Calif.
Scientific-Atlanta, Inc., Atlanta, Ga.
Singer Instrumentation Palo Alto Oper., Palo Alto, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Vari-L Co., Inc., Denver, Colo.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Wiltron Co., Palo Alto, Calif.
Zehntel, Inc., Concord, Cal.

Testers, Motor

Slaughter Co., Ardmore, Okla. Vol 1•505
Chatillon John & Sons, Kew Gardens, N.Y.
De Soto Elec. Prods., De Soto, Mo.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Scientific Columbus, Columbus, Ohio
Singer Co., Little Falls, N.J.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Zehntel, Inc., Concord, Cal.

Testers, Potentiometer

Advance Instr. Corp., Belmar, N. J.
Associated Resch., Chicago, Ill.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Biddle, James G., Plymouth Meeting, Pa.
Bristol Div, Waterbury, Conn
Computer Instrs., Hempstead, N.Y.
Dytro Corp., Hicksville, N.Y.
Electro Sci. Inds., Portland, Ore.
Freudenberg, B., Inc., New York, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Litton Inds., Mt. Vernon, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Penn Airborne Prods., Southampton, Pa.
Solatron Enterprises, Inglewood, Calif.
Taylor Instr. Process Control Div., Rochester, N.Y.
Zehntel, Inc., Concord, Cal.

Testers, Power Supply

Arnold Magnetics, Culver City, Cal.
Automation Dynamics, Northvale, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Del Electronics Corp., Mt. Vernon, N.Y.
Electronic Dev. Corp., Boston, Mass.
Hipotronics, Inc., Brewster, N.Y.
Julie Research Lab., New York, N.Y.
Kepco, Inc., Flushing, N.Y.
Kurz-Kasch Incorporated, Dayton, Ohio
Megavolt, Inc., New York, N.Y.
NH Research, Inc., Santa Ana, Calif.
Optimized Devices Inc., Pleasantville, N.Y.
Pacific Meas., Inc., Palo Alto, Calif.
Peschel Instrs., Cape Coral, Fla.
Universal Voltronics Corp., Mt. Kisco, N.Y.
Zehntel, Inc., Concord, Cal.

Testers, Pulse Jitter

Adar Assocs., Cambridge, Mass.
Wiltron Co., Palo Alto, Calif.

Testers, Radar

Bird Elctrn., Cleveland, Ohio
Cober Elctrns., Inc., Stamford, Conn.
Energy Systems, Palo Alto, Cal.
Epsco, Inc., Westwood, Mass.
Frequency Engrg. Labs., Farmingdale, N.J.
General Microwave Corp., Farmingdale, N.Y.
Kilovolt Corp., Hackensack, N.J.
Megavolt, Inc., New York, N.Y.
Melpar, Falls Church, Va.
Singer Co., Little Falls, N.J.
Tasker Systems, Chatsworth, Cal.
Vega Precision Labs., Vienna, Va.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Testers, Ratio Voltage

Biddle, James G., Plymouth Meeting, Pa.
Electro Sci. Inds., Portland, Ore.
General Resistance, Inc., Mt. Vernon, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Julie Research Lab., New York, N.Y.
NH Research, Inc., Santa Ana, Calif.
North Atlantic Inds., Plainview, N.Y.
RFL Inds., Instr. Div., Boonton, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Zehntel, Inc., Concord, Cal.

Testers, Relay

Anchor Specialty Mfg., Teterboro, N.J.
Artisan Elctrns. Corp., Parsippany, N.J.
Associated Resch., Chicago, Ill.
Avtron Mfg., Inc., Cleveland, Ohio
Counterscan Systems, Sutton, Neb.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
Dit-MCO International, Kansas City, Mo.
Freudenberg, B., Inc., New York, N.Y.
Hathaway Industries Inc., Tulsa, Okla.
Ind'l. Test Equip., Clifton, NJ
Jonard Inds. Corp., Bronx, N.Y.
Kurz-Kasch Incorporated, Dayton, Ohio
New Prod. Engrg., Wabash, Ind.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Ostby & Barton Co., Providence, R.I.
Qualco, Los Altos, Cal.
Sigma Instrs., Inc., Braintree, Mass.
Slaughter Co., Ardmore, Okla.
Solatron Enterprises, Inglewood, Calif.
Struthers-Dunn, Inc., Bettendorf, Iowa
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Teradyne, Inc., Boston, Mass.
Wilmar Elctrns. Inc., Torrance, Cal.
Zehntel, Inc., Concord, Cal.

Testers, Resistivity

W-F Products, Inc., Denver, Co. Vol 1•934
Associated Resch., Chicago, Ill.
Automation Dynamics, Northvale, N.J.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Boonton Elctrns., Parsippany, N.J.
Cosar Corp., Garland, Texas
Custom Sci. Instrs., Inc., Whippany, N.J.
General Radio Co., Concord, Mass.
Hipotronics, Inc., Brewster, N.Y.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Matheson Gas Products, East Rutherford, N.J.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Ostby & Barton Co., Providence, R.I.
Penn Airborne Prods., Southampton, Pa.
PSC Technology Inc., Glendale, Cal.
Rohde & Schwarz Sls., Passaic, N.J.
Shallcross, Selma, N.C.

Testers, Resistor

A. D. Data Sys., Inc., Rochester, N.Y.
Anchor Specialty Mfg., Teterboro, N.J.
Beckman Instrs., Cedar Grove, N.J.
Biddle, James G., Plymouth Meeting, Pa.
Boonton Elctrns., Parsippany, N.J.
Boonton Electronics Corp., Parsippany, N.J.
Davidson Elctrn. Dev. Co., Erie, Pa.
Electro Sci. Inds., Portland, Ore.
Freed Transformer Co., Bklyn., N.Y.
Freudenberg, B., Inc., New York, N.Y.
General Radio Co., Concord, Mass.
General Resistance, Inc., Mt. Vernon, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hickok Elect. Instr., Cleveland, Ohio
Ind'l. Test Equip., Clifton, NJ
IPT Corp., Sunnyvale, Cal.
Julie Research Lab., New York, N.Y.
Keithley Instrs., Inc., Cleveland, Ohio
Luft Instrs., Inc., Lincoln, Mass.
Mercury Elctrns. Corp., Mineola, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Penn Airborne Prods., Southampton, Pa.
Peschel Instrs., Cape Coral, Fla.
Quan-Tech, Whippany, N.J.
RFL Inds., Instr. Div., Boonton, N.J.
Shallcross, Selma, N.C.
Simpson Elec. Co., Chicago, Ill.
Slaughter Co., Ardmore, Okla.
Teradyne, Inc., Boston, Mass.

Testers, Servo—See Analyzers, Servo

Testers, Shock

Cincinnati Sub-Zero Prods., Cincinnati, Ohio ..... Vol 1•383
Blue M Engrg. Co., Blue Island, Ill.
Impact-O-Graph Corp., Bedford, Ohio
IMPACT-O-GRAPH Div., Bedford, Ohio
Jan Hardware Mfg. Co., Inc., Long Island City, N.Y.
L.A.B. Corp., Skaneateles, N.Y.
Larson Aero Dev., Concord, Calif.
Sotcher Measurement, Cupertino, Cal.
Spectral Dynamics Corp. San Diego, San Diego, Cal.

Testers, Short-Turn—See Testers, Coil

Testers, Signal Tracing

AD Automation, Rochester, N.Y. Vol 1•386
Counterscan Systems, Sutton, Neb. Vol 1•417
Kurz-Kasch Incorporated, Dayton, Ohio Vol 1•475
Vaco Prods. Co., Chicago, Ill. Vol 3•1242
Allied Elctrns., Chicago, Ill.
Automated Meas., Oakland, Calif.
Automation Dynamics, Northvale, N.J.
Barnes & Reinecke, Inc., Chicago, Ill.
Circon Corp., Santa Barbara, Ca.
Collins Radio Co., Dallas, Tex.
Comaltest, Danbury, Conn.
Computer Automation, Inc., Irvine, Cal.
Dataprobe, Inc., So. Hackensack, N.J.
Desco Mfg. Co., Glendale, Calif.
Dit-MCO International, Kansas City, Mo.
Dynascan Corp., Chicago, Ill.
Dytro Corp., Hicksville, N.Y.
Heath Co., Benton Harbor, Mich.
Hughes Aircraft Co., Ind'l. Prods. Div./Ind'l. Auto, Oceanside, Cal.
Hunter Tools, El Monte, Calif
Ideal Industries, Inc., Sycamore, Ill.
IE Mfg. Co., Chicago, Ill.
IPT Corp., Sunnyvale, Cal.
Jerrold Electronics Corp., Philadelphia, Pa.
Program Data Co., Carson, Cal.
PSC Technology Inc., Glendale, Cal.
Simpson Elec. Co., Chicago, Ill.
Systron-Donner Corp., Concord, Cal.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tektronix, Inc., Beaverton, Ore.
Teledyne Philbrick, Dedham, Mass.
Workman Elctrn. Prods., Inc., Sarasota, Fla.
Zehntel, Inc., Concord, Cal.

Testers, Solderability—See Machines, Solderability Testing

Testers, Spark

Henry Prods. Co., Inc., Inwood, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Slaughter Co., Ardmore, Okla.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.

Testers, Synchro/Resolver

Advance Instr. Corp., Belmar, N. J.
Astrosystems, Inc., Lake Success, N.Y.
Bendix Aerospace-Elctrns., Teterboro, N.J.
C & A Products, Inc., Woodside, N. Y.
Clifton Precision, Clifton Hgts., Pa.
Computer Conversions Corp., East Northport, N.Y.
Control Technology Co., L.I.C., N.Y.
ILC Data Device Corp., Hicksville, N.Y.
NH Research, Inc., Santa Ana, Calif.
North Atlantic Inds., Plainview, N.Y.
Singer Co., Little Falls, N.J.
Theta Instr. Corp., Fairfield, N.J.
Zehntel, Inc., Concord, Cal.

Testers, Tachometer

Advance Instr. Corp., Belmar, N. J.
New Era Products, Cleveland, Ohio
Singer Co., Little Falls, N.J.
Vibrac Corp., Chelmsford, Mass.
Zehntel, Inc., Concord, Cal.

Testers, Telephone - Also see Telephone Channel Test & Simulator Equipment

Comstron Corp., Richmond Hill, N.Y. Vol 1•500; Vol 2•577
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y. Vol 1•500; Vol 2•577
Communications Technology Corp., Los Angeles, Cal.
Computer Automation, Inc., Irvine, Cal.
Elgin Elctrns. Inc., Waterford, Pa.
Kurz-Kasch Incorporated, Dayton, Ohio
NES, Inc., Itasca, Ill.
Projects Unlimited, Inc., Dayton, Ohio
Voiceprint Laboratories Corp., Somerville, N. J.
Wiltron Co., Palo Alto, Calif.
Zehntel, Inc., Concord, Cal.

Testers, Teletypewriter

Re-el Circuits, Inc., Saddle Brook, N.J. Vol 1•320
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
NES, Inc., Itasca, Ill.

Testers, Thickness (All Types)

Bicron Elctrns. Co., Canaan, Conn.
Biddle, James G., Plymouth Meeting, Pa.
Chemical Etching Equip. & Supply, Alexandria, Va.
Custom Sci. Instrs., Inc., Whippany, N.J.
Edwards High Vacuum, Grand Island, N.Y.
Electron-Machine Corp., Umatilla, Fla.
Kaman Sciences Corp., Colorado Springs, Colo.
Kelk, George Ltd., Don Mills, Ont., Canada
Landis & Gyr, Inc., Elmsford, N.Y.
Lion Precision Corp, Newton, Mass.
Magnaflux Corp., Chicago, Ill.
Minnetech Labs, Minneapolis, Minn.
Sloan Technology Corp., Santa Barbara, Calif.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.

Testers, Torque

Anchor Specialty Mfg., Teterboro, N.J.
Applied Control Co., Fairfield, N.J.
B & F Instrs., Inc., Cornwells Hgts., Pa.
Bendix, Utica, N.Y.
BLH Elctrns., Inc., Waltham, Mass.
Bowmar/ALI, Inc., Acton, Mass.
Chatillon John & Sons, Kew Gardens, N.Y.
Cole-Parmer Instr. Co., Chicago, Ill.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Himmelstein, S. & Co., Elk Grove Village, Ill.
Jonard Inds. Corp., Bronx, N.Y.
McFadden Elctrns. Co., South Gate, Calif.
Owatonna Tool Co., Owatonna, Minn.
Power Instrs., Skokie, Ill.
Sunshine Sci. Instrs., Inc., Philadelphia, Pa.
Techni-Tool, Inc., Philadelphia, Pa.
Vibrac Corp., Chelmsford, Mass.
Waters Mfg., Inc., Wayland, Mass.
West Coast Resch. Corp., Los Angeles, Calif.
Zonic Tech. Labs., Cincinnati, Ohio

Testers, Tracking & Erosion Resistance (Insulation)

Beckman Instrs., Cedar Grove, N.J.
Guildline Instrs., Inc., Larchmont, N.Y.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
ITT Jennings, Instrus. & Systems, San Jose, Calif.

Testers, Transistor

Hickok Elect. Instr., Cleveland, Ohio Vol 4•411*
Kurz-Kasch Incorporated, Dayton, Ohio Vol 1•475; Vol 4•415*
Precision Standards Corp., Santa Ana, Cal. ..... Vol 1•495
American Elctrn. Labs., Inc., Lansdale, Pa.
Automated Meas., Oakland, Calif.
Beckman Instrs., (AISSD), Fullerton, Cal.
Bulova Watch Co., Valley Stream, N.Y.
Custom Sci. Instrs., Inc., Whippany, N.J.
Desco Mfg. Co., Glendale, Calif.
Dynascan Corp., Chicago, Ill.
Fairchild Sys. Technology, Palo Alto, Cal.
General Microwave Corp., Farmingdale, N.Y.
Gralex Inds., Div. Gen. Microwave, Farmingdale, N.Y.
Heath Co., Benton Harbor, Mich.
IPT Corp., Sunnyvale, Cal.
MacDonald & Co., Glendale, Calif.
Mastech, Inc., Syracuse, N.Y.
Optimized Devices Inc., Pleasantville, N.Y.
Quan-Tech, Whippany, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Spectra Sonics, Ogden, Utah
Systron-Donner Concord Instr. Div., Concord, Cal.
Tektronix, Inc., Beaverton, Ore.
Telvac Instr. Co., Van Nuys, Cal.
Teradyne, Inc., Boston, Mass.
Texas Instruments, Dallas, Tex.
Trio-Tech, Inc. of Calif., Burbank, Calif.
Triplett Corp., Bluffton, Ohio
Velonex, Santa Clara, Calif.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Testers, Transmission & Delay

Comstron Corp., Richmond Hill, N.Y. Vol 1•500
Marconi Instrs., Englewood, N.J. Vol 1•484
Seg Elctrns. Sub. Comstron Corp., Richmond Hill, N.Y. ..... Vol 1•500
Bowmar/ALI, Inc., Acton, Mass.
Digitech Data Inds., Inc., Ridgefield, Conn.
Digitech Data Inds., Inc., Ridgefield, Conn.
Dranetz Engrg. Labs., So. Plainfield, N.J.
Edison Elctrns. Div., Manchester, N.H.
International Data Sciences, Providence, R.I.
Phelps Dodge Comm., North Haven, Conn.
Railway Comm., Raytown, Mo.
Rantec Div., Calabasas, Calif.
Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
Vari-L Co., Inc., Denver, Colo.
Wiltron Co., Palo Alto, Calif.
Zehntel, Inc., Concord, Cal.

Testers, Tube

Cober Elctrns., Inc., Stamford, Conn. Vol 1•545
Hickok Elect. Instr., Cleveland, Ohio Vol 4•411*
Venus Scientific, Farmingdale, N.Y. Vol 1•929
Dynascan Corp., Chicago, Ill.
GTE Sylvania Inc., Seneca Falls, N.Y.
Heath Co., Benton Harbor, Mich.
Henry Prods. Co., Inc., Inwood, N.Y.
Lattin Radio Labs., Owensboro, Ky.
Mercury Elctrns. Corp., Mineola, N.Y.
RCA Elctrns. Comps., Harrison, N.J.
RIL Elctrns., Inc., Southampton, Pa.
Scientronics, Barrington, N.J.
Seco Elctrns. Corp., Hopkins, Minn.

Testers, Vibration—See Vibration Test Systems

Testers, Voltage Breakdown

Associated Resch., Chicago, Ill. Vol 1•388,389
Hipotronics, Inc., Brewster, N.Y. Vol 1•455
ITT Jennings, San Jose, Cal Vol 1•458,459
ITT Jennings, Instrus. & Systems, San Jose, Calif. ..... Vol 1•458,459
Slaughter Co., Ardmore, Okla. Vol 1•505
Advanced Kinetics, Costa Mesa, Calif.
Aerotronic Assocs., Inc., Contoocook, N.H.
Automatic Production Systems Inc., Pennsauken, N.J.
Avtron Mfg., Inc., Cleveland, Ohio
Beckman Instrs., Cedar Grove, N.J.
Bendix Corp., Sidney, N.Y.
Bertan Assocs., Inc., Hicksville, N.Y.
Biddle, James G., Plymouth Meeting, Pa.
Cober Elctrns., Inc., Stamford, Conn.
Cole Instrument Corp., Costa Mesa, Cal.
Counterscan Systems, Sutton, Neb.
Del Electronics Corp., Mt. Vernon, N.Y.
Electrical Instr. Svc., Inc., Mt. Vernon, N.Y.
Hughes Aircraft Co., Ind'l. Prods. Div. FACT Sys., Los Angeles, Cal.
IPT Corp., Sunnyvale, Cal.
Kahle Engrg. Co., Union City, N.J.
Kikusui Elctrns. Corp., Kawasaki City, Kanagawa-Pref., Japan
Kilovolt Corp., Hackensack, N.J.
Malco, A Microdot Co., Inc., Chicago, Ill.
Megavolt, Inc., New York, N.Y.
Micro Instr. Co., Hawthorne, Cal.
Opad Elec. Co., Inc., New York, N.Y.
Peschel Instrs., Cape Coral, Fla.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Tektronix, Inc., Beaverton, Ore.
Teradyne, Inc., Boston, Mass.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Velonex, Santa Clara, Calif.

Testing, Environmental—See Services, Environmental Testing

Thermistors

Carborundum Co., Niagara Falls, N.Y. Vol 2•1157-1159
Fenwal Elctrns., Framingham, Mass. Vol 2•1162
Keystone Carbon Co., St. Marys, Pa. Vol 2•1165-1169
NL Inds., Inc., Hightstown, N.J. Vol 2•1170,1171
Omega Engrg., Inc., Stamford, Conn. Vol 2•1173
Triac Elctrn. Sys., Forest Hills, N. Y. Vol 2•371,375
Arcidy Assocs., Manchester, N. H.
Bacharach Instr. Co., Pittsburgh, Pa.
Cal-R, Inc., Capacitor Div., Santa Monica, Cal.
Cal-R, Inc., Santa Monica, Cal.
Cal-R, Inc., Thermonetics Div., Santa Monica, Cal.
Carbone Corp., Boonton, N.J.
Ceramic Magnetics, Inc., Fairfield, N.J.
Conax Corp., Buffalo, N.Y.
Cox & Co., Inc., New York, N.Y.
Electro Mats. Corp. Amer., Mamaroneck, N.Y.
GC Electronics, Rockford, Ill.
General Microwave Corp., Farmingdale, N.Y.
Gulton Inds., Inc., Metuchen, N.J.
Honeywell, Ft. Washington, Pa.
Interelectronics Corp., Congers, N.Y.
Mepco, Inc., Morristown, N.J.
Murata Corp. of America, Elmsford, N.Y.
Murata Mfg. Co. Ltd., Kyoto, Japan
P.E.T., Inc., Pittsburgh, Pa.
PRD Elctrns., Inc., Westbury, N.Y.
RDF Corp., Hudson, N.H.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Rodan Ind's., Anaheim, Ca.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Texas Instruments, Dallas, Tex.
Texas Instruments, Attleboro, Mass.
Thermometrics, Inc., Edison, N.J.
United Elec. Controls Co., Watertown, Mass.
United Sys. Corp., Dayton, Ohio
Victory Engrg. Corp., Springfield, N.J.
Weinschel Engrg. Co., Gaithersburg, Md.
Workman Elctrn. Prods., Inc., Sarasota, Fla.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

Thermo Compression Bonding Equipment

Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.

Thermocouples, Elements & Accessories

Modutec, Inc., Norwalk, Conn. Vol 1•486-489
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 2•358
Omega Engrg., Inc., Stamford, Conn. Vol 2•1172,1173
PPM, Inc., Bedford, Ohio ..... Vol 1•493
Ainor Instr. Co., Chicago, Ill.
Amersil, Inc., Hillside, N.J.
Amperex Electronic Corp., Hicksville, N.Y.
Amphenol Connector Div., Broadview, Ill.
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill.
ARI Inds., Inc., Franklin Pk., Ill.
Bailey Instrs., Inc., Saddle Brook, N.J.
Bailey Meter Co., Wickliffe, Ohio
Ballantine Laboratories, Inc., Boonton,, N. J.
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Barker Elec. Sls., Ship Bottom, NJ
Beckman Instrs., (AISSD), Fullerton, Cal.
Best Elecs. Div., Seattle, Wash.
Bram Metallurgical-Chem. Co., Phila., Pa.
Bristol Div, Waterbury, Conn
Burns Engrg., Inc., Minneapolis, Minn.
Conax Corp., Buffalo, N.Y.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
Foxboro Co., Foxboro, Mass.
Fredericks Co., Huntingdon Valley, Pa.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
General Lab. Assocs., Norwich, N.Y.
Honeywell, Ft. Washington, Pa.
Hy-Cal Engrg., Santa Fe Springs, Cal.
J-B-T Instrs., Inc., New Haven, Conn.
Leeds & Northrup Corp., No. Wales, Pa.
Leico Inds., Inc., New York, N.Y.
Marlin Mfg. Corp., Cleveland, Ohio
Materials for Elctrns., Inc., Jamaica, N.Y.
National Beryllia Corp., Haskell, N.J.
NES, Inc., Itasca, Ill.
Nuclear Sys., Garland, Tex.
RDF Corp., Hudson, N.H.
Revere Elctrn. Div., Wallingford, Conn.
Recorder Systems Div., E. Greenwich, R.I.
Sigma Instrs., Inc., Braintree, Mass.
Simpson Elec. Co., Chicago, Ill.
Syscon Int'l., Inc., So. Bend, Ind.
Texas Instruments, Attleboro, Mass.
Thermal Sys., Los Angeles, Cal.
Thermo Elec. Co., Inc., Saddle Brook, N.J.
United Elec. Controls Co., Watertown, Mass.
United Sensor & Control Co., Watertown, Mass.
Vacuum Prods., Inc., Mt. Vernon, N.Y.
Watlow Elec. Mfg. Co., St. Louis, Mo.
Weston Instruments, Inc., Newark, N.J.
Westronics, Inc., Ft. Worth, Tex.

Thermocouple Devices & Materials—See Cooling/Heating Modules, Thermoelectric

Thermoelectric Generators—See Generators, Thermoelectric

Thermometers, Electronic (All Types)—See Meters, Temperature

Thermometers, Resistance

Elmwood Sensors, Inc., Cranston, R.I. Vol 2•1161
Omega Engrg., Inc., Stamford, Conn. Vol 2•1173

Thermopiles

Bailey Instrs., Inc., Saddle Brook, N.J.
Barnes Engrg. Co., Stamford, Conn.
General Microwave Corp., Farmingdale, N.Y.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Leico Inds., Inc., New York, N.Y.
Omega Engrg., Inc., Stamford, Conn.
RDF Corp., Hudson, N.H.
Santa Barbara Resch. Ctr., Goleta, Calif.
Syscon Int'l., Inc., So. Bend, Ind.
VirTis Co., Gardiner, N.Y.

Thermostats-Also See Switches, Thermally Actuated; Controls, Temperature

Burling Instr. Co., Chatham, N.J.
Chatham Controls Corp., Chatham, N.J.
Cox & Co., Inc., New York, N.Y.
Elmwood Sensors, Inc., Cranston, R.I.
Essex International, Mansfield, Ohio
Fenwal, Inc., Ashland, Mass.
General Electric, Shelbyville, Ind.
Honeywell, Mpls., Minn.
Princo Instrs., Southampton, Pa.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Control Prods. Div., Attleboro, Mass.
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Triac Elctrn. Sys., Forest Hills, N. Y.
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FMC Corp., Homer City, Pa.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
International Rectifier, El Segundo, Cal.
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Sarkes Tarzian, Inc., Bloomington, Ind.
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Autronics Corp., Pasadena, Calif.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bristol Saybrook Co., Old Saybrook, Conn.
Controlcraft Corp., West Chicago, Ill.
Cramer Division, Old Saybrook, Conn.
Datametrics Inc., Wilmington, Mass.
Di/An Controls, Inc., Boston, Mass.
Durant Digital Instrs., Watertown, Wisc.
Eagle Signal, Davenport, Iowa
Eldorado Electrodata, Concord, Cal.
ENM Co., Chicago, Ill.
ESE, Inglewood, Cal.
Fork Standards, W. Chicago, Ill.
General Elec., W. Lynn, Mass.
Guardian California, Culver City, Cal.
Harshaw Chem. Co., Cleveland, Ohio
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Hi-G, Windsor Locks, Conn.
IEC Electronics Corp., E. Rochester, N.Y.
Industrial Timer Corp., Parsippany, N.J.
Kessler-Ellis Prods., Atlantic Highlands, N.J.
Logiconcepts Inc., Los Alamitos, Cal.
Magnecraft Elec., Chicago, Ill.
Master Elctrn. Controls, Santa Monica, Cal.
MKC Elctrns. Corp., Kansas City, Kans.
NES, Inc., Itasca, Ill.
North American Philips Controls Corp., Cheshire, Conn.
PPM, Inc., Bedford, Ohio
Precision Timer Co., Westbrook, Conn.
Presin Co., Inc., Shelton, Conn.
Raymond Controls Corp., Middletown, Conn.
Scientronics, Barrington, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Signetics. Corp., Sunnyvale, Calif.
Soltec Corp., No. Hollywood, Cal.
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Bettendorf, Iowa
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Systron-Donner Datapulse Div., Culver City, Cal.
Systron-Donner Kruse Elctrns. Sub., Sunnyvale, Cal.
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Tektronix, Inc., Beaverton, Ore.
Tempo Instrument, Inc., Plainview, N.Y.
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Connor-Winfield Corp., West Chicago, Ill.
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Cramer Division, Old Saybrook, Conn.
Eagle Signal, Davenport, Iowa
Electronic Research Co., Shawnee Mission, Kan.
ESE, Inglewood, Cal.
General Electric, Shelbyville, Ind.
Hartman Electrical Mfg., Mansfield, Ohio
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Industrial Timer Corp., Parsippany, N.J.
Ingraham Inds., Controls Div., Elizabethtown, Ky.
Landis & Gyr, Inc., Elmsford, N.Y.
Logiconcepts Inc., Los Alamitos, Cal.
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Master Elctrn. Controls, Santa Monica, Cal.
Meson Electronics Co. Inc., Rochester, N. Y.
MKC Elctrns. Corp., Kansas City, Kans.
Potter & Brumfield, Princeton, Ind.
Raymond Controls Corp., Middletown, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Ripley Co., Inc., Middletown, Conn.
Signetics. Corp., Sunnyvale, Calif.
Singer Co., Schiller Park, Ill.
Square D Co., Park Ridge, Ill.
Syracuse Elctrns. Corp., Syracuse, N.Y.
Systron-Donner Concord Instr. Div., Concord, Cal.
Tempo Instrument, Inc., Plainview, N.Y.
Tenor Co., Inc., New Berlin, Wisc.
Triac Elctrn. Sys., Forest Hills, N. Y.
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North American Philips Controls Corp., Cheshire, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Ripley Co., Inc., Middletown, Conn.
Sigma Instrs., Inc., Braintree, Mass.
Struthers-Dunn, Inc., Pitman, N.J.
Tektronix, Inc., Beaverton, Ore.
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Artisan Elctrns. Corp., Parsippany, N.J.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Autronics Corp., Pasadena, Calif.
Bristol Saybrook Co., Old Saybrook, Conn.
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Compuline Corp., Paoli, Pa.
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Farmer Elec. Prods. Co., Inc., Natick, Mass.
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IEC Electronics Corp., E. Rochester, N.Y.
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Ingraham Inds., Controls Div., Elizabethtown, Ky.
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Lab-Line Instrs., Inc., Melrose Park, Ill.
Landis & Gyr, Inc., Elmsford, N.Y.
Ledex, Inc., Dayton, Ohio
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Lisk, G.W. Co., Clifton Springs, N.Y.
Logiconcepts Inc., Los Alamitos, Cal.
Magnecraft Elec., Chicago, Ill.
Mallory Timers, Indpls., Ind.
Master Elctrn. Controls, Santa Monica, Cal.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Meloy Laboratories Inc., Springfield, Va.
Meson Electronics Co. Inc., Rochester, N. Y.
Midtex/Aemco, Mankato, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
NES, Inc., Itasca, Ill.
Panametrics Inc., Waltham, Mass.
Paragon Elec. Co., Two Rivers, Wisc.
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PPM, Inc., Bedford, Ohio
Precision Dynamics Corp., Burbank, Cal.
Raymond Controls Corp., Middletown, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Ripley Co., Inc., Middletown, Conn.
Sangamo Elec. Co., Springfield, Ill.
Scientronics, Barrington, N.J.
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Signetics. Corp., Sunnyvale, Calif.
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Eagle Signal, Davenport, Iowa
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Electronic Research Co., Shawnee Mission, Kan.
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Relay Specialties Inc., Fair Lawn, N.J.
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Bendix, Utica, N.Y.
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Bulova Watch Co., Valley Stream, N.Y.
Bulova Watch Co., Flushing, N.Y.
Burr-Brown Resch. Corp., Tucson, Ariz.
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Controlcraft Corp., West Chicago, Ill.
Controls Div., Elizabeth, N.J.
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Davidson Elctrn. Dev. Co., Erie, Pa.
Deltrol Controls, Milwaukee, Wisc.
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Eagle Signal, Davenport, Iowa
Electro-Module, Inc., Pomona, Cal.
Electronic Research Co., Shawnee Mission, Kan.
ESE, Inglewood, Cal.
Fairchild Space & Defense Sys., Syosset, N.Y.
Fork Standards, W. Chicago, Ill.
Furnas Elec. Co., Batavia, Ill.
Guardian California, Culver City, Cal.
Harshaw Chem. Co., Cleveland, Ohio
Heath Co., Benton Harbor, Mich.
Heitz, Karl, Inc., New York, N.Y.
Hi-G, Windsor Locks, Conn.
Ind'l. Control Co., Farmingdale, N.Y.
Industrial Timer Corp., Parsippany, N.J.
Ingraham Inds., Controls Div., Elizabethtown, Ky.
Landis & Gyr, Inc., Elmsford, N.Y.
Ledex, Inc., Dayton, Ohio
Logiconcepts Inc., Los Alamitos, Cal.
Logitek, Inc., Farmingdale, N.Y.
Magnecraft Elec., Chicago, Ill.
Mallory Timers, Indpls., Ind.
Master Elctrn. Controls, Santa Monica, Cal.
Midtex/Aemco, Mankato, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
NES, Inc., Itasca, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Paragon Elec. Co., Two Rivers, Wisc.
PPM, Inc., Bedford, Ohio
Precision Dynamics Corp., Burbank, Cal.
Precision Mechanisms Corp., Westbury, N.Y.
Precision Timer Co., Westbrook, Conn.
Raymond Controls Corp., Middletown, Conn.
Relay Specialties Inc., Fair Lawn, N.J.
Ripley Co., Inc., Middletown, Conn.
Scientronics, Barrington, N.J.
Signetics. Corp., Sunnyvale, Calif.
Singer Co., Schiller Park, Ill.
Square D Co., Park Ridge, Ill.
Struthers-Dunn, Inc., Bettendorf, Iowa
Syracuse Elctrns. Corp., Syracuse, N.Y.
Taylor Instr. Process Control Div., Rochester, N.Y.
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Connor-Winfield Corp., West Chicago, Ill.
Controlcraft Corp., West Chicago, Ill.
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Cramer Division, Old Saybrook, Conn.
Curtis Dev. & Mfg., Milwaukee, Wisc.
Cutler-Hammer, Milwaukee, Wisc.
Datum, Inc., Anaheim, Calif.
Digital Equip. Corp., Maynard, Mass.
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Eagle Signal, Davenport, Iowa
Electro-Module, Inc., Pomona, Cal.
Electronic Research Co., Shawnee Mission, Kan.
Farmer Elec. Prods. Co., Inc., Natick, Mass.
Ferwalt, W.H., Inc., Lapwal, Idaho
Fork Standards, W. Chicago, Ill.
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Guardian California, Culver City, Cal.
Harrel, Inc., E. Norwalk, Conn.
Hartman Electrical Mfg., Mansfield, Ohio
Heath Co., Benton Harbor, Mich.
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IEC Electronics Corp., E. Rochester, N.Y.
Intermatic, Spring Grove, Ill.
Jordan Controls, Milwaukee, Wisc.
Landis & Gyr, Inc., Elmsford, N.Y.
Ledex, Inc., Dayton, Ohio
Logiconcepts Inc., Los Alamitos, Cal.
Logitek, Inc., Farmingdale, N.Y.
Magnecraft Elec., Chicago, Ill.
Mallory Timers, Indpls., Ind.
Master Elctrn. Controls, Santa Monica, Cal.
Meson Electronics Co. Inc., Rochester, N.Y.
Micro Components Corp., Cranston, R.I.
Midland Standard Inc., Elgin, Ill.
Midtex/Aemco, Mankato, Minn.
MKC Elctrns. Corp., Kansas City, Kans.
National Semiconductor, Santa Clara, Cal.
NES, Inc., Itasca, Ill.
North American Philips Controls Corp., Cheshire, Conn.
Potter & Brumfield, Princeton, Ind.
Precision Dynamics Corp., Burbank, Cal.
Precision Timer Co., Westbrook, Conn.
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Relay Specialties Inc., Fair Lawn, N.J.
Ripley Co., Inc., Middletown, Conn.
Signetics. Corp., Sunnyvale, Calif.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Square D Co., Park Ridge, Ill.
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Struthers-Dunn, Inc., Bettendorf, Iowa
Syracuse Elctrns. Corp., Syracuse, N.Y.
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Erikson Specialized Tool Co., Pico-Rivera, Cal.
General Hardware Mfg. Co., New York, N.Y.
Hunter Tools, El Monte, Calif
Kawecki Berylco Inds., Inc., New York, N.Y.
Keystone Elctrns. Corp., New York, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Moody Tools, Inc., Providence, R.I.
Neuses, P.K., Inc., Arlington Hgts., Ill.
Skyo Industries Inc., Deer Park, N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Telvac Instr. Co., Van Nuys, Cal.
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UNGAR, Compton, Calif.
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Vaco Prods. Co., Chicago, Ill.
X-Acto, Long Island City, N.Y.
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GC Electronics, Rockford, Ill. Vol 3•679
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Erikson Specialized Tool Co., Pico-Rivera, Cal.
Keystone Elctrns. Corp., New York, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Richco Plastic Co., Chicago, Ill.
Skyo Industries Inc., Deer Park, N.Y.
Smith, Herman H., Inc., Bklyn., N.Y.
Syntronic Instrs., Inc., Addison, Ill.
Techni-Tool, Inc., Philadelphia, Pa.
Vaco Prods. Co., Chicago, Ill.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

Tools & Kits, Contact Insertion/Removal

Amphenol Connector Div., Broadview, Ill. Vol 3•572,626,627
Amphenol Sales Div., Bunker Ramo Corp., Broadview, Ill. Vol 3•572,626,627
Mac Panel Co., High Pt., N.C. Vol 3•701
Robinson-Nugent, New Albany, Ind. Vol 4•380*
Mann, Henry Inc., Feasterville, Pa.
Solder Removal Co., Covina, Cal.
Vero Electronics, Inc., Hauppauge, N.Y.
Viking Inds., Inc., Chatsworth, Calif.

Tools, Connector

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Amp Inc., Harrisburg, Pa.
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Molex Inc., Lisle, Ill.
Priority Services, Burbank, Cal.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Thomas & Betts Co., Elizabeth, N.J.
3M Co., St. Paul, Minn.
Viking Inds., Inc., Chatsworth, Calif.

Tools, Crimping & Swaging

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ETC, Div. ITT, Cleveland, Ohio Vol 3•665
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Americon Microwave Inds., Inc., Waltham, Mass.
Amp Inc., Harrisburg, Pa.
Amphenol Cadre Div., Endicott, N.Y..
Amphenol Ind'l. Div., Chicago, Ill.
Ark-Les Switch Corp., Watertown, Mass.
Berg Electronics, New Cumberland, Pa.
Birnbach Co., Inc., Freeport, N.Y.
Black & Webster, Inc., Waltham, Mass.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
Burndy Corp., Norwalk, Conn.
Cambridge Thermionic, Cambridge, Mass
Circon Corp., Santa Barbara, Ca.
Concord Elctrns., New York, N.Y.
Elco, Willow Grove, Pa.
GC Electronics, Rockford, Ill.
General Hardware Mfg. Co., New York, N.Y.
General Radio Co., Concord, Mass.
Hollingsworth Solderless Terminal, Phoenixville, Pa.
Hughes Aircraft Co., Connecting Devices, Newport Beach, Cal.
Hunter Tools, El Monte, Calif
Ideal Industries, Inc., Sycamore, Ill.
ITT Cannon Electric, Santa Ana, Cal.
ITT Holub Inds., Sycamore, Ill.
Jonard Inds. Corp., Bronx, N.Y.

Keystone Elctrns. Corp., New York, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Molex Inc., Lisle, Ill.
Pico Crimping Tools Co., Santa Fe Springs, Calif.
Porter, H.K., Inc., Somerville, Mass.
Shure Bros., Inc., Evanston, Ill.
Sjoberg, C. & Son, Inc., Cranston, R.I.
Superior Mfg. & Instrument Corp., Long Island City, N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Thomas & Betts Co., Elizabeth, N.J.
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3M Co., St. Paul, Minn.
Vector Elctrn. Co., Inc., Sylmar, Cal.
Viking Inds., Inc., Chatsworth, Calif.
Waldom Elctrns., Inc., Chicago, Ill.
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Zierick Mfg. Corp., Mt. Kisco, N.Y.

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Harwil Co., Santa Monica, Calif.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
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Aremco Prods., Inc., Briarcliff Manor, N.Y.
Circon Corp., Santa Barbara, Ca.
General Hardware Mfg. Co., New York, N.Y.
Jonard Inds. Corp., Bronx, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Matrix Engineering Corp., Gardena, Calif.
Orbit Inds., San Luis Obispo, Calif.
Techni-Tool, Inc., Philadelphia, Pa.
UNGAR, Compton, Calif.
Vigor Co., New York, N.Y.
Xcelite, Inc., Orchard Park, N.Y.

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Buchanan Elec. Prods., Union, N.J. Vol 3•558
Air-Vac Engrg. Co., Milford, Conn.
Aremco Prods., Inc., Briarcliff Manor, N.Y.
Engineering & Elctrn. Devices, Inc., Los Angeles, Calif.
General Hardware Mfg. Co., New York, N.Y.
Henes Mfg. Co., Phoenix, Ariz.
Jonard Inds. Corp., Bronx, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Techni-Tool, Inc., Philadelphia, Pa.
Telvac Instr. Co., Van Nuys, Cal.

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GC Electronics, Rockford, Ill.
GTE Automatic Elec., Northlake, Ill.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Neuses, P.K., Inc., Arlington Hgts., Ill.
Techni-Tool, Inc., Philadelphia, Pa.

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Gardner-Denver Co., Quincy, Ill.
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Mann, Henry Inc., Feasterville, Pa.
Mupac Corp., Brockton, Mass.
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Acromag, Inc., Wixom, Mich.
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Applied Control Co., Fairfield, N.J.
Ballantine Laboratories, Inc., Boonton,, N. J.
Bristol Div, Waterbury, Conn
Collins Radio Co., Dallas, Tex.
Controlcraft Corp., West Chicago, Ill.
Datametrics Inc., Wilmington, Mass.
Davidson Elctrn. Dev. Co., Erie, Pa.
Digital Equip. Corp., Maynard, Mass.
Dynapar Corp., Gurnee, Ill.
Dytro Corp., Hicksville, N.Y.
Eagle Signal, Davenport, Iowa
Eldorado Electrodata, Concord, Cal.
Electro-Numerics, Santa Clara, Cal.
Electronic Research Co., Shawnee Mission, Kan.
ENM Co., Chicago, Ill.
ESE, Inglewood, Cal.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Geo Space Sys., Tampa, Fla.
Innovatek Enterprise, Millerton, N.Y.
Monitor Labs, Inc., San Diego, Cal.
Monsanto Company, Electronic Instruments, W. Caldwell, N.J.
NES, Inc., Itasca, Ill.
Norden Div., Norwalk, Conn.
Pinlites, Fairfield, N.J.
Precision Dynamics Corp., Burbank, Cal.
Precision Timer Co., Westbrook, Conn.
Presin Co., Inc., Shelton, Conn.
Railway Comm., Raytown, Mo.
Speed Detectors, Bedford, Ohio
Struthers-Dunn, Inc., Bettendorf, Iowa
Systron-Donner Concord Instr. Div., Concord, Cal.
Takeda Riken Industry Co., Ltd., Tokyo 176, Japan
Tektronix, Inc., Beaverton, Ore.
Theta Instr. Corp., Fairfield, N.J.
Thiem Industries, Inc., Torrance, Cal.
Toledo Scale, Toledo, Ohio

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Systron-Donner Concord Instr. Div., Concord, Cal.
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ABA Industries, Inc., Pinellas Pk., Fla.
Aeroflex Labs., Plainview, N.Y.
Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Barnes Engrg. Co., Stamford, Conn.
Beukers Labs., Inc., Hauppauge, N.Y.
Control Technology Co., L.I.C., N.Y.
Cubic Corp., San Diego, Cal.
Datron Systems, Chatsworth, Cal.
Electrac, Inc., Anaheim, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Honeywell, Minneapolis, Minn.
Ind'l. Control Co., Farmingdale, N.Y.
Kollsman Instr. Co., Syosset, N.Y.
Lear Siegler, Inc., Santa Monica, Calif.
Measurement Sys., Inc., Norwalk, Conn.
Orbit Instr. Corp., Syosset, N.Y.
Parabam, Inc., Compton, Cal.
Quan-Tech, Whippany, N.J.
Rantec Div., Calabasas, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
Scientific-Atlanta, Inc., Atlanta, Ga.
Spectral Dynamics Corp. San Diego, San Diego, Cal.
Tasker Systems, Chatsworth, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.
Whittaker Corp., Los Angeles, Cal.

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Gould, Inc., Cleveland, Ohio .. Vol 2•1177
Ohio Semitronics, Columbus, Ohio Vol 1•491
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American Aerospace Controls Inc., Farmingdale, N.Y.
Ametek/Instrs. & Controls, Feasterville, Pa.
Astrosystems, Inc., Lake Success, N.Y.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
BLH Elctrns., Inc., Waltham, Mass.
Bourns, Inc., Instr. Div., Riverside, Calif.
Bowmar/TIC, Inc., Newbury Park, Calif.
Bristol Div, Waterbury, Conn
Carter Mfg. Corp., Hudson, Mass.
Clifton Precision, Clifton Hgts., Pa.
Collins, G.L. Corp., Long Beach, Calif.
Columbia Resch. Labs., Woodlyn, Pa.
Computer Conversions Corp., East Northport, N.Y.
Computer Instrs., Hempstead, N.Y.
Control Data Corp., Minneapolis, Minn.
Davidson Elctrn. Dev. Co., Erie, Pa.
Del Electronics Corp., Mt. Vernon, N.Y.
Disc Instruments, Inc., Costa Mesa, Ca.
Dynamic Data Corp., Columbus, Ohio
Dynapar Corp., Gurnee, Ill.
Dytronics Co., Columbus, Ohio
Electro Corp., Sarasota, Fla.
Engdahl Enterprises, Costa Mesa, Cal.
Foxboro Co., Foxboro, Mass.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Hamlin, Inc., Lake Mills, Wisc.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Honeywell, Denver, Colo.
Humphrey, Inc., San Diego, Calif.
Jordan Controls, Milwaukee, Wisc.
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Larson Aero Dev., Concord, Calif.
Lion Precision Corp, Newton, Mass.
Litton Inds., Mt. Vernon, N.Y.
Minnetech Labs, Minneapolis, Minn.
Norden Div., Norwalk, Conn.
Pickering & Co., Plainview, N.Y.
Rank Precision Inds., Des Plaines, Ill.
Research, Inc., Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Scientific Technology, Mountain View, Cal.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Statham Instrs., Inc., Oxnard, Cal.
Tektronix, Inc., Beaverton, Ore.
Theta Instr. Corp., Fairfield, N.J.
Transducer Controls Corp., Covina, Calif.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

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Ametek/Instrs. & Controls, Feasterville, Pa.
Autocon Inds., Inc., Minneapolis, Minn.
Bailey Meter Co., Wickliffe, Ohio
Bell & Howell Co., Pasadena, Calif.
Bendix Corp., Davenport, Iowa
BLH Elctrns., Inc., Waltham, Mass.
Bristol Div, Waterbury, Conn
Carolina Medical Elctrns., Inc., King, N.C.
Datametrics Inc., Wilmington, Mass.
Disc Instruments, Inc., Costa Mesa, Ca.
Flow Technology, Inc., Tempe, Ariz.
Foxboro Co., Foxboro, Mass.
Honeywell, Denver, Colo.
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Leeds & Northrup Corp., No. Wales, Pa.
Lion Precision Corp, Newton, Mass.
National Semiconductor, Santa Clara, Cal.
Robertshaw Controls Co., Richmond, Va.
Rosemount Inc., Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Sensotec, Inc., Columbus, Ohio
Signet Scientific Co., Burbank, Cal.
Statham Instrs., Inc., Oxnard, Cal.
Taylor Instr. Process Control Div., Rochester, N.Y.
Thermo Sys., Inc., St. Paul, Minn.
Tylan Corp., Torrance, Calif.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

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Ailtech, City of Industry, Cal.
Aviation Elec., Ltd., Montreal 379, Que., Can.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Biocom, Inc., Culver City, Cal.
BLH Elctrns., Inc., Waltham, Mass.
Bristol Div, Waterbury, Conn
Coil Co. of Amer., Northvale, N.J.
Columbia Resch. Labs., Woodlyn, Pa.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Endevco, Pasadena, Calif.
Engdahl Enterprises, Costa Mesa, Cal.
Foxboro Co., Foxboro, Mass.
Honeywell, Denver, Colo.
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Kulite Semiconductor Prod., Ridgefield, N.J.
Larson Aero Dev., Concord, Calif.
Measurement Sys., Inc., Norwalk, Conn.
Minnetech Labs, Minneapolis, Minn.
National Semiconductor, Santa Clara, Cal.
Norden Div., Norwalk, Conn.
PCB Piezotronics, Inc., Depew, N.Y.
Revere Elctrn. Div., Wallingford, Conn.
Schaevitz Engrg., Pennsauken, N.J.
Sensotec, Inc., Columbus, Ohio
Statham Instrs., Inc., Oxnard, Cal.
Stow Labs., Inc., Hudson, Mass.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Inc., Beaverton, Ore.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Transducer Controls Corp., Covina, Calif.
Transducers, Inc., Whittier, Ca.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zonic Tech. Labs., Cincinnati, Ohio

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Advanced Kinetics, Costa Mesa, Calif.
Airpax Elctrns., Ft. Lauderdale, Fla.
American Aerospace Controls Inc., Farmingdale, N.Y.
Amtron Inc., Midlothian, Ill.

Astrosystems, Inc., Lake Success, N.Y.
Automation Services Div., Windsor, N. Y.
B & K Instrs., Inc., Cleveland, Ohio
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Control Data Corp., Minneapolis, Minn.
Controlcraft Corp., West Chicago, Ill.
Dolan-Jenner Inds., Inc., Melrose, Mass.
Dynapar Corp., Gurnee, Ill.
Electro Corp., Sarasota, Fla.
Flow Technology, Inc., Tempe, Ariz.
Grado Labs., Inc., Brooklyn, N.Y.
Knowles Elctrns., Inc., Franklin Park, Ill.
LDJ Electronics, Troy, Mich.
Norden Div., Norwalk, Conn.
Ohio Semitronics, Columbus, Ohio
PECO Corp., Milpitas, Cal.
Power Instrs., Skokie, Ill.
RFL Inds., Instr. Div., Boonton, N.J.
Schaevitz Engrg., Pennsauken, N.J.
Sensor Corp., Scottsdale, Pa.
Solid State Elctrns. Corp., Sepulveda, Cal.
Sonotone Corp., Elmsford, N.Y.
Speed Detectors, Bedford, Ohio
SRC Div., Newport Bch., Cal.
Statham Instrs., Inc., Oxnard, Cal.
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Advanced Kinetics, Costa Mesa, Calif.
Ailtech, City of Industry, Cal.
Alnor Instr. Co., Chicago, Ill.
Ametek/Instrs. & Controls, Feasterville, Pa.
Autocon Inds., Inc., Minneapolis, Minn.
Aviation Elec., Ltd., Montreal 379, Que., Can.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Bell & Howell Co., Pasadena, Calif.
Bendix Aerospace-Elctrns., Teterboro, N.J.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Biocom, Inc., Culver City, Cal.
BLH Elctrns., Inc., Waltham, Mass.
Bourns, Inc., Instr. Div., Riverside, Calif.
Bristol Div, Waterbury, Conn
Channel Inds., Santa Barbara, Cal.
Columbia Resch. Labs., Woodlyn, Pa.
Conrac Corp., Duarte, Cal.
Consolidated Controls Corp., Bethel, Conn.
Corning Glass Works, Fluidic Products Dept., Corning, N.Y.
Datametrics Inc., Wilmington, Mass.
Dynisco, Westwood, Mass.
Edison, Instr. Div., W. Orange, N.J.
Endevco, Pasadena, Calif.
Foxboro Co., Foxboro, Mass.
Furnas Elec. Co., Batavia, Ill.
Genisco Technolgy Corp., Instrument Div. (Transducers), Compton, Cal.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Harrel, Inc., E. Norwalk, Conn.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Honeywell, Denver, Colo.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Kollsman Instr. Co., Syosset, N.Y.
Kratos, Pasadena, Cal
Kulite Semiconductor Prod., Ridgefield, N.J.
Lear Siegler, Inc., Santa Monica, Calif.
Leeds & Northrup Corp., No. Wales, Pa.
Linden Labs., Inc., State College, Pa.
Lion Precision Corp, Newton, Mass.
Metrix Instr. Co., Houston, Tex.
Minnetech Labs, Minneapolis, Minn.
MKS Instrs., Inc., Burlington, Mass.
National Semiconductor, Santa Clara, Cal.
PCB Piezotronics, Inc., Depew, N.Y.
Penn Engrg. & Mfg. Corp., Doylestown, Pa.
Plessey Enviromental Sys., San Diego, Cal.
Robertshaw Controls Co., Richmond, Va.
Rosemount Inc., Minneapolis, Minn.
Schaevitz Engrg., Pennsauken, N.J.
Sensotec, Inc., Columbus, Ohio
Standard Controls, Seattle, Wash.
Statham Instrs., Inc., Oxnard, Cal.
Stow Labs., Inc., Hudson, Mass.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Inc., Beaverton, Ore.
Teledyne Taber, No. Tonawanda, N.Y.
Texas Instruments, Attleboro, Mass.
Texas Instruments, Inc., Houston, Tex.
Thermo Elec. Co., Inc., Saddle Brook, N.J.
Transducer Controls Corp., Covina, Calif.
Transducers, Inc., Whittier, Ca.
Validyne Engrg. Corp., Northridge, Cal.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

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AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
Ailtech, City of Industry, Cal.
Amphenol Controls Oper. of Connector Div., Broadview, Ill.
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
Columbia Resch. Labs., Woodlyn, Pa.
Consolidated Controls Corp., Bethel, Conn.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Doric Sci. Corp., San Diego, Calif.
Dynisco, Westwood, Mass.
Electro-Numerics, Santa Clara, Cal.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Honeywell, Denver, Colo.
Kaman Sciences Corp., Colorado Springs, Colo.
Kulite Semiconductor Prod., Ridgefield, N.J.
Magnaflux Corp., Chicago, Ill.
Measurement Sys., Inc., Norwalk, Conn.
Micro-Measurements Div., Romulus, Mich.
Ormond Inc., Santa Fe Springs, Cal.
Revere Elctrn. Div., Wallingford, Conn.
Recorder Systems Div., E. Greenwich, R.I.
Sensotec, Inc., Columbus, Ohio
Statham Instrs., Inc., Oxnard, Cal.
Tektronix, Inc., Beaverton, Ore.
Teledyne Taber, No. Tonawanda, N.Y.
Thwing-Albert Instr. Co., Philadelphia, Pa.
Toledo Scale, Toledo, Ohio
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Aviation Elec., Ltd., Montreal 379, Que., Can.
Bailey Meter Co., Wickliffe, Ohio
Barber-Colman Co., Industrial Instrs. Div., Rockford, Ill.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Biocom, Inc., Culver City, Cal.
BLH Elctrns., Inc., Waltham, Mass.
Bristol Div, Waterbury, Conn
Burns Engrg., Inc., Minneapolis, Minn.
Conax Corp., Buffalo, N.Y.
Consolidated Controls Corp., Bethel, Conn.
Consolidated Ohmic Devices, Carle Pl., N.Y.
Datametrics Inc., Wilmington, Mass.
Edison, Instr. Div., W. Orange, N.J.
Faria, Thomas G. Corp., Uncasville, Conn.
Fenwal Elctrns., Framingham, Mass.
Foxboro Co., Foxboro, Mass.
General Elec., W. Lynn, Mass.
Genisco Technolgy Corp., Instrument Div. (Transducers), Compton, Cal.
Honeywell, Ft. Washington, Pa.
Honeywell, Mpls., Minn.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Kahl Scientific Instr. Corp., El Cajon, Calif.
Keystone Carbon Co., St. Marys, Pa.
Kulite Semiconductor Prod., Ridgefield, N.J.
Larson Instr. Co., Inc., Orangeburg, N.Y.
Leeds & Northrup Corp., No. Wales, Pa.
Mag-Con, Inc., New Brighton, Minn.
Marlin Mfg. Corp., Cleveland, Ohio
Micro-Measurements Div., Romulus, Mich.
National Semiconductor, Santa Clara, Cal.
Omega Engrg., Inc., Stamford, Conn.
P.E.T., Inc., Pittsburgh, Pa.
Plessey Enviromental Sys., San Diego, Cal.
Princeton Applied Resch. Corp., Princeton, N.J.
RDF Corp., Hudson, N.H.
Relco Prods., Denver, Colo.
RFL Inds., Thermocontrol Div., Boonton, N.J.
Riverbank Labs., Geneva, Ill.
Robertshaw Controls Co., Richmond, Va.
Rodan Ind's., Anaheim, Ca.
Rosemount Inc., Minneapolis, Minn.
Scientific Columbus, Columbus, Ohio
Sensotec, Inc., Columbus, Ohio
Stow Labs., Inc., Hudson, Mass.
Syscon Int'l., Inc., So. Bend, Ind.
Taylor Instr. Process Control Div., Rochester, N.Y.
Tektronix, Inc., Beaverton, Ore.
Teledyne Geotech, Dallas, Tex.
Texas Instruments, Attleboro, Mass.
Thermal Sys., Los Angeles, Cal.
Thermo Elec. Co., Inc., Saddle Brook, N.J.
Thermometrics, Inc., Edison, N.J.
Trans-Met Engrg., La Habra, Cal.
Tylan Corp., Torrance, Calif.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westinghouse Elec. Corp., Newark, N.J.
Yellow Springs Instr. Co., Inc., Yellow Springs, Ohio

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Aviation Elec., Ltd., Montreal 379, Que., Can.
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bendix Aerospace-Elctrns., Teterboro, N.J.
BLH Elctrns., Inc., Waltham, Mass.
Dillon, W.C. & Co., Van Nuys 340, Calif.
Himmelstein, S. & Co., Elk Grove Village, Ill.
Honeywell, Minneapolis, Minn.
Honeywell, Ft. Washington, Pa.
Larson Aero Dev., Concord, Calif.
Measurement Sys., Inc., Norwalk, Conn.
Minnetech Labs, Minneapolis, Minn.
Ormond Inc., Santa Fe Springs, Cal.
Sensotec, Inc., Columbus, Ohio
Transducer Controls Corp., Covina, Calif.
Triac Elctrn. Sys., Forest Hills, N. Y.
Vibrac Corp., Chelmsford, Mass.
West Coast Resch. Corp., Los Angeles, Calif.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Zonic Tech. Labs., Cincinnati, Ohio

Transducers, Ultrasonic

Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Automation Inds., Danbury, Conn.
Bendix Corp., Davenport, Iowa
Channel Inds., Santa Barbara, Cal.
Crystal Technology, Mountain View, Cal
Edo Western Corp., Salt Lake City, Utah
Electro-Voice, Inc., Buchanan, Mich.
Electronic Resch. Assocs., Moonachie, N.J.
Erie Technological Prods. (EEM), Erie, Pa.
Gulton Inds., Fullerton, Cal.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
James Elctrns., Inc., Chicago, Ill.
Kidde, Walter & Co., Belleville, N.J.
Linden Labs., Inc., State College, Pa.
Magnaflux Corp., Chicago, Ill.
Murata Mfg. Co. Ltd., Kyoto, Japan
National Sonics, Farmingdale, N.Y.
Pacific Technology, Renton, Wash.
Panametrics Inc., Waltham, Mass.
TDK Elctrns. Corp., Long Island City, N.Y.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Uthe Technology Int'l., Sunnyvale, Cal.
Vernitron Piezoelectric Div., Bedford, Ohio

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Ametek/Instrs. & Controls, Feasterville, Pa.
Collins, G.L. Corp., Long Beach, Calif.
Control Data Corp., Minneapolis, Minn.
Datametrics Inc., Wilmington, Mass.
Disc Instruments, Inc., Costa Mesa, Ca.
Edo Western Corp , Salt Lake City, Utah
Electro Corp., Sarasota, Fla.
Engdahl Enterprises, Costa Mesa, Cal.
Geo Space, Houston, Tex.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
Humphrey, Inc., San Diego, Calif.
Pickering & Co., Plainview, N.Y.
Schaevitz Engrg., Pennsauken, N.J.
Speed Detectors, Bedford, Ohio
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Thermo Sys., Inc., St. Paul, Minn.
Transducer Controls Corp., Covina, Calif.
Transicoil, Inc., Worcester, Pa.
Vibra-Metrics, Inc., E. Haven, Conn.

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Advanced Dynamic Instrs. Div., Alexandria, Va.
Amperex Electronic Corp., Hicksville, N.Y.
B & K Instrs., Inc., Cleveland, Ohio
Beckman Instrs., Ectrn. Instrs. Div. Ectrn. Instrumentation, Schiller Park, Ill.
Bell & Howell Co., Pasadena, Calif.
Biocom, Inc., Culver City, Cal.
Channel Inds., Santa Barbara, Cal.
Columbia Resch. Labs., Woodlyn, Pa.
Dynamic Data Corp., Columbus, Ohio
Dytronics Co., Columbus, Ohio
Edo Western Corp., Salt Lake City, Utah
Electro Corp., Sarasota, Fla.
Endevco, Pasadena, Calif.
General Radio Co., Concord, Mass.
Geo Space, Houston, Tex.
Gulton Inds., Servonic/Instr. Div., Costa Mesa, Cal.
H H Controls Co., Inc., Arlington, Mass.
Honeywell, Denver, Colo.
Kaman Sciences Corp., Colorado Springs, Colo.
Kistler Instr. Co., Redmond, Wash.
Knowles Elctrns., Inc., Franklin Park, Ill.
Larson Aero Dev., Concord, Calif.
Linden Labs., Inc., State College, Pa.
Metrix Instr. Co., Houston, Tex.
PCB Piezotronics, Inc., Depew, N.Y.
Robertshaw Controls Co., Richmond, Va.
Shure Bros., Inc., Evanston, Ill.
Sonotone Corp., Elmsford, N.Y.
Sprengnether, W.F. Instr. Co., Inc., St. Louis, Mo.
Statham Instrs., Inc., Oxnard, Cal.
Tektronix, Inc., Beaverton, Ore.
Teledyne Geotech, Dallas, Tex.
Tohoku Metal Inds., Ltd., Tokyo, Japan
Vibra-Metrics, Inc., E. Haven, Conn.
Zonic Tech. Labs., Cincinnati, Ohio

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Active Control Instrumentation, E. Northport, NY
Bristol Div, Waterbury, Conn
Cross Electronics Inc., Warrendale, Pa.
Dranetz Engrg. Labs., So. Plainfield, N.J.
EWC, Inc., Kenilworth, N.J.
Flight Sys., Inc., Mechanicsburg, Pa.
General Elec., W. Lynn, Mass.
Hallmark Standards, Inc., Mt. Vernon, N.Y.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Honeywell, Ft. Washington, Pa.
Kratos, Pasadena, Cal
Omega Engrg., Inc., Stamford, Conn.
RFL Inds., Comms. Div., Boonton, N.J.
Recorder Systems Div., E. Greenwich, R.I.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.
Westinghouse Elec. Corp., Newark, N.J.
Weston Instruments, Inc., Newark, N.J.

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American Magnetics Corp., Carterville, Ill.
Bell Industries, Compton, Cal.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Custom Coil & Transformer Co., Zanesville, Ohio
Davis J.W. & Co., Dallas, Texas
Dietz Design, Inc., Belton, Mo.
Dynaco, Inc., Philadelphia, Pa.
Electrocom Inds., So. Bend, Indiana
Energy Systems, Palo Alto, Cal.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Geo Space, Houston, Tex.
Gotham Audio Corp., New York, N.Y.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Harder, Donald C. Co., Inc., San Diego, Calif.
Hipotronics, Inc., Brewster, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Jensen Sound Labs., Schiller Park, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
Melcor Elctrns. Corp., Farmingdale, N.Y.
Merrimack Magnetics, Lowell, Mass.
Neshaminy Transformer, Furlong, Pa.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Phoenix Transformer Co., Phoenix, Ariz.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Queensboro Transformer & Mach., College Pt., N.Y.
Raytheon Co., Waltham, Mass.
RFL Inds., Comms. Div., Boonton, N.J.
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Staco, Inc., Dayton, Ohio
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Sterling Transformer Corp., Brooklyn, N.Y.
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Allis-Chalmers, Milwaukee, Wisc.
Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
Anzac Elctrns., Waltham, Mass.
Arnold Magnetics, Culver City, Cal.
Astro-Metrix, Burbank, Cal.
Basler Elec. Co., Highland, Ill.
Bell Industries, Compton, Cal.
B.H. Inds., Los Angeles, Cal.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Carson Mfg. Co., Indianapolis, Ind.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Specialty Co., Boalsburg, Pa.
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Del Electronics Corp., Mt. Vernon, N.Y.
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Energy Systems, Palo Alto, Cal.
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Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Gates Elctrn. Co., Bronx, N.Y.
General Radio Co., Concord, Mass.
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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hisonic, Inc., Olathe, Kans.
Hughey & Phillips, Inc., Burbank, Cal.
Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Jefferson Elec., Bellwood, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
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NWL Transformers, Trenton, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Ohmite Mfg. Co., Skokie, Ill.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Perkin-Elmer Corp., Electronic Prods. Dept., Norwalk, Conn.
Peschel Instrs., Cape Coral, Fla.
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Pico Elctrns Inc., Mount Vernon, N.Y.
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Queensboro Transformer & Mach., College Pt., N.Y.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Stancor, Chicago, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
Telrex Labs., Asbury Park, N.J.
Terado Corp., St. Paul, Minn.
Todd Systems, Yonkers, N.Y.
Topaz Electronics, San Diego, Cal.
Torotel, Inc., Grandview, Mo.
Torwico Elctrns., Inc., Lakewood, N.J.
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Westinghouse Elec., Buffalo, N. Y.
Westinghouse Elec., Greenville, Pa.
Zaring Inds., Inc., Westfield, Ind.

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Coil Co. of Amer., Northvale, N.J.
Collins Radio Co., Dallas, Tex.
Component Specialties, Temple City, Cal.
EWC, Inc., Kenilworth, N.J.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
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Magnetico, Inc., E. Northport, N.Y.
Neshaminy Transformer, Furlong, Pa.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
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Pico Elctrns Inc., Mount Vernon, N.Y.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
Solid State Elctrns. Corp., Sepulveda, Cal.
Sterling Transformer Corp., Brooklyn, N.Y.
Stevens-Arnold, Inc., So. Boston, Mass.
Torwico Elctrns., Inc., Lakewood, N.J.
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American Magnetics Corp., Carterville, Ill.
Astro-Metrix, Burbank, Cal.
Bell Industries, Compton, Cal.
Biometrics Instrument Corp., Garland, Tex.
Bogen Div., Paramus, N.J.
Carson Mfg. Co., Indianapolis, Ind.
CML-Macarr, Inc., Edison, N.J.
Coil Co. of Amer., Northvale, N.J.
Constant Voltage Co., Chicago, Ill.
Control Data Corp., Minneapolis, Minn.
Davis J.W. & Co., Dallas, Texas
Del Electronics Corp., Mt. Vernon, N.Y.
Elgin Elctrns. Inc., Waterford, Pa.
Ferrodyne Corp., Venice, Calif.
Geo Space, Houston, Tex.
Hipotronics, Inc., Brewster, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
Kepco, Inc., Flushing, N.Y.
K.G.S. Elctrns., Pasadena, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
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Maxwell Labs., Inc., San Diego, Calif.
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North Electric Co., Galion, Ohio
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
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Power-Matic, Inc., San Diego, Cal.
Queensboro Transformer & Mach., College Pt., N.Y.
Ratelco, Inc., Seattle, Wash.
Shigoto Inds., Ltd., New York, N.Y.
Sola Elec. Div., Elk Grove Village, Ill.
Standard Power, Inc., Santa Ana, Cal.
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TDC, Div. Freq. Technology Inc., Littleton, Mass.
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Triad-Utrad Div., Huntington, Ind.
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Utah Elctrns., Huntington, Ind.
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Amp Inc., Harrisburg, Pa.
Astro-Metrix, Burbank, Cal.
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Avtel Corp., Covina, Cal.
Basler Elec. Co., Highland, Ill.
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B.H. Inds., Los Angeles, Cal.
Biometrics Instrument Corp., Garland, Tex.
Bourns Pacific Magnetic Corp., Romoland, Calif.
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Constant Voltage Co., Chicago, Ill.
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Del Electronics Corp., Mt. Vernon, N.Y.
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Dietz Design, Inc., Belton, Mo.
El-Rad Mfg. Co., Chicago, Ill.
Electrocom Inds., So. Bend, Indiana
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Energy Systems, Palo Alto, Cal.
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Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
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Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
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Lambda Elctrns., Melville, N.Y.
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Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
Merrimack Magnetics, Lowell, Mass.
National Power Prods. Inc., Haverhill, Mass.
North Electric Co., Galion, Ohio
Novatronics, Inc., Pompano Beach, Fla.

Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
PCA Elctrns., Inc., Sepulveda, Calif.
Phoenix Transformer Co., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
Spectran Elctrns., Pompano Beach, Fla.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
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Stanford Applied Engrg., Santa Clara, Cal.
Sterling Transformer Corp., Brooklyn, N.Y.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Torotel, Inc., Grandview, Mo.
Torwico Elctrns., Inc., Lakewood, N.J.
Triad-Utrad Div., Huntington, Ind.
TRW/UTC Transformers, New York, N.Y.
Ward Leonard Elec. Co., Mt. Vernon, N.Y.
Zaring Inds., Inc., Westfield, Ind.

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Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Collins, G.L. Corp., Long Beach, Calif.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Lambda Elctrns., Melville, N.Y.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
North Atlantic Inds., Plainview, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Solid State Elctrns. Corp., Sepulveda, Cal.
Torwico Elctrns., Inc., Lakewood, N.J.

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ADC Prods., Minneapolis, Minn.
Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
Ametek/Instrs. & Controls, Feasterville, Pa.
Automatic Timing & Controls, Inc., King of Prussia, Pa.
Bicron Elctrns. Co., Canaan, Conn.
Bourns, Inc., Instr. Div., Riverside, Calif.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Coil Co. of Amer., Northvale, N.J.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Columbia Resch. Labs., Woodlyn, Pa.
Del Electronics Corp., Mt. Vernon, N.Y.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Lambda Elctrns., Melville, N.Y.
Magnetico, Inc., E. Northport, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Pickering & Co., Plainview, N.Y.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
TRW/UTC Transformers, New York, N.Y.
Zaring Inds., Inc., Westfield, Ind.

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ADC Prods., Minneapolis, Minn.
American Magnetics Corp., Carterville, Ill.
American Trans-Coil Corp., Richmond Hill, N.Y.
Automatic Coil, New Hyde Pk., N.Y.
Bell Industries, Compton, Cal.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
Coil Co. of Amer., Northvale, N.J.
Coil Specialty Co., Boalsburg, Pa.
Coil Winders Div. Caddell-Burns, Mineola, N. Y.
Collins Radio Co., Dallas, Tex.
Dietz Design, Inc., Belton, Mo.
El-Rad Mfg. Co., Chicago, Ill.
Electrocom Inds., So. Bend, Indiana
ESC Elctrns. Corp., Palisades Pk., N.J.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
General Instr. Corp., Automatic Mfg. Div., Chicopee, Mass.
Hisonic, Inc., Olathe, Kans.
Lambda Elctrns., Melville, N.Y.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Piconics Inc., Tyngsboro, Mass.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
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ACDC Elctrns., Oceanside, Cal.
Allied Elctrns., Chicago, Ill.
American Magnetics Corp., Carterville, Ill.
Basler Elec. Co., Highland, Ill.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Clippard Instr., Inc., Cincinnati, Ohio
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Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Carson Mfg. Co., Indianapolis, Ind.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Collins Radio Co., Dallas, Tex.
Control Data Corp., Minneapolis, Minn.
Custom Coil & Transformer Co., Zanesville, Ohio
Dale Elctrns., Inc., Yankton, S.D.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Deltaray Corp., Woburn, Mass.
Dietz Design, Inc., Belton, Mo.
Dormeyer Inds., Chicago, Ill.
Electro-Pacific, Inc., Goleta, Calif.
Elgin Elctrns. Inc., Waterford, Pa.
Energy Systems, Palo Alto, Cal.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Gates Elctrn. Co., Bronx, N.Y.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Harder, Donald C. Co., Inc., San Diego, Calif.
Hipotronics, Inc., Brewster, N.Y.
Hughey & Phillips, Inc., Burbank, Cal.
Huntington Elctrns. Corp., Van Nuys, Cal.
James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
Magnetics, Div. of Spang Industries, Inc., Sandy Lake, Pa.
Megavolt, Inc., New York, N.Y.
Merrimack Magnetics, Lowell, Mass.
Mini-Circuits Lab., Brooklyn, N.Y.
Neshaminy Transformer, Furlong, Pa.
North Atlantic Inds., Plainview, N.Y.
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Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Peschel Instrs., Cape Coral, Fla.
Phoenix Transformer Co., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polygon Inds. Ltd., Toronto 16, Ont., Canada
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
Relcom (Div. Watkins-Johnson), Palo Alto, Calif.
Sanford-Miller Corp., Brooklyn, N.Y.
Shigoto Inds., Ltd., New York, N.Y.
Singer Instrumentation, Los Angeles Oper., Los Angeles, Cal.
Spellman High Voltage Elctrns. Corp., Bronx, N.Y.
Square D Co., Park Ridge, Ill.
Stancor, Chicago, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
Stevens-Arnold, Inc., So. Boston, Mass.
TDC, Div. Freq. Technology Inc., Littleton, Mass.
Tele-Dynamics/Wanlass, Fort Washington, Pa.
Todd Systems, Yonkers, N.Y.
Torotel, Inc., Grandview, Mo.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
Triac Elctrn. Sys., Forest Hills, N. Y.
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Universal Voltronics Corp., Mt. Kisco, N.Y.
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Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
Atlas Sound Div., Parsippany, N.J.
Basler Elec. Co., Highland, Ill.
B.H. Inds., Los Angeles, Cal.
Bogen Div., Paramus, N.J.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Coil Co. of Amer., Northvale, N.J.
Custom Coil & Transformer Co., Zanesville, Ohio
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Dormeyer Inds., Chicago, Ill.
Douglas Randall Div., Pawcatuck, Conn.
Electro-Voice, Inc., Buchanan, Mich.
Electrocom Inds., So. Bend, Indiana
Electrocube, San Gabriel, Cal
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
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James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetico, Inc., E. Northport, N.Y.
NWL Transformers, Trenton, N.J.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oaktron Inds., Monroe, Wisc.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Phoenix Transformer Co., Phoenix, Ariz.
Pico Elctrns Inc., Mount Vernon, N.Y.
Polyphase Instr. Co., Bridgeport, Pa.
Raytheon Co., Waltham, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Signal Transformer, Bklyn., N.Y.
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Sterling Transformer Corp., Brooklyn, N.Y.
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Bell Industries, Compton, Cal.
Blonder-Tongue Labs., Inc., Old Bridge, N.J.
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Bourns Pacific Magnetic Corp., Romoland, Calif.
Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Collins Radio Co., Dallas, Tex.
Delevan Div., Coil Prods., E. Aurora, N.Y.
Delta-Benco Ltd., Rexdale, Ont., Can.
Dietz Design, Inc., Belton, Mo.
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Electro/Data, Inc., Garland, Tex.
Electro Impulse, Inc., Red Bank, N.J.
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Electrocom Inds., So. Bend, Indiana
ESC Elctrns. Corp., Palisades Pk., N.J.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Jerrold Electronics Corp., Philadelphia, Pa.
Kappa Networks, Inc., Carteret, N.J.
K.G.S. Elctrns., Pasadena, Cal.
Krohn-Hite, Cambridge, Mass.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Palomar Engrs., Escondido, Cal.
Phoenix Transformer Co., Phoenix, Ariz.
Piconics Inc., Tyngsboro, Mass.
Polyphase Instr. Co., Bridgeport, Pa.
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RFL Inds., Comms. Div., Boonton, N.J.
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Shigoto Inds., Ltd., New York, N.Y.
Signal Transformer, Bklyn., N.Y.
Sitco Antennas, Portland, Ore.
Sound Technology, Cupertino, Cal.
Staco, Inc., Dayton, Ohio
Sterling Transformer Corp., Brooklyn, N.Y.
TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
TDK Elctrns. Corp., Long Island City, N.Y.
Torotel, Inc., Grandview, Mo.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
Triad-Utrad Div., Huntington, Ind.
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Delevan Div., Coil Prods., E. Aurora, N.Y.
Douglas Randall Div., Pawcatuck, Conn.
Geo Space, Houston, Tex.
Huntington Elctrns. Corp., Van Nuys, Cal.
James Elctrns., Inc., Chicago, Ill.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Magnetico, Inc., E. Northport, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
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Signal Transformer, Bklyn., N.Y.
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American Magnetics Corp., Carterville, Ill.
Bogen Div., Paramus, N.J.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Coil Co. of Amer., Northvale, N.J.
Douglas Randall Div., Pawcatuck, Conn.
Electro-Voice, Inc., Buchanan, Mich.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Gotham Audio Corp., New York, N.Y.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Omnitec Corp., Nytronics Filter Div., Phoenix, Ariz.
Phoenix Transformer Co., Phoenix, Ariz.
Polyphase Instr. Co., Bridgeport, Pa.

Pulse Engrg., Inc., San Diego, Cal.
Shigoto Inds., Ltd., New York, N.Y.
Shure Bros., Inc., Evanston, Ill.
Stancor, Chicago, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
Torotel, Inc., Grandview, Mo.
Triad-Utrad Div., Huntington, Ind.
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ACDC Elctrns., Oceanside, Cal.
ADC Prods., Minneapolis, Minn.
Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
Anzac Elctrns., Waltham, Mass.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Collins Radio Co., Dallas, Tex.
Dietz Design, Inc., Belton, Mo.
Douglas Randall Div., Pawcatuck, Conn.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Gee Space, Houston, Tex.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
Lambda Elctrns., Melville, N.Y.
Magnetic Circuit Elements, Monterey, Cal.
Magnetico, Inc., E. Northport, N.Y.
Microtran Co. Inc., Valley Stream, N.Y.
Mini-Circuits Lab., Brooklyn, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
Piconics Inc., Tyngsboro, Mass.
Polyphase Instr. Co., Bridgeport, Pa.
Pulse Engrg., Inc., San Diego, Cal.
Raytheon Co., Waltham, Mass.
Signal Transformer, Bklyn., N.Y.
Sterling Transformer Corp., Brooklyn, N.Y.
Torotron, Mt. Vernon, N.Y.
Torwico Elctrns., Inc., Lakewood, N.J.
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Coil Co. of Amer., Northvale, N.J.
Collins Radio Co., Dallas, Tex.
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Douglas Randall Div., Pawcatuck, Conn.
Energy Systems, Palo Alto, Cal.
Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Gee Space, Houston, Tex.
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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
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Mag-Con, Inc., New Brighton, Minn.
Microtran Co. Inc., Valley Stream, N.Y.
North Hills Elctrns., Inc., Glen Cove, N.Y.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
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Basler Elec. Co., Highland, Ill.
Bell Industries, Compton, Cal.
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Bulova Watch Co., Freq. Control Prods., Woodside, N.Y.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Coil Craft Inc., Bronxville, N.Y.
Collins Radio Co., Dallas, Tex.
Custom Coil & Transformer Co., Zanesville, Ohio
Dale Elctrns., Inc., Yankton, S.D.
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
Dormeyer Inds., Chicago, Ill.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
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Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
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JB Elctrn. Transformers, Inc., Chicago, Ill.
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Mag-Con, Inc., New Brighton, Minn.
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Oeco Corp., Portland, Ore.
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Signal Transformer, Bklyn., N.Y.
Spectran Elctrns., Pompano Beach, Fla.
Staco, Inc., Dayton, Ohio
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Sterling Transformer Corp., Brooklyn, N.Y.
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Bourns Pacific Magnetic Corp., Romoland, Calif.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Coil Co. of Amer., Northvale, N.J.
Custom Coil & Transformer Co., Zanesville, Ohio
Del Electronics Corp., Mt. Vernon, N.Y.
Dietz Design, Inc., Belton, Mo.
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Elgin Elctrns. Inc., Waterford, Pa.
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Ferrodyne Corp., Venice, Calif.
Freed Transformer Co., Bklyn., N.Y.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Hipotronics, Inc., Brewster, N.Y.
Huntington Elctrns. Corp., Van Nuys, Cal.
JB Elctrn. Transformers, Inc., Chicago, Ill.
K.G.S. Elctrns., Pasadena, Cal.
Lambda Elctrns., Melville, N.Y.
Mag-Con, Inc., New Brighton, Minn.
Megavolt, Inc., New York, N.Y.
Merrimack Magnetics, Lowell, Mass.
Microtran Co. Inc., Valley Stream, N.Y.
Neshaminy Transformer, Furlong, Pa.
Nytronics, Inc., Essex Elctrns. Div., Darlington, S.C.
Oeco Corp., Portland, Ore.
Phoenix Transformer Co., Phoenix, Ariz.
Polyphase Instr. Co., Bridgeport, Pa.
Queensboro Transformer & Mach., College Pt., N.Y.
Raytheon Co., Waltham, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Signal Transformer, Bklyn., N.Y.
Staco, Inc., Dayton, Ohio
Stancor, Chicago, Ill.
Sterling Transformer Corp., Brooklyn, N.Y.
TDC, Div. Freq. Technology Inc., Littleton, Mass.
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Allis-Chalmers, Milwaukee, Wisc.
Altec Div., Anaheim, Calif.
American Magnetics Corp., Carterville, Ill.
Arrow-Hart, Inc., Hartford, Conn.
Basler Elec. Co., Highland, Ill.
BECO, Inc., Salem, Va.
B.H. Inds., Los Angeles, Cal.
Bicron Elctrns. Co., Canaan, Conn.
Bourns Pacific Magnetic Corp., Romoland, Calif.
Carson Mfg. Co., Indianapolis, Ind.
CML-Macarr, Inc., Edison, N.J.
Coast Coil Co., Los Angeles, Calif.
Component Specialties, Temple City, Cal.
Control Data Corp., Minneapolis, Minn.
Custom Coil & Transformer Co., Zanesville, Ohio
Dietz Design, Inc., Belton, Mo.
Dynaco, Inc., Philadelphia, Pa.
E-Tronics, Sepulveda, Cal.
Elcor Prods. Welex Elctrns., Silver Spring, Md.
Electro-Pacific, Inc., Goleta, Calif.
Electrocube, San Gabriel, Cal
Electronic Resch. Assocs., Moonachie, N.J.
Elgin Elctrns. Inc., Waterford, Pa.
Energy Systems, Palo Alto, Cal.
EWC, Inc., Kenilworth, N.J.
Ferrodyne Corp., Venice, Calif.
Geo Space, Houston, Tex.
Grand Transformers, Grand Haven, Mich.
Hammond Mfg. Co. (U.S.) Inc., Buffalo, N.Y.
Harder, Donald C. Co., Inc., San Diego, Calif.
Huntington Elctrns. Corp., Van Nuys, Cal.
Ionics, Inc., Watertown, Mass
James Elctrns., Inc., Chicago, Ill.
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El-Rad Mfg. Co., Chicago, Ill.
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Transitron Elctrn. Corp., Wakefield, Mass.
TRW Capacitors, Ogallala, Neb.
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Calvert Elctrns., Inc., New York, N.Y.
Carter Semiconductor, Syossett, N.Y.
Corvair Elctrns, New York, N.Y.
Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Semiconductor Comps. Div., Hicksville, N.Y.
Int'l. Elctrns., Melville, N.Y.
Kertron, Inc., Riviera Beach, Fla
KMC Semiconductor Corp., Long Valley, N.J.
Micro Components Corp., Cranston, R.I.
Microwave Semiconductor Corp., Somerset, N.J.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nucleonic Prods., Canoga Pk, Cal.
Power Physics Corp., Eatontown, N.J.
Raytheon, Mt. View, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Signetics Corp., Sunnyvale, Calif.
Solitron Devices, Inc., Riviera Bch., Fla.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Crystalonics, Cambridge, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.

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Carter Semiconductor, Syossett, N.Y.
Corvair Elctrns, New York, N.Y.
CSR Industries Inc., E. Farmingdale, N.Y.
Delco Elctrns. Div., Kokomo, Ind.
Electronic Transistors, Flushing, N.Y.
Fairchild Semiconductor Comps. Grp., Mountain View, Cal.
General Instr. Corp., Semiconductor Comps. Div., Hicksville, N.Y.
General Semiconductor Inds., Tempe, Ariz.
International Diode Corp., Jersey City, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Semiconductors, W. Palm Beach, Fla.
Kertron, Inc., Riviera Beach, Fla
KMC Semiconductor Corp., Long Valley, N.J.
Motorola Semiconductor Prods., Phoenix, Ariz.
National Semiconductor, Santa Clara, Cal.
Nucleonic Prods., Canoga Pk, Cal.
Power Physics Corp., Eatontown, N.J.
PowerTech, Inc., Clifton, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Silicon Transistor Corp., Chelmsford, Mass.
Solitron Devices, San Diego, Cal.
Solitron Devices, Inc., Riviera Bch., Fla.
Sprague Elec. Co., No. Adams, Mass.
Teledyne Crystalonics, Cambridge, Mass.
Teledyne Semiconductor, Mountain View, Cal.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.
Transitron Elctrn. Corp., Wakefield, Mass.
Workman Elctrn. Prods., Inc., Sarasota, Fla.

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CSR Industries Inc., E. Farmingdale, N.Y.
Motorola Semiconductor Prods., Phoenix, Ariz.
Raytheon, Mt. View, Calif.
Texas Instruments, Dallas, Tex.
Thor Elctrns. Corp., Elizabeth, N.J.

Transit Cases-Also See Containers, Shipping

American Aluminum Co., Mountainside, N.J.
Calabro Unitrack, Upper Darby, Pa.
Craig Sys. Corp., Lawrence, Mass.
Lewis G. B. Co, Watertown, Wisc
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
M M Elctrn. Enclosures, Hicksville, N.Y.
Perfection Mica Co., Bensenville, Ill.
Skydyne A Brooks & Perkins Co., Port Jervis, N.Y.
TA Mfg. Corp., Los Angeles, Cal.
Union Carbide, Linde Div., New York, N. Y.
Warwick Prods. Co., Independence, Ohio
Zero Mfg. Co., Burbank, Cal.

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Translators, Data

Datatron, Inc., Santa Ana, Cal Vol 1•338
Metric Sys., Ft. Walton Beach, Fla. Vol 1•356,357
Thiem Industries, Inc., Torrance, Cal. Vol 1•367
Climatronics Corp., Hauppauge, N.Y.
Control Equip. Corp., Lowell, Mass.
Control Technology Co., L.I.C., N.Y.
Cubic Corp., San Diego, Cal.
Demex, Inc., Kansas City, Mo.
Dialight Corp., Brooklyn, N.Y.
Nat'l. Wire & Cable, Los Angeles, Cal.
NES, Inc., Itasca, Ill.
Singer - Tele-Signal, Woodbury, N.Y.
Superior Elec., Bristol, Conn.
Theta Instr. Corp., Fairfield, N.J.

Transmission Line, Wire & Cable—See Cable, Transmission Line

Transmission Systems, Data

Metric Sys., Ft. Walton Beach, Fla. Vol 1•356
North Hills Elctrns., Inc., Glen Cove, N.Y. ..... Vol 2•358
A. D. Data Sys., Inc., Rochester, N.Y.
Austin Elctrns., Roselle, N.J.
Autocon Inds., Inc., Minneapolis, Minn.
Bendix Corp. Environmtl. Sci., Baltimore, Md.
Bristol Div, Waterbury, Conn
Cardion Elctrns., Woodbury, N.Y.
Codex Corp., Newton, Mass.
Continental Data Sys., Dayton, Ohio
Cubic Corp., San Diego, Cal.
Data-Control Systems, Danbury, Conn.
Demex, Inc., Kansas City, Mo.
Design Elements, Columbus, Ohio
Digitronics Corp., Albertson, N.Y.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
GTE Automatic Elec., Northlake, Ill.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Hadron Inc., Westbury, N.Y.
Hathaway Instruments, Inc., Denver, Colo.
Hi-G, Windsor Locks, Conn.
Honeywell, Ft. Washington, Pa.
Hy-Cal Engrg., Santa Fe Springs, Cal.
Integrated Systems, Inc., Norcross, Ga.
International Communications Corp., A Milgo Co., Miami, Fla.
Lear Siegler, Inc., Santa Monica, Calif.
Marconi Elctrns. Inc., Elmsford, N.Y.
McDonnell Douglas Electronics Co., St. Charles, Mo.
Memodyne Corp., Newton Upper Falls, Ma.
Metra Instruments, Inc., Mt. View, Cal.
NES, Inc., Itasca, Ill.
North Electric Co., Galion, Ohio
Optical Communications, Inc., Orlando, Fla.
RCA Service Co., Camden, N.J.
Remex, Santa Ana, Cal.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Schneider Instr. Co., Cincinnati, Ohio
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.
Theta Instr. Corp., Fairfield, N.J.
Westinghouse Elec. Corp., Computer & Instr. Div., Pittsburgh, Pa.

Transmitters, Beacon

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A.R.F. Products, Inc., Boulder, Colo.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Intricate Circuit Corp., Port Chester, N.Y.
Marconi Elctrns. Inc., Elmsford, N.Y.
Pacific Communications, Santa Ana, Cal.
Thomson-CSF Inc., New York, N.Y.

Transmitters, Digital Data—See Transmission Systems, Data

Transmitters, Fixed Frequency

Advanced Energy Conversion, Belmont, Cal.
A.R.F. Products, Inc., Boulder, Colo.
Arra Inc., Bay Shore, N.Y.
Autocon Inds., Inc., Minneapolis, Minn.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
Bogen Div., Paramus, N.J.
Brelonix, Inc., Seattle, Wash
Bristol Div, Waterbury, Conn
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Drake, R.L., Co., Miamisburg, Ohio
Dynalab Corp., Van Nuys, Cal.
Electro/Data, Inc., Garland, Tex.
Energy Systems, Palo Alto, Cal.
Farinon Electric, San Carlos, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
Heath Co., Benton Harbor, Mich.
IEC Electronics Corp., E. Rochester, N.Y.
Intricate Circuit Corp., Port Chester, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Johnson E. F. Co., Waseca, Minn.
Linear Sys., Inc., Watsonville, Calif.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Melpar, Falls Church, Va.
Microwave Power Devices, Plainview, N. Y.
Mobil Elctrns., Inc., Anderson, Ind.
OPtimax Inc., Colmar, Pa.
Pace Div., Harbor City, Calif.
Pacific Communications, Santa Ana, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Regency Elctrns., Inc., Indianapolis, Ind.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rohde & Schwarz Sls., Passaic, N.J.
Sierra Sys., Mountain View, Cal.
Special Microwave Devices Oper., Waltham, Mass.
Technical Mat'l., Mamaroneck, N.Y.
Telectro Sys. Corp., Corona, N.Y.

Transmitters, Fixed Station Comm.

American Elctrn. Labs., Inc., Lansdale, Pa.
Bendix Corp, Towson, Md.
Bogen Div., Paramus, N.J.
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Drake, R.L., Co., Miamisburg, Ohio
EG&G, Inc., Bedford, Mass.
Energy Systems, Palo Alto, Cal.
Farinon Electric, San Carlos, Calif.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
IEC Electronics Corp., E. Rochester, N.Y.
Intricate Circuit Corp., Port Chester, N.Y.
ITT Mackay Marine, Elizabeth, N.J.
Johnson E. F. Co., Waseca, Minn.
Linear Sys., Inc., Watsonville, Calif.
Marconi Elctrns. Inc., Elmsford, N.Y.
Microwave Power Devices, Plainview, N. Y.
Mobil Elctrns., Inc., Anderson, Ind.
Pace Div., Harbor City, Calif.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Technical Mat'l., Mamaroneck, N.Y.
Thomson-CSF Inc., New York, N.Y.

Transmitters, Microwave

Cober Elctrns., Inc., Stamford, Conn. **Vol 1•545**
MCL, Inc., La Grange, Ill. .. Vol 1•551,560
Vega Precision Labs., Vienna, Va. **Vol 1•568**
Ailtech, City of Industry, Cal.
Aircom, Inc., Union, N.H.
American Elctrn. Labs., Inc., Lansdale, Pa.
Applied Microwave, Westwood, Mass.
Arra Inc., Bay Shore, N.Y.
Avantek, Inc., Santa Clara, Cal.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Cubic Corp., San Diego, Cal.
Dynalab Corp., Van Nuys, Cal.
Energy Systems, Palo Alto, Cal.
Environmental Communications Inc., Santa Ana, Cal.
Farinon Electric, San Carlos, Calif.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
Greenray Inds., Inc., Mechanicsburg, Pa.
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Melpar, Falls Church, Va.
Microlab/FXR, Livingston, N.J.
Microwave Assocs., Inc., Burlington, Mass.
Premier Microwave, Port Chester, N.Y.
Raytheon Data Systems Co., Norwood, Mass.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RHG Elctrns. Lab., Deer Park, N.Y.
Rodelco, Deer Park, N.Y.
Somerset Radiation Lab., Arlington, Va.
Special Microwave Devices Oper., Waltham, Mass.
Teledyne Mec., Palo Alto, Cal.
Thomson-CSF Inc., New York, N.Y.
Trak Microwave, Tampa, Fla.
Varian Assocs., Palo Alto, Cal.
Varian Assoc., Solid State East Div., Micro-Link Prods., Beverly, Mass
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec. Corp., Defense & Public Sys, Pittsburgh, Pa.

Transmitters, Multiplex

Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Collins Radio Co., Dallas, Tex.
Hathaway Instruments, Inc., Denver, Colo.
Pacific Communications, Santa Ana, Cal.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Singer - Tele-Signal, Woodbury, N.Y.
Special Microwave Devices Oper., Waltham, Mass.
Thomson-CSF Inc., New York, N.Y.

Transmitters, Pulse Code Modulation

Bramco Controls, Piqua, Ohio
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Epsco, Inc., Westwood, Mass.
HB Engineering Corp., Beltsville, Md.
Marconi Elctrns. Inc., Elmsford, N.Y.
Pacific Communications, Santa Ana, Cal.
Phoenix Data Inc., Phoenix, Ariz.
RCA Govt. & Comm. Sys., Moorestown, N.J.
SCS Corporation-Microsystems, Ft. Lauderdale, Fla.

Transmitters, Pulse Phase Modulation

Cober Elctrns., Inc., Stamford, Conn.
Continental Elctrns. Mfg. Co., Dallas, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Raytheon Data Systems Co., Norwood, Mass.
Thomson-CSF Inc., New York, N.Y.

Transmitters, Pulse Time Modulation

Ailtech, City of Industry, Cal.
Autocon Inds., Inc., Minneapolis, Minn.
Bristol Div, Waterbury, Conn
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Continental Elctrns. Mfg. Co., Dallas, Tex.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Thomson-CSF Inc., New York, N.Y.
Vega Precision Labs., Vienna, Va.

Transmitters, Radar—See Radar Systems

Transmitters, Single-Sideband

Arvin Sys., Inc., Dayton, Ohio
Bendix Corp, Towson, Md.
Brelonix, Inc., Seattle, Wash
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Continental Elctrns. Mfg. Co., Dallas, Tex.
Design Automation, Inc., Lexington, Mass.
Drake, R.L., Co., Miamisburg, Ohio
GTE Lenkurt Inc., San Carlos, Calif.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Heath Co., Benton Harbor, Mich.
ITT Mackay Marine, Elizabeth, N.J.
Linear Sys., Inc., Watsonville, Calif.
Marconi Elctrns. Inc., Elmsford, N.Y.
Pace Div., Harbor City, Calif.
Pearce-Simpson, Miami, Fla.
RCA Govt. & Comm. Sys., Moorestown, N.J.
RFL Inds., Comms. Div., Boonton, N.J.
Rohde & Schwarz Sls., Passaic, N.J.
Technical Mat'l., Mamaroneck, N.Y.
Telectro Sys. Corp., Corona, N.Y.
Thomson-CSF Inc., New York, N.Y.

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Alden Elctrn. & Impulse Record. Equip., Westboro, Mass.
Arra Inc., Bay Shore, N.Y.
Autocon Inds., Inc., Minneapolis, Minn.
Beukers Labs., Inc., Hauppauge, N.Y.
BF Elctrns., Solana Beach, Calif.
Biocom, Inc., Culver City, Cal.
Bramco Controls, Piqua, Ohio
Bristol Div, Waterbury, Conn
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Dallas, Tex.
Conic Corp., San Diego, Calif.
Continental Data Sys., Dayton, Ohio
Continental Elctrns. Mfg. Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Dataprobe, Inc., So. Hackensack, N.J.
Elctrn. Comm., Inc., St. Petersburg, Fla.
Epsco, Inc., Westwood, Mass.
General Instr. Corp., Defense & Engrg. Prods. Grp., Elctrn. Sys. Div., Hicksville, N.Y.
Hathaway Instruments, Inc., Denver, Colo.
Honeywell, Ft. Washington, Pa.
Integrated Systems, Inc., Norcross, Ga.
McDonnell Douglas Electronics Co., St. Charles, Mo.
OPtimax Inc., Colmar, Pa.
Pacific Communications, Santa Ana, Cal.
Phoenix Data Inc., Phoenix, Ariz.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Resdel Engrg. Corp., Arcadia, Cal.
RFL Inds., Comms. Div., Boonton, N.J.
Schneider Instr. Co., Cincinnati, Ohio
Singer Co., Philadelphia, Pa.
Special Microwave Devices Oper., Waltham, Mass.
Trak Microwave, Tampa, Fla.
Watkins Johnson Co., Palo Alto, Cal.

Transmitters, Tropospheric Scatter

Arra Inc., Bay Shore, N.Y.
CCA Elctrns. Corp., Gloucester, N.J.
Cober Elctrns., Inc., Stamford, Conn.
Energy Systems, Palo Alto, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
Marconi Elctrns. Inc., Elmsford, N.Y.
Microwave Power Devices, Plainview, N. Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.

Transmitters, UHF/VHF

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Advanced Energy Conversion, Belmont, Cal.
AIL, Div. Cutler-Hammer, Inc., Deer Park, N.Y.
A.R.F. Products, Inc., Boulder, Colo.
Arra Inc., Bay Shore, N.Y.
Bendix Corp., Ft. Lauderdale, Fla.
Bendix Corp, Towson, Md.
CCA Elctrns. Corp., Gloucester, N.J.
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Dynalab Corp., Van Nuys, Cal.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
IEC Electronics Corp., E. Rochester, N.Y.
Intricate Circuit Corp., Port Chester, N.Y.
Lundy Elctrns. & Sys., Inc., Glen Head, N.Y.
Melpar, Falls Church, Va.
Microwave Power Devices, Plainview, N. Y.
OPtimax Inc., Colmar, Pa.
Pace Div., Harbor City, Calif.
Pacific Communications, Santa Ana, Cal.
Pearce-Simpson, Miami, Fla.
RCA Corp., Camden, N.J.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Regency Elctrns., Inc., Indianapolis, Ind.
Thomson-CSF Inc., New York, N.Y.

Transmitters, ULF/VLF

Advanced Energy Conversion, Belmont, Cal.
Dynalab Corp., Van Nuys, Cal.
Intricate Circuit Corp., Port Chester, N.Y.
RCA Govt. & Comm. Sys., Moorestown, N.J.
Technical Mat'l., Mamaroneck, N.Y.
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AMF Electical Prods., Alexandria, Va.
A.R.F. Products, Inc., Boulder, Colo.
Bendix Corp., Ft. Lauderdale, Fla.
Bendix Corp, Towson, Md.
Bramco Controls, Piqua, Ohio
Cincinnati Elctrns. Corp., Cincinnati, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Collins Radio Co., Dallas, Tex.
Cubic Corp., San Diego, Cal.
Epsco, Inc., Westwood, Mass.
ESC Elctrns. Corp., Palisades Pk., N.J.
GTE Sylvania Inc., Elctrn. Sys. Gp., Waltham, Mass.
McDonnell Douglas Electronics Co., St. Charles, Mo.
RCA Elctrns. Comps., Harrison, N.J.
Resdel Engrg. Corp., Arcadia, Cal.

Triacs—See Thyristors

Triggers, SCR—See Controls, SCR

Trimmer Potentiometers—See Potentiometers, Trimmer

Tube Heat Dissipators

Atlee Corp., Woburn, Mass.
Eimac, San Carlos, Calif.
Int'l. Elctrn. Resch., Burbank, Cal.
Lear Siegler, Inc., Elyria, Ohio
Nanotron Relay Co., Burbank, Cal.
Waterbury Pressed Metal Co., Waterbury, Conn.

Tube Pullers—See Pullers, Tube

Tube Testers—See Testers, Tube

Tubes, Backward Wave

Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
ITT Electron Tube, Easton, Pa.
Litton Inds., San Carlos, Calif.
Raytheon Co., Burlington, Mass.
Raytheon Co., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Varian Assocs., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Watkins Johnson Co., Palo Alto, Cal.

Tubes, Ballast—See Resistors, Ballast

Tubes, Cathode-Ray, Data Storage, TV Picture

Amperex Electronic Corp., Hicksville, N.Y. ..... Vol 3•521
Raytheon Co., Quincy, Mass. Vol 2•1191
Data General Corp. (E), Southboro, Ma.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
General Electrodynamics Corp., Garland, Tex.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
ITT Electron Tube, Easton, Pa.
Litton Inds., San Carlos, Calif.
Rauland, Melrose Pk., Ill.
RCA Elctrns. Comps., Harrison, N.J.
Thomas Elctrns., Inc., Wayne, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode-Ray, Instrument Use

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Coleman Instr. Div., Oak Brook, Ill.
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
General Atronics, Phila., Pa.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
RCA Elctrns. Comps., Harrison, N.J.
Tektronix, Inc., Beaverton, Ore.
Thomas Elctrns., Inc., Wayne, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode-Ray, Multiple Gun

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Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
General Atronics, Phila., Pa.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
GTE Sylvania Inc., Seneca Falls, N.Y.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Rank Precision Inds., Des Plaines, Ill.
Raytheon Co., Quincy, Mass.
Thomas Elctrns., Inc., Wayne, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode-Ray, Projection

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Amperex Elctronic Corp., Slatersville, R.I.
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
General Atronics, Phila., Pa.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Rank Precision Inds., Des Plaines, Ill.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomas Elctrns., Inc., Wayne, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode-Ray, Scan Conversion

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•614
Raytheon Co., Quincy, Mass. Vol 2•1191
DuMont Electron Tubes, Clifton, N.J.
General Electrodynamics Corp., Garland, Tex.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode-Ray, Shaped-Beam

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•614
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
General Atronics, Phila., Pa.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
GTE Sylvania Inc., Seneca Falls, N.Y.
Hughes Aircraft Co., Image Devices Ind'l. Prods. Div., Oceanside, Calif.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Rank Precision Inds., Des Plaines, Ill.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Westinghouse Elec., Elmira, N.Y.

Tubes, Cathode Ray, TV Picture—See Tubes, Cathode-Ray Data Storage TV Picture

Tubes, Ceramic (Electron)

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•614
Amperex Electronic Corp., Hicksville, N.Y.
Apollo Corp., Shinagawa-Ku, Tokyo, Japan
Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Machlett Labs., Inc., Stamford, Conn.
Murata Mfg. Co. Ltd., Kyoto, Japan
Rank Precision Inds., Des Plaines, Ill.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Varian Assocs., Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Counting

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Amperex Electronic Corp., Hicksville, N.Y.
Burroughs Corp., Plainfield, N.J.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Pinlites, Fairfield, N.J.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
Shigoto Inds., Ltd., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.

Tubes, Diode, Temperature Limited

Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
GTE Sylvania Inc., Seneca Falls, N.Y.
Signalite, Neptune, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Electrometer

Amperex Electronic Corp., Hicksville, N.Y.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
Raytheon Co., Quincy, Mass.
Thor Elctrns. Corp., Elizabeth, N.J.

Tubes, Electron Multiplier

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183
Hamamatsu Corp. (E), Middlesex, N. J. Vol 2•1185
Amperex Electronic Corp., Hicksville, N.Y.
Bendix Corp., Sturbridge, Mass.
Calvert Elctrns., Inc., New York, N.Y.
Coleman Instr. Div., Oak Brook, Ill.
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
GTE Sylvania Inc., Seneca Falls, N.Y.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Murata Mfg. Co. Ltd., Kyoto, Japan
RCA Elctrns. Comps., Harrison, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Uthe Technology Int'l., Sunnyvale, Cal.
Wagner Elec. Corp., Livingston, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Flash

Amersil, Inc., Hillside, N.J.
Dutrex Inds., Inc., New York, N.Y.
EG & G, Inc., Salem, Mass.
General Radio Co., Concord, Mass.
Heimann GmbH, Mt. Vernon, N.Y.
Illumination Inds., Inc., Sunnyvale, Cal.
Int'l. Elctrns., Melville, N.Y.
Kemlite Labs., Inc., Chicago, Ill.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
U.S. Scientific Instrs., Watertown, Mass.
Xenon Corp., Medford, Mass.

Tubes, Forward Wave

Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Raytheon Co., Waltham, Mass.
Sperry Elctrn. Tube, Gainesville, Fla.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.

Tubes, Gas

Semtech Corp., Newbury Pk., Cal. Vol 2•936
Amperex Electronic Corp., Hicksville, N.Y.
Black Light Corp. Amer., San Gabriel, Cal.
Burroughs Corp., Plainfield, N.J.
Cetron Elctrn. Corp., Geneva, Ill.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
Electrons Co., Fairfield, N.J.
GTE Sylvania Inc., Seneca Falls, N.Y.
Harshaw Chem. Co., Cleveland, Ohio
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Kemlite Labs., Inc., Chicago, Ill.
National Elctrns., Geneva, Ill.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Signalite, Neptune, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Ultra-Violet Prods., Inc., San Gabriel, Cal.
Varian Assocs., Palo Alto, Cal.

Tubes, Ignitron

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183
Advanced Kinetics, Costa Mesa, Calif.
Amperex Electronic Corp., Hicksville, N.Y.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
Illumination Inds., Inc., Sunnyvale, Cal.
Int'l. Elctrns., Melville, N.Y.
International Rectifier, El Segundo, Cal.
National Elctrns., Geneva, Ill.
Raytheon Co., Burlington, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Triac Elctrn. Sys., Forest Hills, N. Y.
Varian Assocs., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Image Converter

General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y. ..... Vol 2•614
Ind'l Elctrn. Engrs., Van Nuys, Cal. Vol 2•509
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Machlett Labs., Inc., Stamford, Conn.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varo, Garland, Tex.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Westinghouse Elec., Elmira, N.Y.

Tubes, Indicator—See Tubes, Readout

Tubes, Industrial Power

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1182,1183
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Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Cetron Elctrn. Corp., Geneva, Ill.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
Electrons Co., Fairfield, N.J.
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Machlett Labs., Inc., Stamford, Conn.
National Elctrns., Geneva, Ill.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Triac Elctrn. Sys., Forest Hills, N. Y.
Varian Assocs., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Klystron

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Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Raytheon Co., Burlington, Mass.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Sperry Elctrn. Tube, Gainesville, Fla.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.

Varian Assocs., Eastern Tube Div., Beverly, Mass.
Varian Palo Alto Tube Div., Palo Alto, Cal.

Tubes, Laser

Amersil, Inc., Hillside, N.J.
Dutrex Inds., Inc., New York, N.Y.
EG & G, Inc., Salem, Mass.
Int'l. Elctrns., Melville, N.Y.
Kemlite Labs., Inc., Chicago, Ill.
Optics Technology, Palo Alto, Calif.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Spectra-Physics, Inc., Mountain View, Calif.
Thermal Amer. Fused Quartz, Montville, N.J.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.

Tubes, Magnetron

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183
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Amperex Electronic Corp., Hicksville, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Bowmar/TIC, Inc., Newbury Park, Calif.
Calvert Elctrns., Inc., New York, N.Y.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Microwave Assocs., Inc., Burlington, Mass.
Raytheon Co., Burlington, Mass.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Varian Palo Alto Tube Div., Palo Alto, Cal.
VTM Microwaves, Inc., Boulder, Colo.

Tubes, Microwave

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1182,1183
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Amperex Electronic Corp., Hicksville, N.Y.
Bowmar Instr. Corp., Ft. Wayne, Ind.
Calvert Elctrns., Inc., New York, N.Y.
Co-Operative Inds., Inc., Chester, N.J.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Elctrn. Enterprises, Newark, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Litton Inds., San Carlos, Calif.
Machlett Labs., Inc., Stamford, Conn.
Microwave Assocs., Inc., Burlington, Mass.
Raytheon Co., Burlington, Mass.
Raytheon Co., Waltham, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Signalite, Neptune, N.J.
Sperry Elctrn. Tube, Gainesville, Fla.
Teledyne Mec., Palo Alto, Cal.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Varian Assocs., Travel Wave Tube Div., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
VTM Microwaves, Inc., Boulder, Colo.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Watkins Johnson Co., Palo Alto, Cal.

Tubes, Noise Source

Elgenco, Inc., Santa Monica, Cal. Vol 1•441
Dutrex Inds., Inc., New York, N.Y.
General Microwave Corp., Farmingdale, N.Y.
Int'l. Elctrns., Melville, N.Y.
Signalite, Neptune, N.J.
Sperry Elctrn. Tube, Gainesville, Fla.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian Assocs., Eastern Tube Div., Beverly, Mass.
Warnecke Electron Tubes, Inc., Des Plaines, Ill.
Waveline, Inc., W. Caldwell, N.J.

Tubes, Photomultiplier

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183
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Hamamatsu Corp. (E), Middlesex, N. J. Vol 2•1185,1186
Amperex Electronic Corp., Hicksville, N.Y.
Bailey Instrs., Inc., Saddle Brook, N.J.
Bendix Corp., Sturbridge, Mass.
Calvert Elctrns., Inc., New York, N.Y.
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Dutrex Inds., Inc., New York, N.Y.
Gamma Sci., San Diego, Cal.
GTE Sylvania Inc., Seneca Falls, N.Y.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Rank Precision Inds., Des Plaines, Ill.
RCA Elctrns. Comps., Harrison, N.J.
SSR Instrs. Co., Santa Monica, Cal.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.

Tubes Read Out (CRT, Cold-Cathode, Vacuum Fluorescent, Incandescent, Etc.)

Inter-Tech. Grp., Inc., Irvington-on-Hudson, N.Y..... Vol 2•1187
Raytheon Co., Quincy, Mass. Vol 2•1191
Wagner Elec. Corp., Livingston, N.J. Vol 2•539
Alco Elctrn. Prods., North Andover, Mass.
Amperex Elctronic Corp., Slatersville, R.I.
Amperex Electronic Corp., Hicksville, N.Y.
Amperex Elctrn., Slatersville, R.I.
Apollo Corp., Shinagawa-Ku, Tokyo, Japan
Burroughs Corp., Plainfield, N.J.
Calvert Elctrns., Inc., New York, N.Y.
Corvair Elctrns, New York, N.Y.
DuMont Electron Tubes, Clifton, N.J.
Ind'l Elctrn. Engrs., Van Nuys, Cal.
Int'l. Elctrns., Melville, N.Y.
Litton Inds., San Carlos, Calif.
Major Data Corp., Costa Mesa, Cal.
National Elctrns., Geneva, Ill.
Pinlites, Fairfield, N.J.
Raytheon Co., Burlington, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Signalite, Neptune, N.J.
TEC, Inc., Tucson, Ariz.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Receiving

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1182,1183
Allied Elctrns., Chicago, Ill.
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Cetron Elctrn. Corp., Geneva, Ill.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
GTE Sylvania Inc., Elctrn. Comps. Grp., Waltham, Mass.
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Components Corp., Farmingdale, N. Y.
Int'l. Elctrns., Melville, N.Y.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Shigoto Inds., Ltd., New York, N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Varian, Solid State West Division, Palo Alto, Cal.
Watkins Johnson Co., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Rectifying, Gas-Filled

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1182,1183
Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Cetron Elctrn. Corp., Geneva, Ill.
Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
Electrons Co., Fairfield, N.J.
Gordos Corp., Bloomfield, N.J.
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Elctrns., Melville, N.Y.
National Elctrns., Geneva, Ill.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Wagner Elec. Corp., Livingston, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Rectifying, Vacuum

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1182,1183
Semtech Corp., Newbury Pk., Cal. Vol 2•936
Allied Elctrns., Chicago, Ill.
Amperex Electronic Corp., Hicksville, N.Y.
Apollo Corp., Shinagawa-Ku, Tokyo, Japan
Calvert Elctrns., Inc., New York, N.Y.
Cetron Elctrn. Corp., Geneva, Ill.
Coleman Instr. Div., Oak Brook, Ill.
Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
Gordos Corp., Bloomfield, N.J.
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Elctrns., Melville, N.Y.
International Rectifier, El Segundo, Cal.
Machlett Labs., Inc., Stamford, Conn.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Varian Assocs., Palo Alto, Cal.
Varian Palo Alto Tube Div., Palo Alto, Cal.
Victoreen Instr., Cleveland, Ohio
Westinghouse Elec., Elmira, N.Y.

Tubes, Strobe—See Lights, Stroboscopic

Tubes, Switching

Amperex Elctronic Corp., Slatersville, R.I. ..... Vol 2•1183
Victoreen Instr., Cleveland, Ohio Vol 2•1193
Amperex Electronic Corp., Hicksville, N.Y.
Burroughs Corp., Plainfield, N.J.
Calvert Elctrns., Inc., New York, N.Y.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
EG & G, Inc., Salem, Mass.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
GTE Sylvania Inc., Seneca Falls, N.Y.
Int'l. Elctrns., Melville, N.Y.
Machlett Labs., Inc., Stamford, Conn.
RCA Elctrns. Comps., Harrison, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Torr Labs., Los Angeles, Cal.
Varian Assocs., Palo Alto, Cal.
Westinghouse Elec., Elmira, N.Y.

Tubes, Tv Camera Pickup

Hamamatsu Corp. (E), Middlesex, N. J. Vol 2•1185,1186
Amperex Elctronic Corp., Slatersville, R.I.
Calvert Elctrns., Inc., New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
General Elec. Co., Elctrn. Comps. Sls. Dept., Schenectady, N.Y.
General Electrodynamics Corp., Garland, Tex.
Hamamatsu TV Co., Ltd., Hamamatsu City, Shizuoka Pref., Japan
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
Javelin Div., Apollo Lasers, Inc., Los Angeles, Ca.
RCA Corp., Camden, N.J.
RCA Elctrns. Comps., Harrison, N.J.
Texas Instruments, Dallas, Tex.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Thyratron

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Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Cetron Elctrn. Corp., Geneva, Ill.
Corvair Elctrns, New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
EG & G, Inc., Salem, Mass.
Elctrn. Enterprises, Newark, N.J.
Electrons Co., Fairfield, N.J.
Int'l. Elctrns., Melville, N.Y.
ITT Electron Tube, Easton, Pa.
National Elctrns., Geneva, Ill.
Raytheon Co., Burlington, Mass.
Raytheon Co., Quincy, Mass.
RCA Elctrns. Comps., Harrison, N.J.
Signalite, Neptune, N.J.
Thomson-CSF Electron Tubes, N.Y., N.Y.
Thor Elctrns. Corp., Elizabeth, N.J.
Varian Assocs., Palo Alto, Cal.
Wagner Elec. Corp., Livingston, N.J.
Westinghouse Elec., Elmira, N.Y.

Tubes, Transmit-Receive (TR)

Amperex Electronic Corp., Hicksville, N.Y.
Calvert Elctrns., Inc., New York, N.Y.
Dutrex Inds., Inc., New York, N.Y.
Int'l. Elctrns., Melville, N.Y.
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Cetron Elctrn. Corp., Geneva, Ill.
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Dutrex Inds., Inc., New York, N.Y.
Eimac, San Carlos, Calif.
Elctrn. Enterprises, Newark, N.J.
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ITT Electron Tube, Easton, Pa.
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Machlett Labs., Inc., Stamford, Conn.
Raytheon Co., Burlington, Mass.
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Watkins Johnson Co., Palo Alto, Cal.
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Aremco Prods., Inc., Briarcliff Manor, N.Y.
Basic Ceramics Inc., Hawthorne, N.J.
Bram Metallurgical-Chem. Co., Phila., Pa.
Carborundum Co., Niagara Falls, N.Y.
Coors Porcelain Co., Golden, Colo.
Corning Glass Works, Tech. Prods. Div., Corning, N.Y.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
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National Beryllia Corp., Haskell, N.J.
Nat'l. Ceramic Co., Trenton, N.J.
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E.I. DuPont DeNemours & Co., Wilmington, Del.
GC Electronics, Rockford, Ill.
High Voltage Engrg. Corp., Burlington, Mass.
K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan
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Maury Microwave Corp., Cucamonga, Calif.
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Scientific Communications, Garland, Tex.
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Microwave Development Labs., Inc., Needham Hgts., Mass.
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R L C Elctrns., Inc., Mt. Kisco, N.Y.
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Co-Operative Inds., Inc., Chester, N.J.
Corning Glass Works, Television Prods. Div., Corning, N.Y.
Gabriel Elctrns. Inc., Scarborough, Me.
Marconi Elctrns. Inc., Elmsford, N.Y.
Maury Microwave Corp., Cucamonga, Calif.
Microwave Development Labs., Inc., Needham Hgts., Mass.
RF Systems, Inc., Cohasset, Mass.
Servometer Corp., Clifton, N.J.
Systron-Donner Microwave Div., Van Nuys, Cal.
Uniform Tubes, Collegeville, Pa.

Wave-Absorbing Materials, Electromagnetic

TDK Electronics Co., Ltd., Chiyoda-ku, Tokyo 101, Japan
Zippertubing Co., Los Angeles, Calif.

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3M Co., St. Paul, Minn.
Westinghouse Elec., Sykesville, Md.

Welding Equip., Semiconductor Devices

Associate General Labs., Inc., Brookfield, Ill.
Ewald Instrs. Corp., Kent, Conn.
Freudenberg, B., Inc., New York, N.Y.
GTI Corp. (E), Pittsburgh, Pa.
Hadron Inc., Westbury, N.Y.
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Hughes Aircraft Co., Welding Equip./Ind'l. Prods. Div., Oceanside, Calif.
Kahle Engrg. Co., Union City, N.J.
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National Elctrns., Geneva, Ill.
Sonobond Corp., West Chester, Pa.
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Tekform Prods. Co., Anaheim, Cal.

Union Carbide, San Diego, Cal.
Uthe Technology Int'l., Sunnyvale, Cal.
Varian Assocs., Vacuum Div., Palo Alto, Cal.

Whiteprint Machines
Keuffel & Esser Co., Morristown, N.J.
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Windows, Waveguide
Aircom, Inc., Union, N.H.
Airtron, Morris Plains, N.J.
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American Elctrn. Labs., Inc., Lansdale, Pa.
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Ceramaseal, Inc., New Lebanon Center, N.Y.
Latronics Corp., Latrobe, Pa.
Microwave Development Labs., Inc., Needham Hgts., Mass.
Plessey Ceramic Div., Frenchtown, N.J.
Premier Microwave, Port Chester, N.Y.
RF Systems, Inc., Cohasset, Mass.
Rogers Corp., Rogers, Conn.
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Manhattan Elec. Cable Corp., Brooklyn, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
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Standard Wire & Cable, Los Angeles, Cal.
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Associated Engrg. & Mfg. Corp., Upper Montclair, N. J.
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General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
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Judd Wire Div., Burlington, Mass.
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Cities Svc. Co., Chester, N.Y.
Columbia Eletrn. Cables, New Bedford, Mass.
Copperweld Bimetallics, Glassport, Pa.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
GC Electronics, Rockford, Ill.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
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GTE Sylvania Inc., Warren, Pa.
Judd Wire Div., Burlington, Mass.
Lance Inds., Sylmar, Calif.
Pace Wire & Cable Corp., Oceanside, N.Y.
Prestolite Wire Div., Eltra Co., Port Huron, Mich.
Rohn Mfg., Peoria, Ill.
Standard Wire & Cable, Los Angeles, Cal.
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Wire Research Corp., Chatsworth, Cal.
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Asco Wire & Cable Co., Bridgeport, Conn.
Belden Corp. Elctrn. Div., Richmond, Ind.
Bram Metallurgical-Chem. Co., Phila., Pa.
Consolidated Wire & Assoc. Corps., Chicago, Ill.
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Philips Elmet Corp., Lewiston, Me.
Slepian, Arthur & Co., Bridgeport, Conn.
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Belden Corp. Elctrn. Div., Richmond, Ind.
Birnbach Co., Inc., Freeport, N.Y.
Bram Metallurgical-Chem. Co., Phila., Pa.
Caddel-Burns Mfg. Co., Inc., Mineola, N. Y.
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Columbia Superconductor & Cryogenics Co., Allentown, Pa.
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Essex Int'l., Inc., Fort Wayne, Ind.
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Philips Elmet Corp., Lewiston, Me.
Phoenix Wire, Inc., S. Hero, Vt.
Reynolds Metals Co., Richmond, Va.
Shigoto Inds., Ltd., New York, N.Y.
Slepian, Arthur & Co., Bridgeport, Conn.
Standard Wire & Cable, Los Angeles, Cal.
Victor Wire & Cable, L.A., Cal.
Viking Wire Co., Inc., Danbury, Conn.
Wire Research Corp., Chatsworth, Cal.

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Wire, Plastic Insulated—See Wire Hookup (All Types)

Wire, Plated (All Types)

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Wire Research Corp., Chatsworth, Cal.

Wire, Radiation-Resistant

ARI Inds., Inc., Franklin Pk., Ill.
Brand-Rex Co., Willimantic, Conn.
Cerro Wire & Cable Co., New Haven, Conn.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
General Elec., Bridgeport, Conn
Gore, W.L. & Assocs., Inc., Newark, Del.
Hudson Wire Co, Ossining, N Y
ITT Surprenant Div., Clinton, Mass.
Judd Wire Div., Burlington, Mass.
Molecu-Wire Corp., Farmingdale, N.J.
Permaluster, Inc., Burbank, Calif.
Standard Wire & Cable, Los Angeles, Cal.
Tensolite, Tarrytown, N.Y.
Times Wire & Cable, Wallingford, Conn.
Victor Wire & Cable, L.A., Cal.

Wire, Resistance

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Hoskins Mfg. Co., Detroit, Mich.
Prestolite Wire Div., Eltra Co., Port Huron, Mich.
Wire Research Corp., Chatsworth, Cal.
Wireflex Inc., Calumet City, Ill.

Wire, Resistance Thermometer

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GTE Sylvania Inc., Newark, N.J.
Hudson Wire Co, Ossining, N Y
Kates Scientific Instrs., Inc., Watertown, Mass.
Leico Inds., Inc., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
Molecu-Wire Corp., Farmingdale, N.J.
Omega Engrg., Inc., Stamford, Conn.
Wire Research Corp., Chatsworth, Cal.
Wireflex Inc., Calumet City, Ill.

Wire, Ribbon

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Cohn, Sigmund, Mt. Vernon, N.Y.
Columbia Eletrn. Cables, New Bedford, Mass.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Flexible Circuits, Inc., Warrington, Pa.
Gavitt Wire & Cable Div., Brookfield, Mass.
Gore, W.L. & Assocs., Inc., Newark, Del.
GTE Sylvania, Inc., Towanda, Pa.

GTE Sylvania Inc., Newark, N.J.
GTE Sylvania Inc., Warren, Pa.
Hoskins Mfg. Co., Detroit, Mich.
Hudson Wire Co, Ossining, N Y
Judd Wire Div., Burlington, Mass.
Leico Inds., Inc., New York, N.Y.
Manhattan Elec. Cable Corp., Brooklyn, N.Y.
Nesor Alloy Corp., W. Caldwell, N.J.
NL Inds., Inc., Metal Div., New York, N.Y.
Permaluster, Inc., Burbank, Calif.
Spectra-Strip Corp., Garden Grove, Cal.
Standard Wire & Cable, Los Angeles, Cal.
Tensolite, Tarrytown, N.Y.
Wire Research Corp., Chatsworth, Cal.
Woven Elctrns., Mauldin, S. C.
Zippertubing Co., Los Angeles, Calif.

Wire, Semiconductor Lead

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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
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Fansteel Inc., N Chicago, Ill.
General Elec. Co., Lamp Parts & Equip. Sales Oper., Cleveland, Ohio
GTE Sylvania Inc., Newark, N.J.
GTE Sylvania Inc., Warren, Pa.
Henes Mfg. Co., Phoenix, Ariz.
Leico Inds., Inc., New York, N.Y.
Molecu-Wire Corp., Farmingdale, N.J.
Nat'l-Standard Co., Niles, Mich.
Nesor Alloy Corp., W. Caldwell, N.J.
Revere Elctrn. Div., Wallingford, Conn.
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Tensolite, Tarrytown, N.Y.
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Cerro Wire & Cable Co., New Haven, Conn.
Cimco Wire & Cable, Allendale, N.J.
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Hudson Wire Co, Ossining, N Y
ITT Surprenant Div., Clinton, Mass.
Judd Wire Div., Burlington, Mass.
Lynn Elctrns. Corp., Feasterville, Pa.
Malco, A Microdot Co., Inc., Chicago, Ill.
Markel, L. Frank & Sons, Norristown, Pa.
Nat'l. Wire & Cable, Los Angeles, Cal.
Nesor Alloy Corp., W. Caldwell, N.J.
Norelcom Inds., Inc., Farmingdale, N.Y.
Okonite Co., Ramsey, N.J.
Pace Wire & Cable Corp., Oceanside, N.Y.
Permaluster, Inc., Burbank, Calif.
Prestolite Wire Div., Eltra Co., Port Huron, Mich.
Revere Elctrn. Div., Wallingford, Conn.
Standard Wire & Cable, Los Angeles, Cal.
Teledyne Western Wire & Cable, Los Angeles, Cal.
Tensolite, Tarrytown, N.Y.
Texas Instruments, Attleboro, Mass.
Times Wire & Cable, Wallingford, Conn.
Victor Wire & Cable, L.A., Cal.
Whitmor Wire & Cable, No. Hollywood, Cal.
Wire Research Corp., Chatsworth, Cal.
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Judd Wire Div., Burlington, Mass.
Leico Inds., Inc., New York, N.Y.
Materials Resch. Corp., Orangeburg, N.Y.
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Chemplast, Inc., Wayne, N.J.
Cohn, Sigmund, Mt. Vernon, N.Y.
Columbia Eletrn. Cables, New Bedford, Mass.
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Gore, W.L. & Assocs., Inc., Newark, Del.
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Leico Inds., Inc., New York, N.Y.
Malco, A Microdot Co., Inc., Chicago, Ill.
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Nat'l. Wire & Cable, Los Angeles, Cal.
Norelcom Inds., Inc., Farmingdale, N.Y.
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Standard Wire & Cable, Los Angeles, Cal.
Storm Products Co., Los Angeles, Ca.
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Cities Svc. Co., Chester, N.Y.
Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
Essex Int'l, Inc., Sycamore, Ill.
ITT Surprenant Div., Clinton, Mass.
Judd Wire Div., Burlington, Mass.
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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Dearborn Wire & Cable Co., Rosemont, Ill.
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Gore, W.L. & Assocs., Inc., Newark, Del.
Hatfield Wire & Cable Div., Linden, N.J.
Lynn Elctrns. Corp., Feasterville, Pa.
Malco, A Microdot Co., Inc., Chicago, Ill.
Mupac Corp., Brockton, Mass.
Saxton Prods., Congers, N.Y.
Standard Wire & Cable, Los Angeles, Cal.
Storm Products Co., Los Angeles, Ca.
Superior Cable Div., Hickory, N.C.
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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Eaton Corp., Engired. Fasteners Div., Cleveland, Ohio
Electrovert, Mt. Vernon, N.Y.
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Grayhill Inc., LaGrange, Ill.
Hanscom, H.F. Co., Inc., Providence, R.I.
ITT Holub Inds., Sycamore, Ill.
K. C. C. Shokai Ltd., Nada-ku, Kobe 657, Japan
Mann, Henry Inc., Feasterville, Pa.
Plastiglide Mfg. Corp., Santa Monica, Cal.
Richco Plastic Co., Chicago, Ill.
Saxton Prods., Congers, N.Y.
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3M Co. Electro Prods. Div., St. Paul, Minn.
TRW/Holyoke Wire & Cable, Holyoke, Mass.
Waldom Elctrns., Inc., Chicago, Ill.
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Wire Cutters, Automatic

Eraser Co., Syracuse, N.Y.
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MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Molex Inc., Lisle, Ill.
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Communications Technology Corp., Los Angeles, Cal.
Engineering & Elctrn. Devices, Inc., Los Angeles, Calif.
Erikson Specialized Tool Co., Pico-Rivera, Cal.
ETC, Div. ITT, Cleveland, Ohio
GC Electronics, Rockford, Ill.
General Hardware Mfg. Co., New York, N.Y.
Henes Mfg. Co., Phoenix, Ariz.
Hollis Engrg., Inc., Nashua, N.H.
Hunter Tools, El Monte, Calif
Ideal Industries, Inc., Sycamore, Ill.
ITT Holub Inds., Sycamore, Ill.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Manger Elec. Co., Inc., Stamford, Conn.
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Plymouth Rubber Co., Inc., Canton, Mass.
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Storm Products Co., Los Angeles, Ca.
Thomas & Betts Co., Elizabeth, N.J.
Zippertubing Co., Los Angeles, Calif.

Wire-Marking Machines, Automatic

Ackerman Gould Co., Inc., Oceanside, N.Y.
Artos Engrg. Co., New Berlin, Wisc.
Brady, W.H. Co., Milwaukee, Wisc.
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Matthews, Jas & Co., Pittsburgh, Pa.

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Ackerman Gould Co., Inc., Oceanside, N.Y.
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Daburn Elctrns. & Cable Corp., Bronx, N.Y.
Estes Engrg. Co., Gardena, Calif.
Manger Elec. Co., Inc., Stamford, Conn.
Metex Corp., Edison, N.J.
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Norelcom Inds., Inc., Farmingdale, N.Y.
Standard Wire & Cable, Los Angeles, Cal.
Storm Products Co., Los Angeles, Ca.
Texas Instruments, Attleboro, Mass.
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High Speed Hammer Co., Inc., Rochester, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Molex Inc., Lisle, Ill.
Omega Engrg., Inc., Stamford, Conn.
Taylor-Winfield Corp., Warren, Ohio
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ETC, Div. ITT, Cleveland, Ohio
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ITT Holub Inds., Sycamore, Ill.
Jonard Inds. Corp., Bronx, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
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Stevens, Geo. Mfg. Co., Inc., Chicago, Ill.
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Telvac Instr. Co., Van Nuys, Cal.
Thomas & Betts Co., Elizabeth, N.J.
Utica Tool Co., Inc., Orangeburg, S.C.
Waldom Elctrns., Inc., Chicago, Ill.
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Xcelite, Inc., Orchard Park, N.Y.

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American Elec. Heater, Detroit, Mich.
Eraser Co., Syracuse, N.Y.
Hunter Tools, El Monte, Calif
Ideal Industries, Inc., Sycamore, Ill.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Pioneer Magnetics, Santa Monica, Cal.
Techni-Tool, Inc., Philadelphia, Pa.
Teledyne Kinetics, Solana Beach, Cal.
Thomas & Betts Co., Elizabeth, N.J.
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Carpenter Mfg. Co., Inc., Manlius, N.Y.
Eraser Co., Syracuse, N.Y.
Gardner-Denver Co., Quincy, Ill.
Jonard Inds. Corp., Bronx, N.Y.
MacDonald & Co., Glendale, Calif.
Mann, Henry Inc., Feasterville, Pa.
Storm Products Co., Los Angeles, Ca.
Techni-Tool, Inc., Philadelphia, Pa.

Wire Twisters, Hand Operated

Carpenter Mfg. Co., Inc., Manlius, N.Y.
Eraser Co., Syracuse, N.Y.
Jonard Inds. Corp., Bronx, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
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Gardner-Denver Co., Quincy, Ill.
General Hardware Mfg. Co., New York, N.Y.
Glenair, Inc., Glendale, Calif.
Hunter Tools, El Monte, Calif
Kawecki Berylco Inds., Inc., New York, N.Y.
Klein, Mathias & Sons, Chicago, Ill.
MacDonald & Co., Glendale, Calif.
Moody Tools, Inc., Providence, R.I.
Owatonna Tool Co., Owatonna, Minn.
Raymond Engrg. Inc., Middletown, Conn.
Skyo Industries Inc., Deer Park, N.Y.
Techni-Tool, Inc., Philadelphia, Pa.
Thomas & Betts Co., Elizabeth, N.J.
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Vigor Co., New York, N.Y.
Xcelite, Inc., Orchard Park, N.Y.

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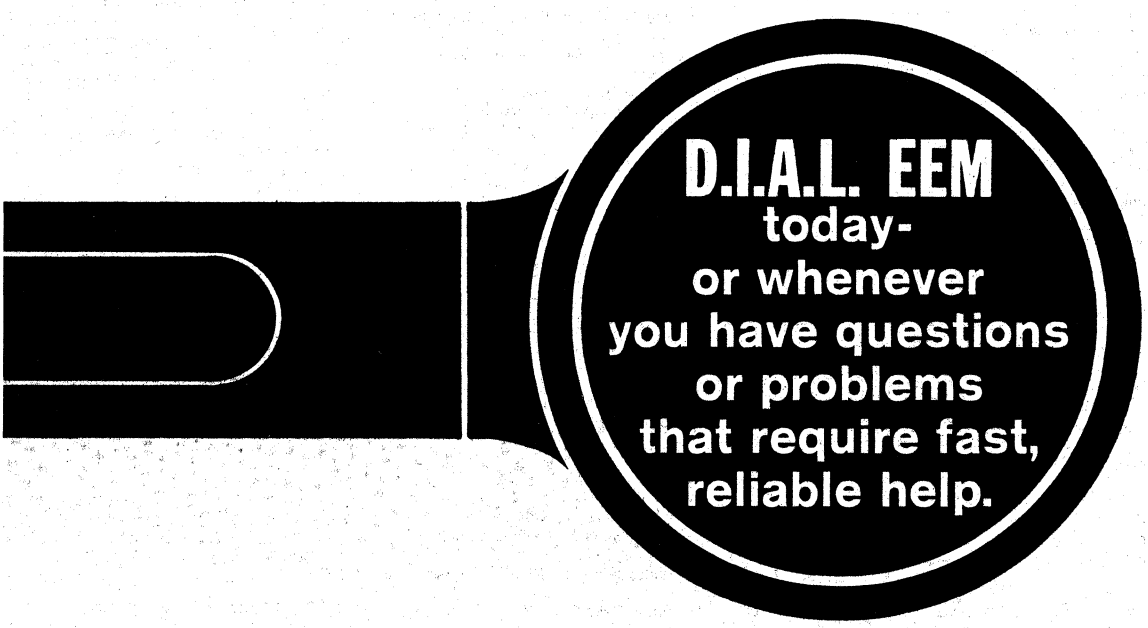

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Vol.2•379	2300	Crystals & Mechanical Tuning Devices; Oscillators
Vol.2•456	2400	Panel Components (Including Lighting & Readouts)
Vol.2•544	2700	Filters
Vol.2•588	3130	Integrated Circuits & Hybrid Microcircuits
Vol.2•607	3450	Microwave, Laser & Radar (Components/Accessories)
Vol.2•630	3500	Motors, Rotating Components & Accessories
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Vol.2•683	4500	Relays & Solenoids
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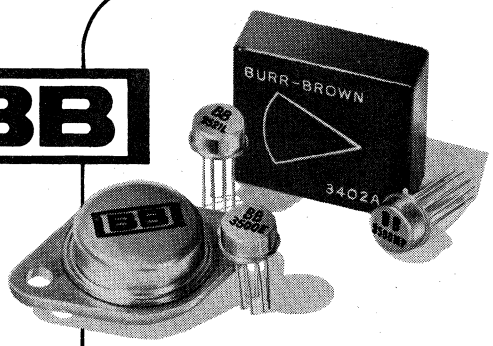

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MODEL 3431J—
VARACTOR/ELECTROMETER AMPLIFIER
0.01 pA max. Bias Current
30 μV/°C max. Voltage Drift
10^{14} Ω Input Impedance
Price (1-9) $55.00

SPECIAL PURPOSE
These amplifiers provide output voltage and current levels outside the range available in IC op amps.
MODEL 3460—WIDE SUPPLY RANGE FET
±11 VDC to ±150 VDC Supply Range
106 dB Open Loop Gain
±140 V Common Mode Voltage Range
25 pA max. Bias Current
10 V/μsec Slew Rate
Price (1-9) $89.00

LOW VOLTAGE DRIFT
Burr-Brown manufactures the industry's broadest line of low drift op amps ranging from IC's to chopper-stabilized types, including the only FET input IC with low drift AND low noise.

MODEL 3291/14—CHOPPER STABILIZED AMPLIFIER
0.1 μV/°C max. Voltage Drift
0.5 pA/°C max. Current Drift
140 dB Open Loop Gain
6 V/μsec Slew Rate
Price (1-9) $75.00

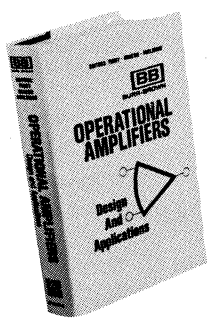
MODEL 3521L—LOW DRIFT FET INPUT IC OP AMP
The only commercially available FET op amp with 1μV/°C max. drift and TO-99 packaging.
Other features are:
250 μV max. Offset Voltage
10 pA max. Bias Current
1.5 μV p-p Input Noise
Price (100-249) $28.00

WIDEBAND/FAST SETTLING
This family of high speed op amps is optimized to meet nearly all high speed signal processing requirements. Stability is assured by nominal 6 dB/octave frequency rolloff, low output impedance, and low input capacitances.

MODEL 3400A—WIDEBAND DIFFERENTIAL
A differential FET input stage allows the 3400 to be used as a non-inverting buffer with bandwidth extending into the video range.
100 MHz Bandwidth
1000 V/μsec Slew Rate
Price (1-9) $55.00

MODEL 3507J—FAST-SLEWING IC
A low-cost IC amplifier offering fast transient response for applications such as A/D and D/A conversion, multiplexing and sample/hold.
120 V/μsec Slew Rate
300 μsec Settling Time
Price (100-249) $7.50

LOW INPUT CURRENT
Amplifiers in this category combine low input current, low voltage drift, and low cost through the use of monolithic, super-β processing.
MODEL 3502B—SUPER-β IC
2 nA max. Bias Current
5 μV/°C max. Voltage Drift
Price (100-249) $7.50



The Industry's first reference book on Operational Amplifiers! From McGraw-Hill and Burr-Brown

■ This book is divided into two principal parts and two appendices. Part I considers the design of operational amplifiers, provides insight into the factors which determine performance characteristics, and outlines the techniques available for their control. Part II presents an extensive selection of practical operational amplifier applications and provides sufficient descriptions of operation to permit design adaptation from the specific circuits described. In Appendix A, the basic theory of operational amplifiers is reviewed to provide an accompanying reference. Appendix B gives concise definitions of the performance parameters used to characterize operational amplifiers and provides associated test circuits.

■ U.S. and Canada Price 15.00 Dollars, Postpaid.

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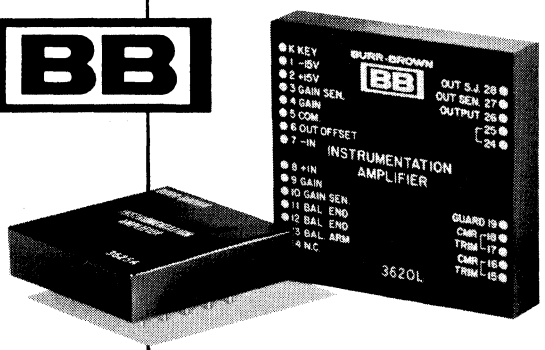


Burr-Brown Instrumentation and Data Amplifiers

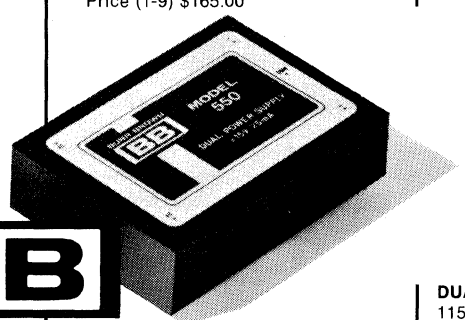
■ *These Burr-Brown differential-input amplifiers accurately amplify millivolt-level signals from strain-gauge bridges, thermocouples, biological probes, and many other transducers. All have high input impedance, high common-mode rejection, and low input drift.*

■ *Burr-Brown has designed a variety of instrumentation amplifiers in order to optimize price/performance for specific applications. Amplifiers shown are only a few of many Burr-Brown designs available.*

MODEL 3620L—
PREMIUM PERFORMANCE
This modular amplifier has a number of useful features that make it most versatile. Gain is set by a single external resistor. The common-mode voltage is available for connection to signal shield or guard for improved noise rejection. Active low-pass filtering can easily be added externally.
Wide Gain Range of 1-10,000
±0.25 μV/°C, Voltage Drift, 1 μV, p-p Input Noise
110 dB CMR
±0.01% Nonlinearity
2" x 2" x 0.4" Package
Price (1-9) $165.00

MODEL 3625A—
LOWEST COST
The 3625 Series is optimized for applications where cost is the paramount factor, but where input signal quality cannot be sacrificed. Gain is set by a single external resistor.
±3 μV/°C Input Drift
2 μV, p-p Noise
Price (1-9) $29.00

MODELS 3600K and 3601K—
DIGITALLY PROGRAMMED GAIN
Typical applications for these amplifiers include low-level and high-level data acquisition in computer-controlled or auto-ranging systems. Gains are programmed by DTL or TTL level digital signals.
Differential-Input
(models with single-ended, non-inverting, FET input are available)
±1 μV/°C Low Input Drift
Many Gain Steps
Model 3600...46 levels, 0 to 3840
Model 3601...44 levels, 0 to 1500
±0.01% Non-Linearity
Price (1-9) $245.00



Burr-Brown Modular Power Supplies

STANDARD SERIES
LOW COST, SMALL SIZE
DUAL AND SINGLE OUTPUTS
50 to 400 Hz INPUT
EXCELLENT STABILITY
5V output @ 250 mA, 500 mA and 1 A
±15 V output @ ±25mA, ±50 mA, ±100 mA, and ±200 mA
Burr-Brown's standard series of power supplies offers a wide range of output voltage and current ratings at very attractive prices. The standard supplies are current - limited to protect the supply in an overload condition or during a temporary output short to common. Price range (1-9) $23.00 to $69.00

DUAL PRIMARY MODULES
115 VAC or 230 VAC INPUT
±15 Vdc @ ±50 mA, ±120 mA, and ±200 mA
47 to 1000 Hz INPUT
EXCELLENT STABILITY
These Burr-Brown power supply modules feature dual transformer primaries. By merely changing the input wiring, the power supply can be connected for 115 VAC or 230 VAC operation. Price range (1-9) $39.00 to $95.00

DC—DC CONVERTERS
REGULATED ±15 VDC FROM UNREGULATED DC INPUT
FAST TRANSIENT RESPONSE
HIGH OUTPUT CURRENTS
WIDE TEMPERATURE OPERATION
The DC-DC Converter Modules from Burr-Brown provide maximum flexibility in systems design. The Model 546, for example, provides ±15 at 120 mA from a 5 volt dc input and is therefore particularly useful for powering analog interface circuitry in digital systems.

The other DC input modules provide ±15 Vdc from unregulated inputs ranging from 11 to 14 Vdc or 22 to 34 Vdc. Price range (1-9) $69.00 to $148.00

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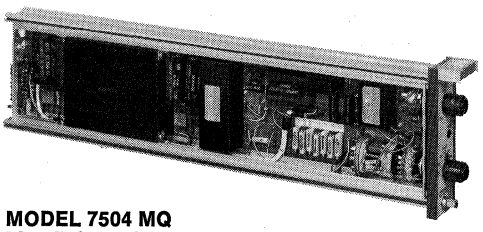
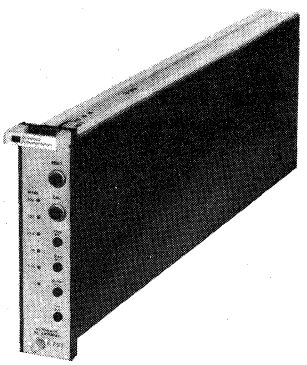
For over a decade Dynamics has been the acknowledged leader in the design and manufacture of instrumentation amplifiers for aerospace, laboratory and industrial applications. A complete range of differential, single-ended and charge amplifiers with various options and extra performance features, such as selectable filters, separate input and output zero controls and strain gauge power supply, are available. Many models have dual isolation 100mA outputs, full scale zero offset controls, galvanometer matching networks and switched or fixed current limiting provisions.

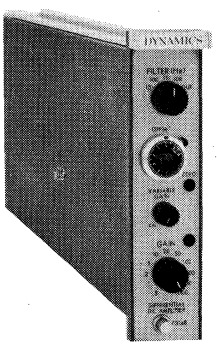


A description of some of the models is given below. On the opposite page is a table of working parameters for each of the models described.

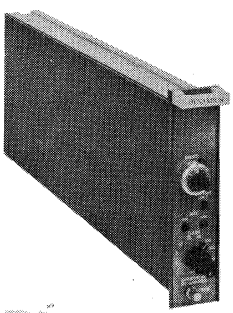


MODEL 7504 MQ
Line Driver Differential DC Amplifier
Wide Bandwidth, fast overload recovery and ability to operate over long input cables without loss of common-mode rejection ratio makes this instrument ideally suited for driving long lines under adverse common-mode conditions.

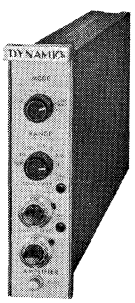
MODEL 7511
Automatic Programmable Differential DC Amplifier
A choice of either fully automatic or remotely programmable gain switching is available. Symmetrical input circuitry (true differential configuration) may be connected for either inverting or non-inverting gain polarity.



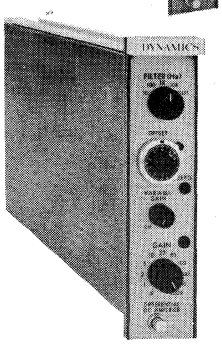
MODEL 7514
High Gain Differential DC Amplifier
Two standard models accommodate eighteen options to offer the designer the widest selection of operating parameters. Gains from .1-3300, common-mode operating level of ±20V make this the most popular model.
Options include dual outputs (±100 mA), five and seven position wideband filters.



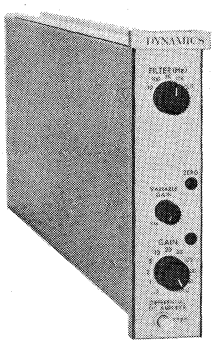
MODEL 7520
Fast Recovery DC Amplifier
14 options available on two basic models offer the systems designer a wide selection of operating parameters. All controls are front panel mounted for easy access. Recovery time is less than 50 μs.



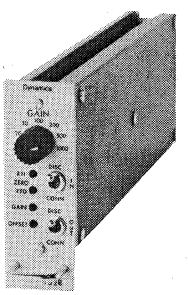
MODEL 7350
Triple Mode Differential Charge Amplifier
Isolated Charge Amplifier, Differential DC Amplifier, AC Line Amplifier, three gain options, dual outputs and filters make the Model 7350 one of the most versatile instrumentation amplifiers available.



MODEL 7521
50 Volt Common-Mode/Wide Band DC Amplifier
Designed for use in data acquisition systems having common-mode voltage levels up to ±50V. The unit utilizes integrated circuits. Twelve options are offered. Complete compatibility with Dynamics 7514, 7520 and 7525 amplifier line.

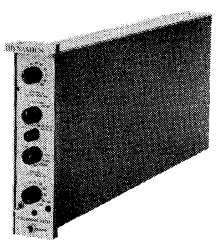


MODEL 7525
Wide Band (DC to 2 MHz) Differential DC Amplifier
Designed to provide maximum speed, performance, and reliability in high speed data acquisition systems. Compatible with all tape recorders for direct recording.



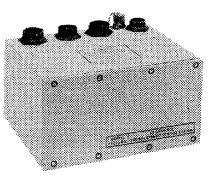
MODEL 7528
Economical Differential DC Amplifier
High performance characteristics are found in a smaller assembly than in conventional instrumentation amplifiers. Ideally suited for data acquisition systems where multiple channels are required but space is limited.

Model	Gain Range	Accuracy	Output	Common Mode	Frequency Response	Slewing Rate	Noise	Zero Stability
7504	0.1 to 10 5 steps	±0.1%	±10V, ±100mA	90 dB ±10V	—3dB above 100 kHz	6.0 V/μs	1.0 mV/RTO	±200 μV plus ±50.0 μV/°CRTI
7511	1.0 to 1000 10 steps	±0.1%	±10V, ±100mA	120 dB ±10V	—3dB above 50 kHz	2.0 V/μs	5.0 μV/RTO	±5 μV plus ±1.0 μV/°CRTI
7514	0.1 to 3300 9 steps	±0.1%	±10V, ±100mA	120 dB ±20V	—3dB above 75 kHz	3.8 V/μs 6.0 V/μs available)	7.0 μV/RTO	±5 μV plus ±0.4 μV/°CRTI
7520	1.0 to 3300 7 steps	±0.1%	±10V, ±100mA	120 dB ±10V	—3dB above 75 kHz	2.0 V/μs	4.0 μV/RTO	±2 μV plus ±0.4 μV/°CRTI
7521	1.0 to 3300 7 steps	±0.1%	±10V, ±100mA	120 dB ±50V	—3dB above 75 kHz	1.5 V/μs	4.0 μV/RTO	±2 μV plus ±0.4 μV/°CRTI
7525	3.0 to 1000 6 steps	±0.1%	±10V, ±100mA	120 dB ±20V	—3dB above 2 MHz	20.0 V/μs	15.0 μV/RTO	±3 μV plus ±1.2 μV/°CRTI
7528	1.0 to 3300 7 steps	±0.1%	±10V, ±10mA (100mA available)	120 dB ±10V	—3dB above 75 kHz	1.5 V/μs	4.0 μV/RTO	±3 μV plus ±1.0 μV/°CRTI
7350 DC	1 to 3300 mV/V	±0.1%	±10V, ±100mA	120 dB ±10V	—3dB above 75 kHz	1.5 V/μs	4.0 μV/RTO	±3 μV plus ±0.4 V/°CRTI
Charge	0.01-3300 mV/pC	±1.5%		5 mV/V from dc to 60 Hz	—3dB 0.7 Hz to 75 kHz		.007pC-10 kHz	±1mV plus ±0.5 mV/°CRTO
AC Line	1-33,000 mV/pC	±2.5%		7.5 mV/V from dc to 60 Hz	—3dB 1 Hz to 50 kHz		.02 pC-10 kHz	±1mV plus ±0.5 mV/°CRTO



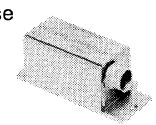
MODEL 6364A
Precision "Active" Electronic Filters

Phase matching to within 1° is possible in the Linear Phase mode. Terminal Slopes of 36 dB/Octave are standard with Butterworth and/or Linear Phase characteristics. Four different low-pass/high-pass frequency multipliers cover the frequency band DC to 1MHz.



MODEL 7703/QK
12 Channel Airborne Signal Conditioning System

Provides operating power input/output interconnections and mounting space for up to 12 Differential Amplifiers and signal conditioning channels.

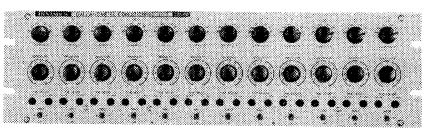


MODEL 7307
Airborne Charge Amplifier

A miniature, solid-state instrument ideally suited for airborne applications demanding accuracy and reliability.

MODEL 7202
Galvanometer Driver/DC Amplifier

A solid state single ended DC Amplifier with 100 mA output current, variable offset, current limiting and filtering capability.



MODEL 301/303
12 Channel Galvanometer Conditioning Unit

The Dynamics Model 301 is a 12-channel rack-mounting Galvanometer Conditioning Unit which provides variable signal level attenuation and matching between a wide range of signal sources and oscillograph galvanometers.

Galvanometers ranging from low frequency high sensitivity to high frequency low sensitivity types are accommodated. Each of the channels have an 11-position sensitivity control with multi-turn trimming potentiometers, damping resistor selector, galvanometer reversing switch, and disconnect switch. Model 303 is a 6-channel configuration and is equal in all respects as the Model 301.

Model	Type	No. of Channels	Power Required	Excitation	Amplifier Gain	Filter	
7703/QK	D.C. Differential	12	28V DC	±1V to ±10V Per Channel	1-1000	6 Poll Selectable	Butterworth 3-10,000 Hz

	Gain Range	Accuracy	f. Resp.	Noise	Lin.
7202	0.1-330	1%	50 KHz	5 μVRTI	.05%

	Gain Range	Accuracy	f. Resp.	Noise
7307	.5-200 mv/pC	Adjustable	30 KHz	.008 pCb

	Gain	fc L.P.	fc H.P.	Z (Input)	Terminal Slope	Output Capability
6364A	1	dc-1 MHz	dc-1 MHz	100 MΩ	36 dB/oct	±10v ±100 mA

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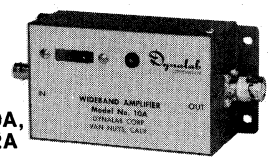
WIDEBAND AMPLIFIERS

Dynalab's high performance, general purpose, wideband amplifiers are invaluable aids for a wide variety of instrumentation and laboratory applications. Accurate, stable gain with flat response assures dependable performance.



10A, 12A

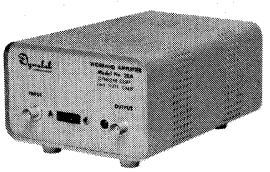
The Dynalab Model 10A and 12A Wideband Amplifiers are compact, self-powered units capable of extending the useful sensitivity of such instruments as oscilloscopes, voltmeters, counters, and analyzers, and are very useful for general purpose laboratory applications. Both amplifiers have 20 dB of gain, with the 10A offering flat response to 150 mHz while the 12A has a flat response to 500 mHz. Two amplifiers of the same type may be cascaded. The units employ self-contained, rechargeable battery power sources.

The Model 20A Wideband Power Amplifier can provide high level CW or swept output from signal generators, VHF/UHF test oscillators (such as the HP3200B), and sweepers over the 10 to 500 mHz range at power levels up to 5 watts. The 20A Amplifier can also be used to supply r.f. amplification and power for experimental set-ups.

The Model 20A has a built-in AC power supply.

The amplifiers have a gain accuracy and response flatness typically better than ±1 dB and the maximum output ratings are for 1 dB compression. Both the Models 10A and 12A have a noise figure of less than 5 dB. All amplifiers have nominal input and output impedances of 50 ohms and are provided with BNC input/output connectors. Other standard connectors are available at small extra charge.

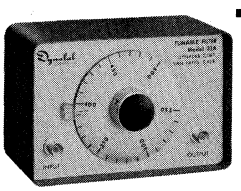
SPECIAL ORDERS—Wideband and bandpass amplifiers are available on special order for frequencies up to 3000 mHz, at powers up to 100 watts. Submit requirements for prompt quotation.



MODEL 20A

MODEL	RESPONSE	GAIN	OUTPUT	PRICE
10A	0.1-150 mHz	20dB	+3dBm	$275.00
12A	0.1-500 mHz	20dB	+3dBm	525.00
20A	10-500 mHz	20dB	5 Watts	1250.00

TUNABLE FILTERS



MODEL 32A

The Dynalab tunable bandpass filters are available in approximate octave tuning ranges over 50 to 1000 mHz. These single section filters have 3 dB bandwidths of approximately 5% of center frequency. Insertion loss is typically less than 1 dB.

Input and output impedances are nominally 50 ohms. Standard connectors are BNC; others available on special order.

MODEL	TUNING RANGE	PRICE
30A	50-125 mHz	$250.00
21A	125-250 mHz	260.00
32A	250-500 mHz	275.00
33A	500-1000 mHz	290.00

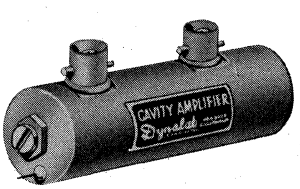
LABORATORY POWER SUPPLIES

51A

All models have precision regulation with continuously variable output voltage and excellent voltage setting resolution. Other features of these outstanding units are: • Adjustable current limiting • Remote programming • Floating output • Voltage/current metering • Line regulation <0.02% or 1 mv • Load regulation <0.02% or 1 mv • Ripple/noise <2 mv p-p • Subrack sizes.

51A	0-20V	0.5A	$130.00	59A	0-40V	0.5A	$175.00
52A	0-20V	1.A	155.00	58A	0-40V	1A	195.00
53A	0-20V	2A	195.00	59A	0-40V	2A	225.00
60A	+6v/—6v	5A ea.	375.00	50A	Dynamic loads to 40v/2A		

SPECIAL CUSTOM PRODUCTS



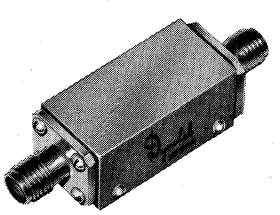
High power cavity amplifiers to 4000 mHz. • Broadband models • Compact models • Submit requirements for prompt quotation.

OTHER SPECIAL CUSTOM PRODUCTS

• Filters 1 Hz to 4 gHz, all types • Multicouplers active/passive • Very stable LC oscillators • Wide Range VCO's 5 — 1500 mHz • Step Diode Multipliers • Solid State Power Amplifiers • Other Special RF Circuits • Submit Requirements For Prompt Quotation.

NEW!

Subminiature UHF/S-BAND DISCRETE FILTERS



New type of UHF/S-band discrete filters. Low-pass, high-pass, bandpass, bandstop, and notch, 500 mHz through 2500 mHz. Very small. Overcomes stripline/coax style filter spurious responses. SMA connectors. Submit specific requirements for prompt quotation.

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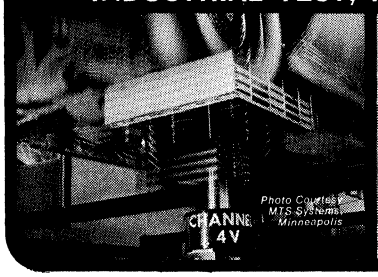
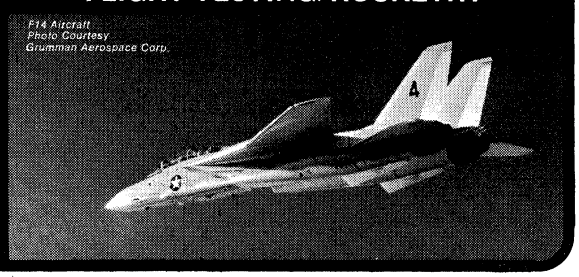
VEHICLE TESTING

INDUSTRIAL TEST, PROCESS CONTROL



FLIGHT TESTING/ROCKETRY



400 SERIES

ENVIRONMENTAL SERIES
Up to 100 G Shock
−25°C to +71°C
.5 μV/°C Stability
Thermal Shock Resistant
Bridge Excitation
RFI Resistant
120 dB CMR
100V CMV
Gains to 1000
Zero Suppression
Rack or Stud Mounting
Approx. 8 oz. wt.
12 or 28V dc Power
From $330

500 SERIES

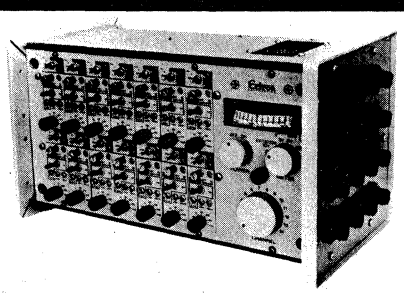
ECONOMY SERIES
1 μV/°C optional
114 dB CMR
Gains x .01 to x 2500
16 Amps per Rack
3.5" high models
80 kHz Bandwidth
Sw. Selectable filter
Dual outputs
10 or 100 mA output
Bridge Bal. & Completion
Bipolar shunt Cal.
Bridge Excitation Supplies
20M ohm input Impedance
From $135

600 SERIES

INDUSTRIAL SERIES
Strain Gage Conditioning
Thermocouple Conditioning
Thermocouple Linearization
Reference Junctions
Multifunction Amplifiers
Bridge Excitation
Bipolar Shunt Cal.
Expanded Scale Operation
.2 μV/°C Zero Stability
120 dB CMR
300V CMV
12 or 28V dc power
115 or 220V ac power
From $255

700 SERIES

WIDEBAND SERIES
100 kHz Bandwidth
Manual Gain
Programmable Gain
Digital Storage
Local Readout
1 μV/°C
.003%/°C Gain T.C.
.01% Gain Accuracy
300V CMV
126 dB CMR
3-pole filters
Dual outputs
From $385 manual gain
From $745 programmable gain



COMPLETE SIGNAL CONDITIONING SYSTEMS

The 14 channel system shown at the left is designed for Airborne or Vehicular service involving moderately high G forces. It includes 14 stable 400 series amplifiers, a monitor meter and monitor selection switch, individual CAL switches, bridge excitation, bridge balance and optionally thermocouple conditioning.

Data During 100G Shock (system not shown). Includes stable 400 series amplifiers with subcarrier oscillators & mixer, bridge excitation supply, FET simultaneous double shunt calibration (±100% ±50%), Channel identification signal, and rechargeable Ni Cad batteries. Less than 2 lbs. per channel.

8133 Engineer Road, San Diego, California 92111
Phone (714) 278-0600/TWX 910-335-1259

Specialists in Airborne, Marine and Industrial Environments

Ectron CORPORATION

ENI - the world's leader in solid state rf power amplifiers

Covering the frequency spectrum of 10 KHz to 560 MHz ENI offers a full line of solid state power amplifier models with outputs ranging from 300 milliwatts to more than 1000 watts.

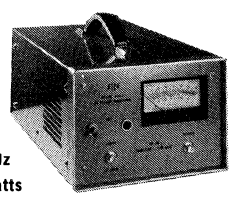
Capable of being driven by virtually any signal generator, frequency synthesizer or sweeper, ENI amplifiers are versatile and flexible sources of power for a wide variety of applications.

Completely broadband and untuned, these highly linear units will amplify inputs of AM, FM, SSB, TV and pulse modulations with minimum distortion. Although all power amplifiers will deliver their rated power output to a matched load **only ENI power amplifiers will deliver their rated power to any load regardless of match.** ENI units are designed to internally absorb reflected power from a mismatched load.

Whether used as a laboratory instrument or for an OEM application, ENI can provide the right unit to suit your requirements.

Write to us for a copy of our **complete** catalog of amplifiers and power multi-couplers.

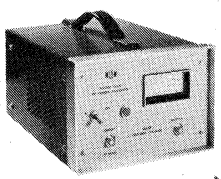
40 WATT / MODEL 240L



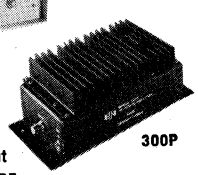
- 20 KHz to 10 MHz coverage
- 50 dB ±1.5 dB gain
- Useable 12 Khz to 12 MHz
- Up to 150 watts of saturated power out
- Works into any load

Unbelievable performance for a wide range of ultrasonic applications. Combine with the Model 420L and provide over 10 volts/meter field intensities from 12 KHz to 280 MHz for EMI/RFI measurements.

3 WATT / MODELS 300L & 300P



300L

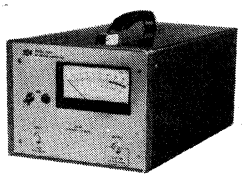


300P

- 250 KHz to 110 MHz coverage
- 40 dB ±1 dB gain
- 5 watts pulse output
- 50 ohms input/output
- 300L complete with RF output meter and AC supply
- 300P requires 25 volts at 0.9 amp.

The lowest power members of the 300 family of amplifiers, these low noise, high dynamic range units are excellent for general laboratory work and signal distribution applications.

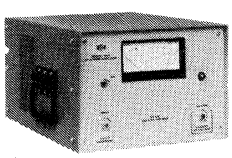
20 WATT / MODEL 320L



- 250 KHz to 110 MHz coverage
- 50 dB ±1 dB gain
- Up to 40 watts pulse output
- Less than 5 Nanosec rise time
- Unconditionally stable

This low distortion unit is an outstanding performer in NMR / ENDOR spectroscopy for laser modulation. Constant forward power is available regardless of load impedance.

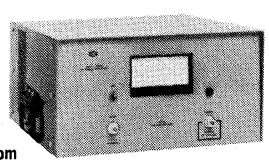
50 WATT / MODEL 350L



- 250 KHz to 105 MHz
- 50 dB ±1.5 dB gain
- Useable 120 KHz to 120 MHz
- 90 watts pulse power
- More than 100V RMS into high impedance load

Portable and lightweight, this unit is rugged enough for field operation and powerful enough for use in AM, FM, SSB and Data Communication Systems.

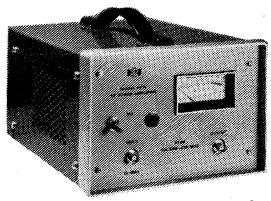
100 WATT / MODEL 3100L



- 250 KHz to 105 MHz
- Up to 180 watts pulse
- Operates from 115/230V AC single phase line
- Driven by any signal generator
- Works into any load

Weighing less than 70 pounds and operating from single phase AC power, the 3100L is the highest output solid state instrumentation amplifier available.

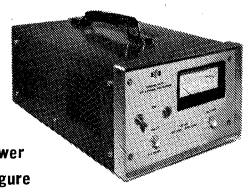
2.7 WATT / MODEL 403L



- 150 KHz to 250 MHz coverage
- 37 db ±1.5 dB gain
- 50 ohms input/output
- 2.5 Nanosec pulse rise time
- RF output meter

The extended frequency coverage of this compact power amplifier along with its ability to work into any load make it ideal for general laboratory work as well as signal distribution.

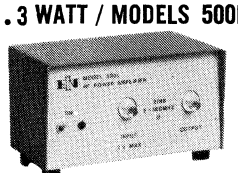
20 WATT / MODEL 420L



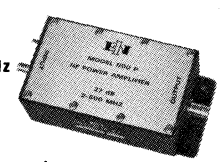
- 150 KHz to 250 MHz coverage
- 45 dB ±1.5 dB gain
- Useable 100 KHz to 280 MHz
- 25 watts saturated power
- 8 dB noise figure

This high reliability unit will withstand 20 dB of overdrive for all load conditions. An excellent amplifier for TV distribution and EMI/RFI testing.

.3 WATT / MODELS 500L & 500P



500L



500P

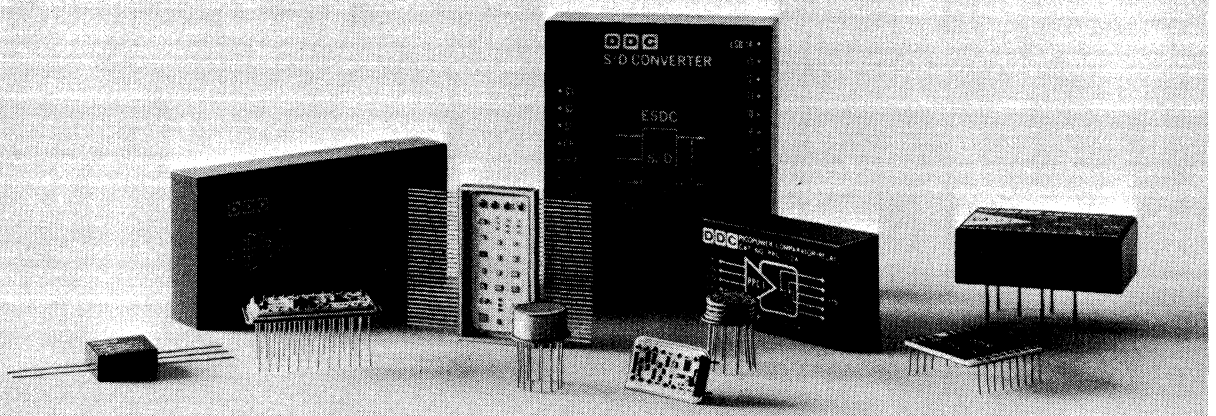
- Flat 27 dB gain 2 MHz to 500 MHz
- 1.7 MHz to 560 MHz useable coverage
- 8 dB noise figure
- Thin film hybrid construction
- 500L has AC power supply
- 500P requires 24 VDC at 0.3 AMP

These compact units deliver 300 milliwatts from 1.7 MHz to 560 MHz at low distortion. Brand new, these units utilize microelectronic circuits on a microstrip mother board to achieve state-of-the-art performance at a very modest price.

ELECTRONIC NAVIGATION INDUSTRIES INCORPORATED
3000 WINTON ROAD SOUTH. ROCHESTER, NEW YORK 14623 • (716) 473-6900 • TELEX 97-8283 ENI ROC

DATA DEVICES from DDC

Wideband Amplifiers, Data Converters, Custom Hybrids

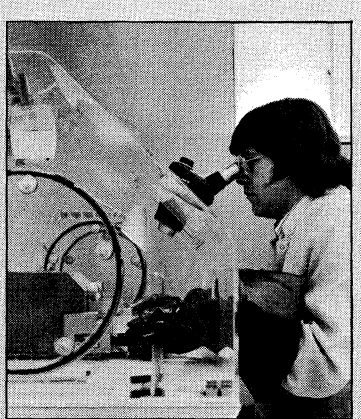


Developed for use in military, avionic and industrial systems, DDC signal conditioning devices and converters meet the most critical standards for accuracy, dependability, ruggedness and long life. Quality assurance and process controls meet the most stringent military and industrial requirements.

WIDEBAND AMPLIFIERS

Ideal for radar and display systems, as video summing and subtracting amplifiers, in data conversion and pulse amplification, sample and hold circuits, driving coax lines and in other high frequency applications.

- Hybrid & discrete
- 1,000 V/μs slew rates
- 150 nS settling times to 0.1%
- 150 MHz gain-bandwidth products
- Coax line drivers
- Differential and inverting models
- Short-circuit protected



Stringent process and quality controls, combined with state-of-the-art thick film hybrid technology, assure extremely high reliability for standard products and custom hybrid devices.

OPERATIONAL AMPLIFIERS

- Hybrid and discrete
- FET and bipolar
- Low voltage drift
- High CMRR
- High CMV
- Synchro and servo drivers
- Ultra-stable

DATA CONVERSION HYBRID PRODUCTS

- Single-module converters
- Multi-module converters to permit custom assembly
- Synchro/digital converters
- Synchro/resolver angle indicators
- Sample and hold circuits
- Multiplexers
- Circuit protectors
- Power drivers
- Data acquisition systems

For details, SEE VOLUME I, Section 2000.

DDC CAN HELP YOU. Write for information, capabilities and specifications.

DDC
ILC DATA DEVICE CORPORATION
100 TEC STREET, HICKSVILLE, N.Y. 11801
(516) 433-5330

APPLICATIONS AND SERVICE CENTERS

CALIFORNIA: Mr. Bill Wille, 2750 Bellflower Blvd. Long Beach 90815 (213) 597-5744
WASHINGTON: Mr. Al Dolgoff, 900 So. Washington St. Falls Church, Va. 22046 (703) 536-2212
BELGIUM: Mr. Fred Gans, Ave Roger Vandenriessche 51, 1150 Bruxelles, Belgium Tel. 62.01.59

CUSTOM HYBRIDS

Advanced technology and processes applied to standard hybrid products and wideband amplifiers are available for meeting custom prototype and production requirements for commercial, industrial and military applications. The latest equipment and processes are utilized, including clean room techniques, parallel seam welding, beam lead as well as other types of bonding, and precision resistor trimming. The DDC quality and process controls conform to the requirements of MIL-STD-883.

Specific hybrid capabilities include:

- Thick film resistor deposition from 1 ohm to megohm ranges
- Multilayer substrates
- Active trimming capability
- Resistor matching to 0.03%
- TO, DIP, and flat pack packaging

REPRESENTATIVE HYBRID PRODUCTS AVAILABLE

- Wideband Amplifiers
- Coaxial Drivers
- Differential FET Amplifiers
- 8-12 Bit Ladder Networks
- Ladder Switches
- Video Multiplexer
- Log IF Amplifier Stages
- Level Sensors
- Comparator Relays
- Active Filters

intronics

Quality and Design Optimization is available in five families of Analog Function Modules.

MULTIPLIER/DIVIDERS

Intronics' solid-state analog multiplier/dividers perform the four operations of multiplication $\frac{xy}{10}$, squaring $\frac{x^2}{10}$, square rooting $\sqrt{10z}$, and division $\frac{10z}{x}$.

These devices are available in six "stretchable" generic designs:

Series M530 — Self-contained monolithic design. 1 MHz bandwidth with accuracies from 2% to ½%.

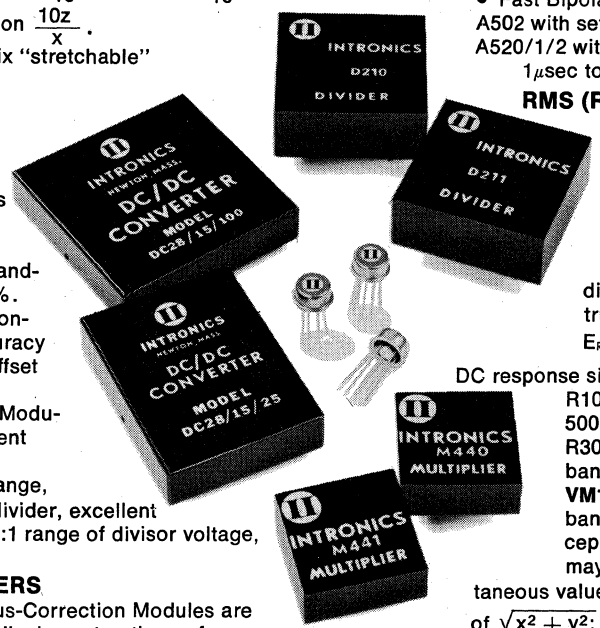
M440, M441 — Economy models — low cost, small size, wide bandwidth.

M507, M508 — Features wide bandwidth of 5MHz; accuracy to 0.5%.

M610, M611 — Precision transconductance, high pretrimmed accuracy to 0.25%; 600kHz bandwidth. Offset drift only 100μV/°C.

M310, M311 — Precision Pulse-Modulation, accuracy to 0.5%, excellent 50μV/°C temperature stability.

D210, D211 — Wide Dynamic Range, compact, two quadrant analog divider, excellent accuracies to 0.5% over a 1000:1 range of divisor voltage, bandwidth independent.



CRT DEFLECTION OPTIMIZERS

C102/C103 CRT Geometry/Focus-Correction Modules are used to create extremely linear displays at optimum focus on flat face magnetic-deflection CRT's. These modules accept horizontal (H) and vertical (V) input voltages, and generate three outputs: The first two outputs, the H and V signals corrected for 'pincushion' distortion, are fed to the horizontal and vertical deflection amplifiers; the third output, a correction for dynamic focus, is fed to the dynamic focus amplifier. Unique solid-state circuitry smoothly synthesizes these functions. These modules are internally set for total deflection angles from 20 to 90 degrees, and are accurate to 0.1% of total deflection angles. Provision is made for external adjustments. The C102 and C103 provide 10MHz and 1MHz bandwidths, respectively.

C201, C202 CRT Geometry-Correction Modules employ economical transconductance techniques to generate the horizontal and vertical correction functions with 1% accuracy, and 1MHz bandwidth. A compatible focus-correction module (FC101) is available.

DYNAMICALLY OPTIMIZED OPERATIONAL AMPLIFIERS

are designed to optimize the most single important dynamic parameter-settling time, which includes the total effect of delay time, slew rate, and final settling to a specified percent error. These modules are especially useful in CRT display and converter applications. Generic types include:

- Fast FET Differential Input Amplifiers

FA530/1 settling from a 10V step input ± to within 0.01% in 500nsec.

FA540/1 settling time to within 0.01% in 1.5μsec.

- Fast Bipolar Inverting Input Amplifiers

A502 with settling time of 60nsec to 0.1%.

A520/1/2 with settling time of 200nsec to 0.1% and 1μsec to .01%.

RMS (ROOT MEAN SQUARE) TO DC CONVERTERS/VECTOR OPERATOR

The R101/R301/R310 generic line of RMS operators rapidly compute the true RMS value of AC or DC (or combination) input waveforms. Solid-state circuitry directly synthesizes the equation for true RMS measurement:

$$E_{RMS} = \sqrt{\frac{1}{T}\int_0^T e(t)^2\,dt}$$

DC response simplifies calibration problems.

R101 — General Purpose Converter, 500kHz bandwidth, accuracy to 0.2%.

R301, R310 — Precision Converters, 1MHz bandwidth, accuracy to .05%.

VM101 VECTOR OPERATOR is a wideband (1MHz) solid-state module that accepts bipolar AC/DC inputs, and which may be used to compute: (a) the instantaneous value of $\sqrt{x^2 + y^2}$; (b) the average value of $\sqrt{x^2 + y^2}$; (c) the absolute or average value of X or Y. Two units may be connected to compute $\sqrt{x^2 + y^2 + z^2}$. Application include: vector summation; rectangular-to-polar conversion; CRT-intensity correction; precision full-wave rectification.

POWER CONVERSION MODULES include generic types for both AC-to-Regulated-DC voltage conversion, and DC-to-Regulated-DC voltage conversion.

Precision Modular Power Supplies accept 105-125 VAC, 50 to 440 Hz input (other input voltages from 90 up to 240 VAC available as options), and provide single, dual, or triple, line-and-load-regulated outputs preset to 0.5% accuracy. Line isolation is provided by the internal transformer, with special shielded, high-isolation units available on special order. Output voltages available range from 5V to 24V, with up to 10W total output. Five-Volt logic supplies feature overvoltage protection, and all units are short-circuit protected.

Miniature Modular DC/DC Converters offer conversion efficiencies greater than 50% and 3W output in only 2" x 2" x 0.4" module dimensions. Dual-regulated (0.02% line and load) outputs are isolated from both input lines, and a sophisticated input-filter design provides maximum power-source EMI/RFI protection . . . Input and output voltage options range from 5 to 30V, with single or dual outputs available, preset to 1% accuracy. A metal case provides electrostatic shielding.

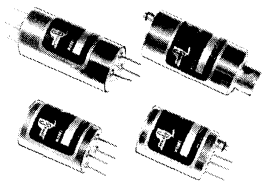
Intronics' offers a wide variety of analog functions, both off the shelf and custom designed for your requirements. Call our Applications Engineering Department for further information.

intronics

57 CHAPEL ST./NEWTON, MASSACHUSETTS 02158/617-332-7350/TWX 710-335-6835

VERSATILITY IN AC INSTRUMENTATION

ITHACO

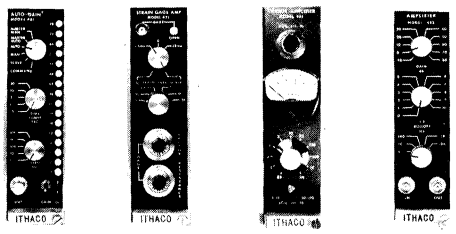


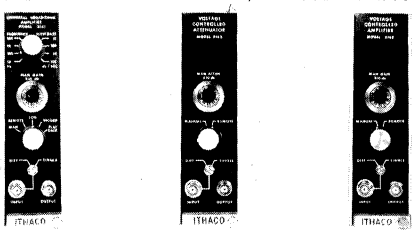
LOW NOISE PREAMPLIFIERS – 100 SERIES

- PREAMPS FOR HIGH AND LOW IMPEDANCE SOURCES
- FREQUENCY RANGE .001Hz TO 1MHz
- GAINS TO 10^5 (100dB)
- PREMIUM NOISE PERFORMANCE
- VOLTAGE, CHARGE, AND CURRENT INPUTS

POST AMPLIFIERS – 400 SERIES

- POSTAMPS FOR VOLTAGE, CHARGE, AND STRAIN GAGE INPUTS
- SINGLE-ENDED AND DIFFERENTIAL; RACK MOUNTABLE
- COMPUTER, AUTOMATIC, AND MANUAL GAIN CONTROL
- SELECTABLE FREQUENCY RESPONSE
- GAINS TO 100dB; FREQUENCY RANGE 1Hz TO 100KHz



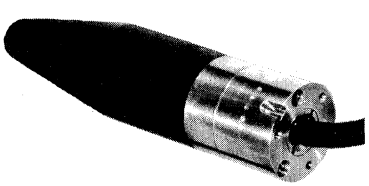


LOG AMPLIFIERS, ATTENUATORS, INSTRUMENTS – 3100 SERIES

- 80dB GAIN RANGE, 1Hz TO 200KHz FREQUENCY RESPONSE
- LOGARITHMIC CONVERTER, LOG AND LINEAR RATIOS
- COMPRESSION, EXPANSION, AND NORMALIZATION
- MANUAL, REMOTE, OR COMPUTER CONTROLLED OPERATION
- RECORD AND RECOVER WIDE DYNAMIC RANGE DATA ON A SINGLE TAPE TRACK

LOCK–IN AMPLIFIERS AND RATIOMETERS

- MODEL 391A DYNATRAC$^{T.M}$ – HETERODYNE LOCK-IN AMPLIFIER
  - ISOLATED INPUTS AND INPUT TRACKING FILTER
  - 0.1Hz TO 200KHz; FULL SCALE SENSITIVITY TO 100 pv
- MODEL 353 MODULAR LOCK-IN AMPLIFIER
- SINGLE AND DUAL CHANNEL, LOGARITHMIC, RATIOMETRIC, AND AUTOMATIC PHASING SYSTEMS

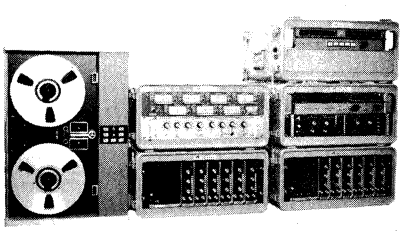


HYDROPHONES – 600 SERIES

- HIGH SENSITIVITY WITH OPTIMUM NOISE PERFORMANCE
- ONMIDIRECTIONAL
- ALL MOLDED CONSTRUCTION WITH BUILT-IN PREAMP
- LOW SENSITIVITY TO HORIZONTAL AND VERTICAL ACCELERATION
- FREQUENCY RESPONSE TO ABOVE 100KHz

AUTOMATIC DATA ACQUISITION SYSTEMS – 900 SERIES

- AUTOMATIC SIGNAL ACQUISITION, CONDITIONING AND RECORDING
- DESIGNED FOR VIBRATION, ACOUSTICS, OTHER AC MEASUREMENTS
- PROVISIONS FOR SYSTEM CAL AND ON LINE OUTPUT ANALYSIS
- PORTABLE OR RACK AND PANEL CONFIGURATIONS
- COMPUTER CONTROLLED OR AUTOMATIC OPERATION



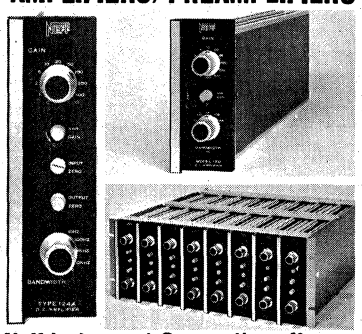
ITHACO also manufactures a complete line of precision variable electronic filters for use in all signal conditioning applications. See Section 2700.

ITHACO INC, 735 W CLINTON STREET, ITHACA, N Y 14850 PHONE (607) 272–7640 TWX 510–255–9307

INSTRUMENTATION FOR MEASUREMENT & CONTROL

NEFF INSTRUMENT CORPORATION

AMPLIFIERS/PREAMPLIFIERS

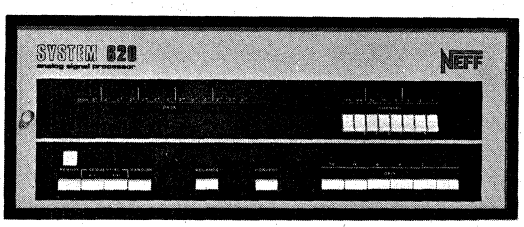


Neff Instrument Corporation offers a complete line of instrumentation amplifiers for laboratory, industrial, and aerospace applications with prices ranging from $100 to $3000. If your requirements are not met by one of the listed models, please contact our sales office listed below. Chances are they can suggest a model for your exact application.

Many Neff Amplifiers include the following standard features. Integral Power Supply; Full Scale Offset; Multiplexed Output; Galvanometer Matching; Simultaneous Wideband and Narrow Band Outputs; Input and Output Zero Control; 8 or 16 Channel Rack Enclosures; Single Channel Case. Products available on GSA. Please request Federal Supply Catalog.

	Model					
	119	**122**	**124 A**	**126**	**127**	**128**
Features	20kHz Chopper Stabilized.	100kHz General purpose	100kHz 300 volt CMV.	50kHz Multiplexed Systems	100kHz Automatic/ Programmable	50kHz General purpose
Gain Switch Steps Accuracy Variable Gain Input Impedance	1 to 3000 1, 2, 5, . . . 1000 0.1% and 0.01% 1 to 3 Multiplier 100 Megohms	1 to 2500 1, 2, 5, . . . 1000 0.1% and 0.01% 1 to 2.5 Multiplier 100 Megohms	1 to 2500 1, 2, 5, . . . 1000 0.1% and 0.01% 1 to 2.5 Multiplier 100 Megohms	0.2 to 2500 0.2, 0.5, 1, . . . 1000 0.1% 1 to 2.5 Multiplier 10 Megohms	1 to 1000 Programmable 0.1% and 0.01% 100 Megohms	0.2 to 2500 0.2, 0.5, 1 . . . 1000 ±0.1% 1 to 2.5 multiplier 10 megohms
Bandwidth	20kHz Filter–Switch Selectable	100kHz Filter–Switch Selectable	100kHz Filter–Switch Selectable	50kHz Filter–Switch Selectable	100kHz Filter–Switch Selectable	50kHz Filter–Switch Selectable
Output	±10 volts, ±100 MA	±10 volts, ±100 MA	±10 volts, ±100 MA	±10 volts, ±10 MA	±10 volts, ±100 MA	±10 volts, ±100 MA
Common Mode	120db ±50 volts	120db ±25 volts	120db ±300 volts	120db ±10 volts	120db ±10 volts	120 db ±10 volts
Zero Stability	±1 microvolt ±0.2μv/°C	±5 microvolts ±0.5μv/°C	±5 microvolts ±0.5μv/°C	±5 microvolts ±1μv/°C	±5 microvolts ±1μv/°C	±5 microvolts ±1μv/°C
Noise 10KHz 10Hz	3μv RMS 3μv peak-to-peak	2μv RMS 0.5μv peak-to-peak	2μv RMS 0.5μv peak-to-peak	2μv RMS 1μv peak-to-peak	2μv RMS 1.5μv peak-to-peak	2μv RMS 1μv peak-to-peak

SYSTEM 620



Complete high-speed, low-level data acquisition system featuring amplifier-per-channel at price of low level multiplexer to provide isolation right at signal source with higher Common Mode Rejection, low noise and crosstalk and high accuracy. Includes high level filter and continuous analog output for each channel, 50kHz throughput, local and remote modes, direct interface to computer. 64 channel system takes just 7" of rack height. Is expandable to 256 or 2048 channels.

Gain Preamplifier: 10 to 1000, selected by plug-in module. (Extended to 0.1 to 1,000 with attenuator)
Programmable Amplifier: Gains of 1, 2, 4, 10, 20, 40
Accuracy: ±0.01%
Stability: ±0.01% for 6 months
Temp. Coef.: ±0.005%/°C
Calibration: ±1% adjustment

Bandwidth DC to 5kHz

Filter 1Hz to 1kHz (plug-in module)

Throughput 20kHz or 50kHz
No sequence restrictions

Input Impedance 10 megohms Independent of multiplex rate

Max Input Voltage ±20 volts (Diff or common mode)

Output Digital: 12 and 14-bits
Sample & hold: 75 nanoseconds aperture
Analog output: ±10 volts fs continuous each channel

Linearity ±0.02%

Common Mode Rejection 120db DC to 60Hz

Zero Stability Preamplifier: ±4μv RTI ±40μv RTO
Programmable Amplifier: ±50μv RTO

Noise P–P

	10Hz	100Hz	1kHz
Preamplifier, RTI:	1μv	2μv	7μv
Preamplifier, RTO:	50μv	50μv	50μv
Prog. Ampl. RTI:	50μv	50μv	50μv
Prog. Ampl. RTO:	0.5mv	0.5mv	0.5mv

DIMENSIONS (64 channel)
7-inches h, 19-inches w, 23-inches d
Expansion: 256 or 2048 channels

SALES OFFICES Albuquerque (505) 299-7658 • **Boston** (617)861-8620 • **Chicago** (312) 585-5485 • **Cleveland** (216) 261-5440 • **Dallas** (214) 231-2573 • **Dayton** (513) 426-5551 • **Denver** (303) 934-5505 • **Detroit** (313) 526-8800 • **Greensboro** (919) 273-1918 • **Houston** (713) 621-0040 • **Huntsville** (205) 881-6220 • **Indianapolis** (317) 293-0696 • **Hartford** (203) 633-0777 • **Kansas City** (913) 432-4110 • **Los Angeles** (213) 245-9404 • **Milwaukee** (414) 464-5555 • **Minneapolis** (612) 544-9393 • **Montreal** (514) 670-1212 • **Newark** (201) 687-8737 • **New York** (914) 769-1811 • **Orlando** (305) 843-1510 • **Ottawa** (613) 725-3354 • **Philadelphia** (215) 887-9610 • **Phoenix** (602) 947-7841 • **Pittsburgh** (412) 371-9449 • **Rochester** (716) 266-1400 • **San Diego** (714) 565-2555 • **San Francisco** (408) 244-1505 • **Seattle** (213) 357-2281 • **St.Louis** (314) 524-6900 • **Toronto** (416) 678-1500 • **Vancouver, BC** (604) 253-7136 • **Washington, DC** (215) 887-9610

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172 S. Alta Vista Blvd., Los Angeles, Calif. 90036
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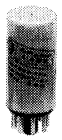
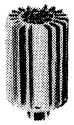
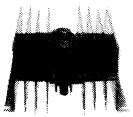
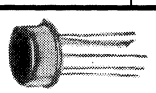
AMPLIFIERS

— SEND FOR CATALOG —
We manufacture over 50 products

FREE — 50 Industrial & Audio Operational Amplifier Applications

	 MODEL 360M Microphone Preamplifier	 MODEL 416 D.C. Thru Audio Operational Power Amplifier	MODEL 435 Medium Voltage D.C. Operational Amplifier	 MODEL 440 D.C. Thru Audio Operational Power Amplifier	MODEL SM-100K Dual Channel 50 W RMS or Mono 100 W Power Amplifier Kit
POWER REQUIREMENTS	±12v to ±24v @ 30ma or +12v to +50v @ 30ma or −12v to −50v @ 30ma	±12v to ±24v ±12 ma to ±30 ma plus load current	+12v to ±25v ±8 ma to ±15 ma plus load current	±12v to ±36v ±12ma to ±30ma plus load current	115v - 60 Cy. - 1 Phase @ 2.0 Amps
OPERATING TEMPERATURE RANGE (Case)	−20°C to +85°C	−20° to +85°C	−55°C to +85°C	−55°C to +85°C	−20°C to +70°C
INPUT					**Per Channel**
Impedance (Open Loop)	50, 250, and 600 Ohms	20K	20K	20K	5K
Offset Voltage (R_S = 10K)		±100 mv	±20 mv	±100mv	
Bias Current		0.2 μa	0.5 μa	0.2 μa	
Common Mode Voltage Range		Up to ±30v	Up to ±20v	Up to ±30v	
Equivalent Drift (R_S = 10K)		±0.5 mv/°C	±20 μv/°C	±0.5 mv/°C	
Equivalent Noise	−127 DBM	20 μv	2 μv (−115 dbm)	20 μv	20 μv
Common Mode Rejection Ratio	Has internal input isolation transformer	80 DB	80 DB	80 DB	
TRANSFER					
Voltage Gain	Adj.: 30 to 60 DB	650	20,000	650	10 (20 DB)
Unity — Gain BandWidth	20 cy to 20 kc (−3 DB)	2 mc	2 mc	2 mc	May be changed via Feedback Resistor
OUTPUT					
Impedance (open loop)	10 ohms	0.5 Ohm	50 Ohms	0.1 Ohm	0.1 Ohm
Voltage Swing/Load		Up to ±20v/8 Ohms	±20v/50 Ohms	±24v/4 Ohms	±28v/8 Ohms
Slewing Rate		5v/μsec	5v/μsec	5v/μs	
Full Power		D.C. to 20 kc	D.C. to 20 kc	D.C. to 20 kc	D.C. to 20 kc
Maximum Current		2 Amps	±400 ma	7 Amps	5 Amps
Peak Power		40w music		100 Watts	100 Watts
RMS Power		10w	2 w	50 Watts	50 Watts
Level	+14 DBM with ±24v	+40 dbm	+33 dbm		
Total Harmonic distortion at full power.	0.25%	0.5%	0.05% @ +24 dbm	< 0.5% any supply voltage & power level	0.5%
SIZE	1″ Dia. x 2″ Seated Height	2″ dia. x 3″ Seated height	5-Pin Modified TO-3 Case Mates with 9-Pin Noval Tube Socket	4¾″ x 5½″ x 2⅝″ Seated Height	7″ H x 19″ w Panel—Chassis Plug-in Ampl. and Power Supply
PRICE	$30.00/1 to 99 $27.00/100 to 999	$30.00/1 to 99 $25.00/100 to 999	$30.00/1-99 $25.00/100-999	$60.00 Model 440 $35.00 Model 440K Kit	Kit $170.00/ea. Wired $250.00/ea.



MODEL 4009
Medium Voltage
D.C. Operational Amplifier

POWER REQUIREMENTS			
Power Supply Voltage	±12v	±24v	±36v
Power Supply Current	±2.5 ma	±5 ma	±8 ma
OPERATING TEMPERATURE RANGE (Case)	−55°C to +125°C	−55°C to +125°C	−55°C to +70°C
INPUT			
Input Offset Voltage	< 100 mv	< 100 mv	< 100 mv
Input Bias Current	0.2 μa	0.2 μa	0.2 μa
Input Impedance	20 K	20K	20K
Input Common Mode Voltage Range	±10v	±20v	±30v
Equivalent Input Drift	< 0.5 mv/°C	< 0.5 mv/°C	< 0.5 mv/°C
Equivalent Input Noise	2 μv	2 μv	2 μv
TRANSFER			
Internal Power Dissipation	60 mw	240 mw	600 mw
Open Loop Voltage Gain	500	650	800
Unity-Gain Bandwidth	30 mc	30 mc	30 mc
Common Mode Rejection Ratio	60 DB	80 DB	80 DB
OUTPUT			
Output Impedance	2.5K	2.5K	2.5K
Output Voltage Swing/Load	±10v/50K ± 8v/10K ± 3v/ 2K	±20v/50K ±15v/10K ± 8v/ 2K	±30v/50K ±20v/10K ±10v/ 2K
Output Capacitance Loading	0.1 μf	0.1 μf	0.1 μf
Output Slewing Rate	10v/μs	10v/μs	10v/μs
Overload Recovery	5 μs	5 μs	5 μs
SIZE	Low Silhouette Modified TO-5 Can	Low Silhouette Modified TO-5 Can	Low Silhouette Modified TO-5 Can
PRICE	$10.00/1 to 999 $8.00/1K to 10K		

MODEL 425
Medium Voltage
D.C. Operational Amplifier

POWER REQUIREMENTS		
Power Supply Voltage	±12v	±25v
Power Supply Current (Standby)	±8 ma	±15 ma
OPERATING TEMPERATURE RANGE (Case)	−20°C to +85°C	−20°C to +85°C
INPUT		
Input Offset Voltage	±20 mv	±20 mv
Input Bias Current	0.5 μa	0.5 μa
Input Impedance (Open Loop)	20K	20K
Input Common Mode Voltage Range	±10v	±20v
Equivalent Input Drift (R_S = 10K)	±20 μv/°C	±20 μv/°C
Equivalent Input Noise (R_S = 1K)	2 μv (−115 dbm)	2 μv (−115 dbm)
TRANSFER		
Internal Power Dissipation	200 mw	750 mw
Open Loop Voltage Gain	5,000	20,000
Unity-Gain Bandwidth	2 mc	2 mc
Common Mode Rejection Ratio	80 DB	80 DB
OUTPUT		
Output Impedance (Open Loop)	100 Ohms	100 Ohms
Output Voltage Swing/Load	±10v/1K ±8v/600 Ohms (+16 dbm) ±3v/50 Ohms	±20v/1K ±18v/600 Ohms (+24 dbm) ±7v/50 Ohms
Output Slewing Rate	5v/μs	5v/μs
Full Power Output	D.C. to 25 kc	D.C. to 25 kc
SIZE	1″ Dia. x 1⅝″ Seated Height	1″ Dia. x 1⅝″ Seated Height
PRICE	$25.00/1 to 99 $22.00/100 to 999	

PRESTON

FLOATING DIFFERENTIAL INSTRUMENTATION AMPLIFIERS

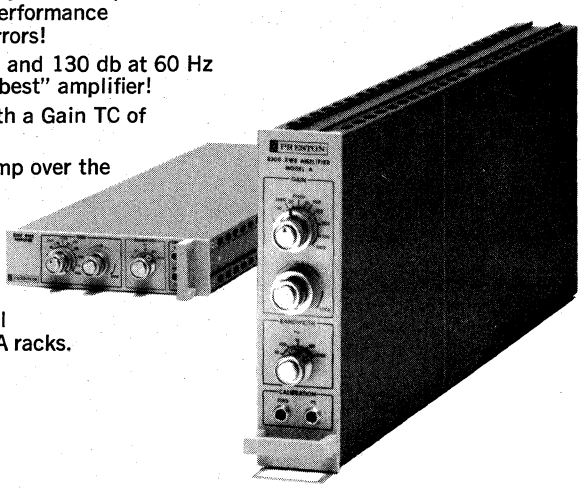
Preston's amplifiers deliver precision many times better than any other amplifier! Our "Balanced Precision" 8300 XWB Series have greatly improved performance to overcome the FOUR major sources of instrumentation amplifier errors!

COMMON MODE REJECTION — Preston's CMR of 150 db at DC and 130 db at 60 Hz reduces errors by a factor of 3 to 10 times over the "next best" amplifier!

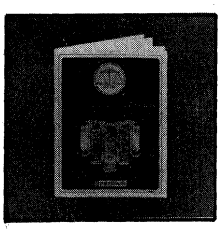
TEMPERATURE STABILITY — Preston is 2 to 5 times better with a Gain TC of only 10 ppm/°C and Zero Shift of less than 0.1μV/°C RTI!

PUMPOUT CURRENT — 10 times better! Stays under ½ nanoamp over the entire temperature operating range!

OVERLOAD RECOVERY — 10 times as fast! Recovers to within 0.01% in 30 μsec!



The 8300 XWB Series is versatile, too! You can select from many combinations of ACCURACY, LINEARITY, and both FIXED and ADJUSTABLE BANDWIDTH! And they all have their own integral power supply and mount in standard RETMA racks.



To obtain complete information on the entire Preston instrumentation amplifier line, ask for your copies of our technical literature, and for our new 12 page "Balanced Precision" brochure that shows how to determine the true performance of your instrumentation system, and how Preston's 8300 XWB Series amplifiers will deliver all the precision you need!

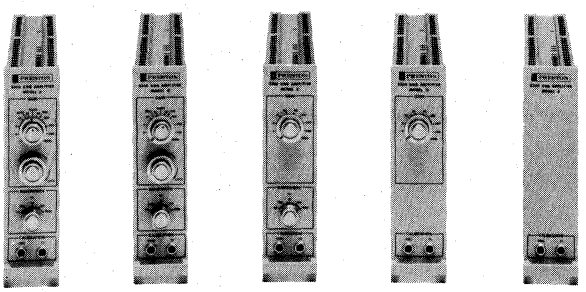
8300 XWB Series

Floating Differential Instrumentation Amplifiers

All of the models of Preston's 8300 XWB Series meet all of these performance specifications:

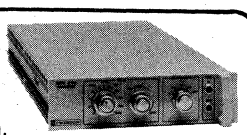
Input Impedance	100 Megohms shunted by less than 0.001 μfd at DC
Input Noise	3 μV (100 kHz bandwidth)
Pumpout Current	Less than 0.2 nanoamps at constant temperature and less than 0.01 nanoamps change/°C
Common Mode Rejection	150 db at DC, 130 db at 60 Hz, 110 db at 400 Hz
Common Mode Voltage	350 Volts maximum peak AC or DC
Bandwidth	DC to 100 kHz
Gain Stability	0.01% (six month term)
Settling Time	30 μsec to within 0.01% of input signal
Long Term Zero Drift	±5 μV RTI, ±1 mV RTO (six month term)
Output Noise	0.2 millivolts peak
Output Capability	±10 volts at 100 ma.

Five basic models provide versatility to meet every need:



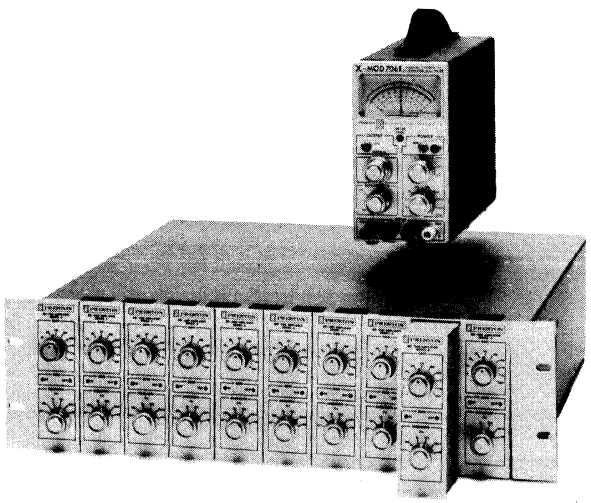
MODEL	A	B	C	D	E
Gain	Ten Steps plus Variable to 2500 X		Ten Steps Fixed to 1000 X		Fixed 1X to 2000 X
Gain Accuracy	±0.01%		±0.1%		±0.01%
Gain Linearity	±0.005%		±0.01%		
Drift (μV/°C)	0.1 μV RTI ±20 μV RTO		0.3 μV RTI ±100 μV RTO		
Bandwidth	Selectable to 100 kHz			Preset up to 100 kHz (max)	

A programmable gain version of the Model "A" is also available. And all of the models of the 8300 XWB Series can be ordered in this "horizontal" configuration.



PRESTON SCIENTIFIC INCORPORATED 805 East Cerritos Ave., Anaheim, Calif. 92805 Tel : (714) 776-6400 TELEX 65-5321

VERY WIDE BAND, DIRECT COUPLED AMPLIFIERS FLOATING DIFFERENTIAL AMPLIFIER–NULL METER



MD-1000 Series

Very Wide Band Direct Coupled Amplifiers

Here is the answer to your requirements for ACCURACY, STABILITY, VERSATILITY and LOW COST. These new amplifiers include many new features:

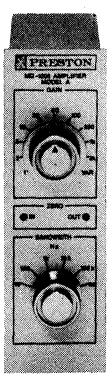
GAIN IS ADJUSTABLE — Front panel switches let you select 10 gain settings from 1 to 1000 with 0.1% accuracy!

BANDWIDTH IS ADJUSTABLE — Delivered with any fixed bandwidth up to 1 MHz, or a 6 position switch that lets you select bandwidths from 10 Hz to 1 MHz!

LOW PUMPOUT CURRENT — Less than 1 nanoamp at all temperatures for highest system accuracy!

VERSATILE — Includes output multiplexer and recessed zero adjustments on front panel.

Get years ahead with Preston's MD-1000 Series Amplifiers. You'll be assured of lasting performance advantages, plus Preston's proven reliability — all for unit prices that start at only $300!

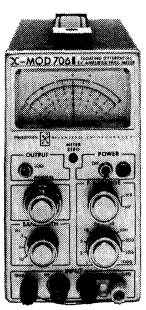


X-MOD 706

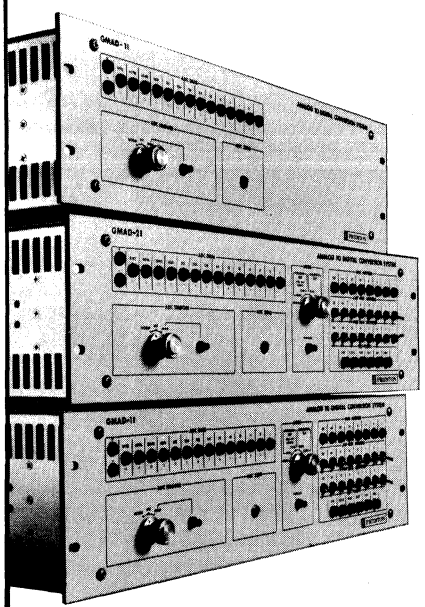
Floating Differential Amplifier and Null Meter

20 input ranges — from 1 volt full scale **all the way down to 1 microvolt full scale** — can be selected by front panel switches on this exceptionally stable and accurate amplifier. Long term stability is **0.1% for 6 months,** and drift is less than 0.1 microvolts/°C RTI!

And with input isolation greater than 10 gigaohms, a CMR of 120 db at 60 Hz, a center reading null meter, and three selectable bandwidths — 0.1 Hz, 1 Hz and 10 Hz — the X-MOD 706 is ideal for special applications including strip chart pen drives, galvo drives, and very-low-level transducer signal conditioning applications.



PRESTON Builds the World's Finest, Fastest A-D Conversion and Data Acquisition Systems, too!



The GM Series of A-D Conversion Systems includes a full range of resolutions, accuracies and speeds — all the way from 9 bits in 20 μsec up to 15 bits in 1 μsec!

And every GM Series ADC System can include any type of input amplifier, multiplexers, sample-and-hold amplifiers, and special logic control circuits for custom interfacing with your other data system components.

Low Level Multiplexers and Programmable Gain Amplifiers have just been added to the Preston ADC family, to make Preston your best source for complete ADC systems.

For the finest, most reliable, most precise and versatile A-D Conversion Systems you can specify, take a good look at Preston. You'll find more details on pages 368 and 369 in Volume 1 of EEM.

For complete information, write or call to —

PRESTON SCIENTIFIC INCORPORATED
805 East Cerritos Avenue,
Anaheim, California 92805
Telephone: (714) 776-6400
TELEX 65-5321

PRESTON

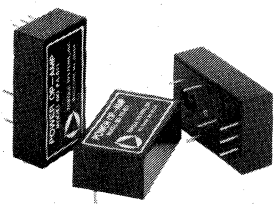
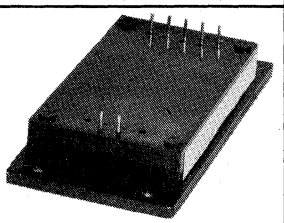
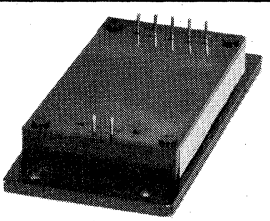
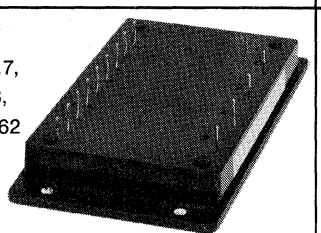
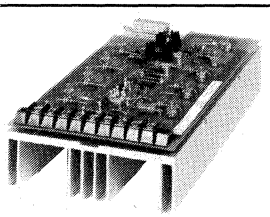
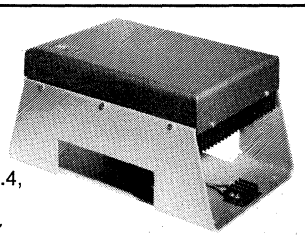
Snapper Series Wide Bandwidth

DC SERVO AMPLIFIERS

(FOR COMPLETE SNAPPER SPEED/POSITION CONTROL SYSTEMS, SEE **EEM** Vol.2•991)

(FOR SNAPPER MOTOR SEE **EEM** Vol.2•668)

These high performance servo op-amps are all silicon transistor, linear, bi-directional class B, short circuit protected to provide a ruggedness suitable for tough environments while retaining the low cost of production items. Detailed notes on specific applications are available on request, as well as immediate quotations on specias.

PACKAGE	SPECIFICATIONS	PRINCIPAL FEATURES
PA-011 Length 2.0, Width 1.1, Height 0.62 	Output Watts = 20 Output Volts = ±20 Output Amps = ±1 Internal Dissipation: Peak Watts = 20 Average Watts = 5 Response, Full Power = 5 KHz Open Loop Gain = 20,000 v/v Power Supply Volts = ±24	Designed for PC card mounting, for driving small servo motors, valves, solenoids, etc. Gain is sufficient for high performance applications. Feedback components for gain shaping to be mounted on same PC card. Unit is epoxy molded for maximum reliability. Price 100 quan. — $29.00
PA-121 Length 3.5, Width 1.8, Height 0.47 	Output Watts = 22 Output Volts = ±22 Output Amps = ±1 Internal Dissipation: Peak Watts = 40 Average Watts with 1.2°C per watt heat sink = 28 Response, Full Power = 20 KHz Voltage Gain = 25 v/v Power Supply Volts = +28	Bridge type amplifier designed for use with single polarity, +28 volts supply. Fast response power booster for IC Op-Amps. Mating Socket PC-120 for convenient location of input, balancing, and current limit adjust components. Price 100 quan. — $68.00
PA-112 Length 3.5, Width 1.8, Height 0.47 	Output Watts = 60 Output Volts = ±20 Output Amps = ±3 Internal Dissipation @ 25°C: Peak Watts = 80 Average Watts with 1.2°C per watt heat sink = 40 Response, Full Power = 10 KHz Open Loop Gain = 60,000 v/v Power Supply Volts = ±24	Designed for "plug in" applications utilizing mating socket and servo feedback component board PC-110. Rated for driving size 32 and larger DC motors. Must be mounted onto model HS-200 heat sink or equivalent for full performance. Price 100 quan. — $49.00
PA-223 Length 4.7, Width 2.8, Height 0.62 	Output Watts = 110 Output Volts = ±22 Output Amps = ±5 Internal Dissipation: Peak Watts = 150 Average Watts with 0.12°C per watt heat sink = 130 Response, Full Power = 1.0 KHz Open Loop Gain = 100,000 v/v Power Supply Volts = +28	Bridge type amplifier designed for use with single polarity power supply. Nominal supply volts = +28 only, and minus reference voltage is internally generated. Unit includes "inhibit" input for clamping output to zero volts. Use with heat sink HS-200F or equivalent. Price 100 quan. — $99.00
PA-601 Length 8.0, Width 4.4, Height 2.0 	Output Watts = 525 Output Volts = ±35 Output Amps = ±15 Internal Dissipation: Peak Watts = 600 Average Watts Using 50 CFM Forced Air = 350 Response, Full Power = 5 KHz Open Loop Gain = 60,000 v/v Power Supply Volts = ±40	Designed for high acceleration low cycle servos, where large peak power is involved. Amplifier contains provisions for feedback components, and its own heat sink extrusion. Optional fan and bracket available. Price 100 quan. — $125.00
PA-301 Length 12.4, Width 7.7, Height 6.7 	Output Watts = 1000 Output Volts = ±25 Output Amps = ±40 Internal Dissipation: Peak Watts = 1400 Average Watts = 700 Response, Full Power = 1.5 KHz Open Loop Gain = 20 v/v Power Supply Volts = +35 Reference Supply Volts = −15 ±5	Designed as a power stage for severe average as well as good peak power, from a single power supply. Contains provisions for front end "plug ins" internally, and has its own heat sink and fan. Available at 40 volts output, and also with a pulse power capability to 2000 watts. Price 100 quan. — $395.00

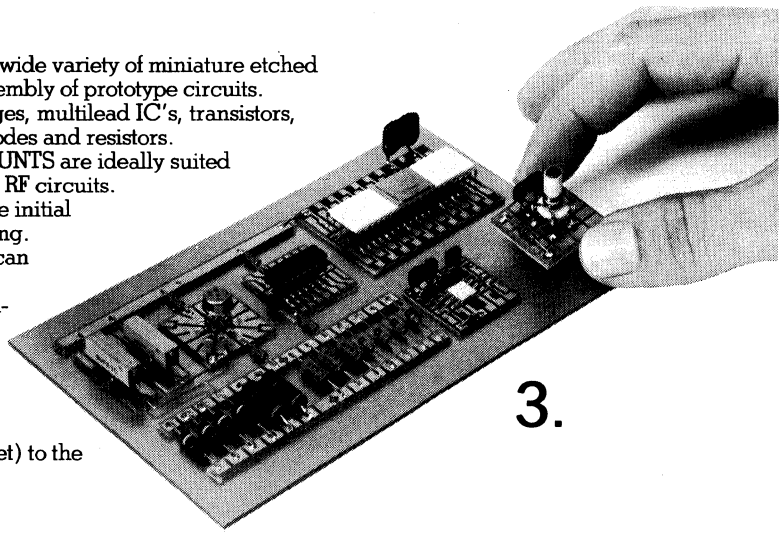
Torque Systems Inc.

P.O. Box 167, 225 Crescent Street, Waltham, Mass. 02154 (617) 891-0230

Breadboarding?

Consider MINI-MOUNTS™. They give you answers to some of the thorniest questions in breadboarding.

- ☐ The MINI-MOUNT system offers you a wide variety of miniature etched patterns for quick and inexpensive assembly of prototype circuits. Included are mounts for DIP IC packages, multilead IC's, transistors, trimmer potentiometers, capacitors, diodes and resistors.
- ☐ From DC to the GHz region, MINI-MOUNTS are ideally suited for analog circuits, digital circuits, and RF circuits.
- ☐ With MINI-MOUNTS, you eliminate the initial artwork, etching and bothersome drilling.
- ☐ Following your circuit schematic, you can design a finished board in minutes.
- ☐ MINI-MOUNTS can be easily disassembled for re-use.



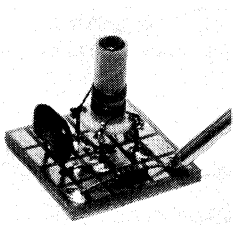
3.

Look, No holes.

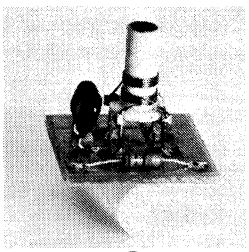
There are just three easy steps:

1. Solder your component (or socket) to the MINI-MOUNT pattern.
2. Peel off the pressure-sensitive backing.
3. Position MINI-MOUNT on ground plane.

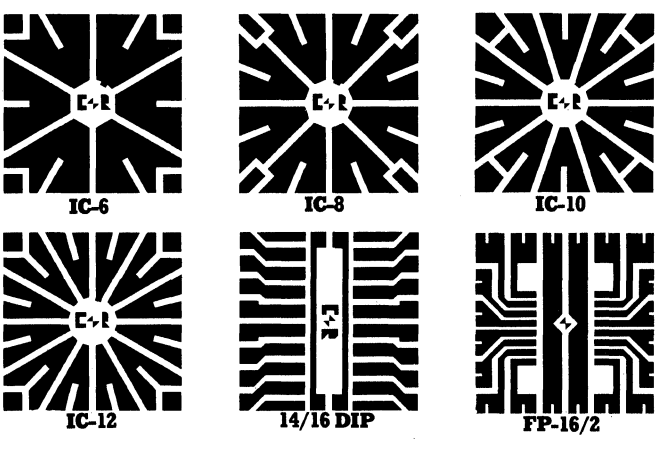
Then all you have left is to interconnect the system with soldered wires.



1.



2.

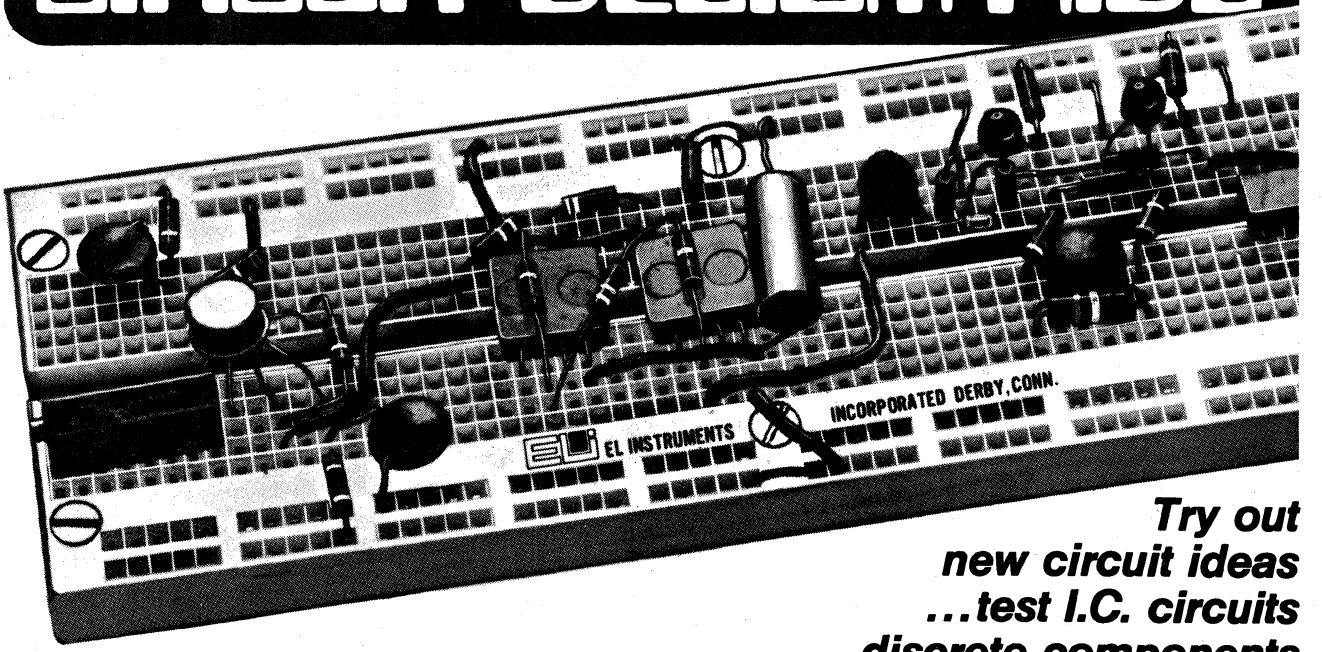


The above patterns are all shown as actual size.

Pat. Pending

CHRISTIANSEN RADIO, INC.
3034 Nestall Road□ Laguna Beach, California 92651
Telephone (714) 497-1506

CIRCUIT DESIGN AIDS



the EL Socket SK-10

Try out new circuit ideas ...test I.C. circuits ...discrete components only $17.75

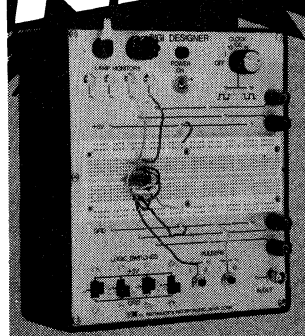
Quantity Discounts Available

Your EL SOCKET is ready-to-use. Just insert components . . . like ¼ watt resistors, ceramic capacitors, diodes, I.C.'s, transistors, etc. . . . and your circuit is built. There are no special patch cords needed, because components are interconnected with solid No. 22 gauge wire.

Each contact junction has 5 tie points; one for a component lead, 3 for input and output wires and the other for a test probe. Unique, new tie point contacts were developed to create solderless griping yet solid electrical contact . . . so, the grip on inserted pins exceeds conventional spring sockets. Contacts are spring loaded nickel silver.

Accepts all Standard Components • No soldering • Just plug-in • No Special patch cords needed • Completely reusable

NEW!



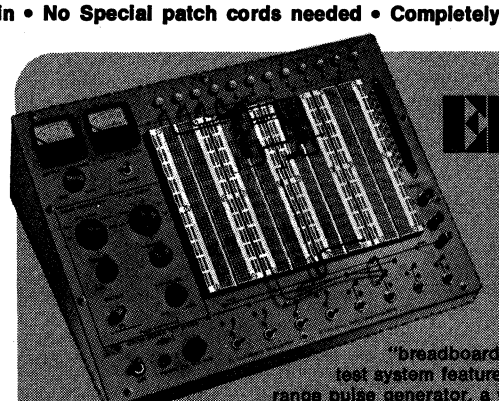
Build your own circuit designer, with the outstanding features of expensive models . . . now at a low, low budget price!

THE DIGI DESIGNER

This compact package contains a regulated 5 VDC supply, selectable frequency clock, EL-Socket, dual bounce-free pushbuttons (pulsers), 4 slide switches for voltage/ground, plus 4 independent "logic lights" for on/off states of various logic circuitry. Exclusive Breadboarding Pins offer input/output connections to socket eliminating all soldering. Use any 22 gauge solid wire.

DD1-K, Kit Form, **$59.95** (Incl. p.c. boards, all components, instruction manual)

DD1-A, Assembled, ready for use. **$95.00**



ELITE ONE

CIRCUIT DESIGN SYSTEM

This dynamic "breadboard" circuit design test system features a built-in wide range pulse generator, a variable metered power supply, independent circuit monitor "logic lights", isolated pushbuttons and toggle switch arrays. Plus, the ELITE-1 offers universal component acceptance with the EL Socket (described above), almost unlimited fan in/fan out capability and No. 22 gauge solid hook up wire interconnections.

$650.

See our complete line of modestly priced, quality Circuit Design Aids, described in the FREE idea-packed, illustrated Circuit Design Catalog. Write or phone for your FREE copy today!

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CU-7360

A C I

ACTIVE CONTROL INSTRUMENTATION

BOX 194, EAST NORTHPORT, N.Y. 11731
(516) 864-2111

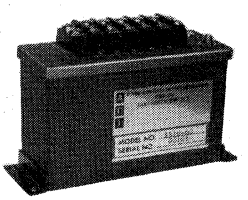
MEASUREMENT AND CONTROL

"an advanced line of instrumentation . . . industry oriented . . . utilizing state-of-the-art techniques providing high performance economically . . ."

FREQUENCY MONITOR

All standard line voltages available
Model 3510 (55-65 Hz)
Model 3511 (380-420 Hz)

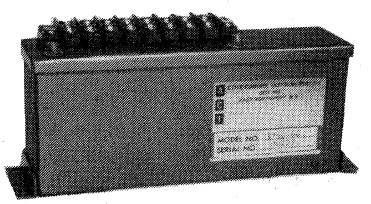
Output: 0 to 10 VDC
Accuracy: 1%
Linearity: .05% center Freq.
Temp.: −20°C to +71°C
Size: 4½" x 1½" x 3"



FREQUENCY MONITOR/ CONTROLLER

All standard line voltages available
Model 3750 (55-65 Hz)
Model 3751 (380-420 Hz)

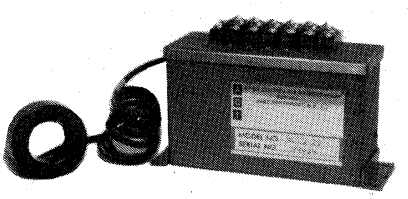
Output 1: 0 to 10 VDC
Output 2: Solid State or Relay Hi and Lo limits adjustable through entire Range
Accuracy: 1%
Linearity: .05% center Freq.
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"



A.C. CURRENT CONTROLLER

Thru-Current Range
0-100 Amps
Model 4015
Output: N.O. Solid State

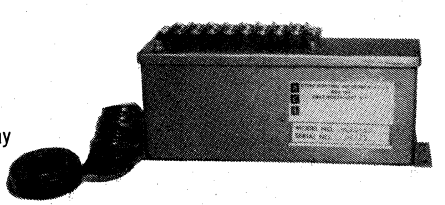
Excitation: 115 or 220 VAC 50-400 Hz
Control Point: .1A to 100A (adjustable)
Repeatability: ±2%
Temp.: −20°C to +71°C
Size: 4½" x 1½" x 3"



A.C. CURRENT MONITOR/ CONTROLLER

Thru-Current Range
0-100 Amps
Model 4020 Single Trip Point
Model 4025 Adj. Band Limits
ANALOG output adjustable for for ANY full scale within Range

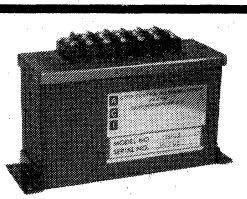
Excitation: 115 or 220 VAC 50-400 Hz
Control Point: 0-100A (adjustable)
Repeatability: ±1%
Output 1: 0-5 VDC Analog
Output 2: Solid State or Relay
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"



A.C. VOLTAGE MONITOR

All standard line voltages available
Model 9001 (60 Hz)
Model 9002 (400 Hz)

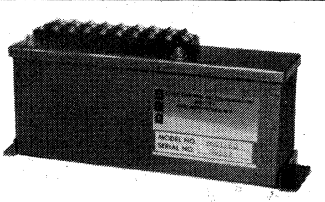
Input: 90-140 VAC
Output: 0-500 MV to 0-5 VDC
Accuracy: 1%
Response: to 2 MSEC
Temp.: −20°C to +71°C
Size: 4½" x 1½" x 3"



A.C. VOLTAGE MONITOR/ CONTROLLER

All standard line voltages available
Model 9601 (60 Hz)
Model 9602 (400 Hz)

Input: 90-140 VAC
Output 1: 0-500 MV to 0-5 VDC
Output 2: Solid State or Relay
Accuracy: 1%
Response: to 2 MSEC
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"



ACTIVE CONTROL INSTRUMENTATION

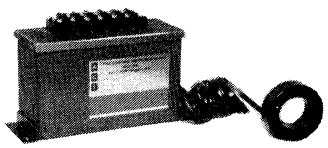
BOX 194, EAST NORTHPORT, N.Y. 11731
(516) 864-2111

MEASUREMENT AND CONTROL

WATTS MONITOR/ CONTROLLER

All standard line voltages available 60 Hz or 400 Hz

Input: 90-140 VAC 100W F.S. to 10KW F.S.
Output 1: 0-5 VDC Analog
Output 2: Solid State or Relay
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"

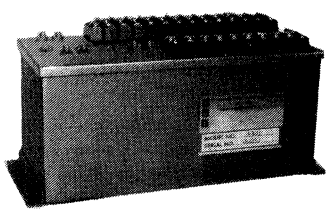


POWER LINE MONITOR/ CONTROLLER

Adjustable **HI-LO** limit detect.

Model 4301
1ϕ Voltage and Frequency
Model 4302
3ϕ Voltage and Frequency

Voltage Band: 100-130 VAC
Freq. Band: 50-70 Hz
Hi-Lo Limits: Adj. to any points within Band
Output Relay: SPDT or 3PDT 10 Amp
Time Delay: 0.5 Sec Fixed or Adj. Option
Temp.: −20°C to +71°C
Size: 7½" x 3" x 3½"



FAST RESPONSE D.C. CURRENT SENSOR

Thru-Current Ranges:
From 0-10 MA
to 0-100 Amps
Model 6001

Excitation: 28 VDC ±4 VDC
Output: 0-5 VDC
Accuracy: 0.5%
Response: 1 MSEC
Temp.: −20°C to +71°
Size: 4½" x 1½" x 3"

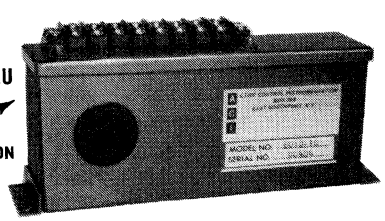
PASS-THRU

D.C. CURRENT SENSOR

Thru-Current Ranges:
From 0-10 MA
to 0-100 Amps
Model 6010 D.C. Averaging

Excitation: 115 VAC ±10% 60 Hz
Output: 0-5 VDC
Accuracy: 2%
Response: 0.5 Sec
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"

PASS-THRU
50KV ISOLATION

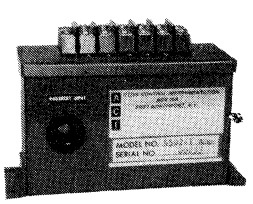


FAST RESPONSE D.C. CURRENT SENSOR/ LEVEL DETECTOR

Thru-Current Ranges:
From 0-10 MA
to 0-100 Amps
Model 4502

Excitation: 28 VDC ±4 VDC
Output 1: 0-5 VDC
Output 2: D.C. Logic '0' or 5 VDC TTL Compatible
Accuracy: 0.5%
Response: 1 MSEC
Temp.: −20°C to +71°C
Size: 4½" x 1½" x 3"

PASS-THRU

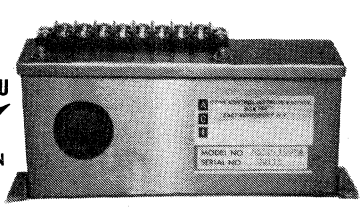


D.C. CURRENT SENSOR/ LEVEL DETECTOR

Thru-Current Ranges:
From 0-10 MA
to 0-100 Amps
Model 4550

Excitation: 115 VAC ±10% 60 Hz
Output 1: 0-5 VDC
Output 2: N.O. Relay Cont.
Accuracy: 2%
Response: 20 MSEC
Temp.: −20°C to +71°C
Size: 6½" x 1½" x 3"

PASS-THRU
50KV ISOLATION



Telephone or write for individual detail sheets prices and applications assistance.

American Aerospace Controls Inc.
131 VERDI STREET, FARMINGDALE, NEW YORK 11735 □ (516) 694-5100

CURRENT, VOLTAGE AND POWER INSTRUMENTATION

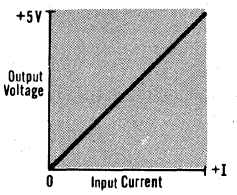
CURRENT SENSORS D.C.

American Aerospace Controls' D.C. current sensors are used for measurement and control applications requiring an accurate high level D.C. output signal proportional to the input current. Most models feature "pass thru hole" construction for the power cable providing complete electrical isolation of the output. Models are available in grades suitable for industrial and military applications.

913A

HIGH ACCURACY
SMALL SIZE

Current Ranges Amps DC
100
50
20
10



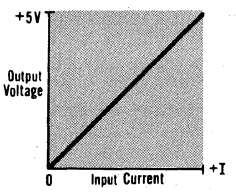
Output Volts	0 to 5 VDC
Response	1 ms
Accuracy	±1% F.S.
Excitation	24-32 VDC
Temp. Coef.	.08% F.S./°C
Size	1⅝ x 1⅝ x 2⅜

902 and 916

HIGH CURRENT RANGES

Current Ranges Amps DC

902	916
300	1000
200	750
100	500
50	



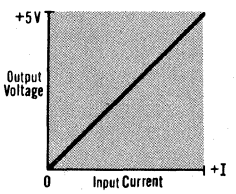
Output Volts	0 to 5 VDC
Response	5 ms
Accuracy	±1% F.S.
Temp. Coef.	.05% F.S./°C
Excitation	24-32 VDC
Size	2 3/16 x 3¾ x 3 1/16

903 and 923

MEDIUM CURRENT RANGES

Current Ranges Amps DC

903		923
2.0	0.1	50
1.0	0.05	20
0.5	0.02	10
0.2	0.01	5

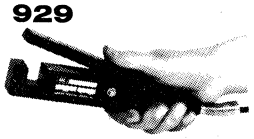


Output Volts	0 to 5 VDC
Response	50 ms
Accuracy	±1%
Temp. Coef.	.04%/°C
Excitation	24-32 VDC
Size	2 x 2 9/16 x 2⅞

CURRENT SENSORS MOVEABLE JAW TYPE

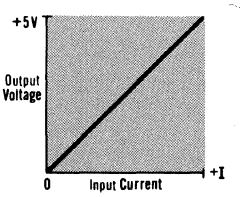
A complete line of moveable jaw type current sensors are available for D.C., A.C. and combination D.C. and A.C. current measurements. Models cover both military and industrial applications. These transducers are well suited for diagnostic testing of automotive electric circuits. Uses include measurement of starter current, battery drain, and generator-alternator current. Fast response units permit accurate analysis of current wave forms. Output voltage can be indicated on a meter, scope or recorder.

929



HI-ACCURACY
MIL-SPECS

Current Ranges Amps. D.C.
0-1000
0-500
0-200
0-100
0-50



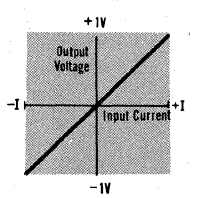
Output	0 to 5 VDC
Accuracy	±1% F.S.
Excitation	28 VDC ±4 VDC
Response	200 μsec
Temp. Range	−55°C to +85°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

930

DUAL RANGE
FAST RESPONSE BIDIRECTIONAL

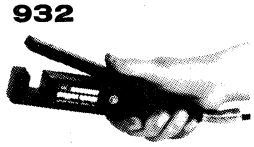
Current Ranges Amps. DC

±1000	±150
± 500	±100
± 400	± 50
± 300	± 30



Output Volts	0 to ±1 VDC
Accuracy	±2% F.S.
Response	100 μsec
Excitation	±15 VDC @ 50 MA
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

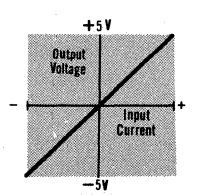
932



SINGLE RANGE
FAST RESPONSE BIDIRECTIONAL

Current Ranges Amps. DC

±50	±500
±40	±400
±30	±300
±20	±200
±10	±100



Output	0 to ±5 VDC
Accuracy	1% F.S.
Excitation	±15 VDC ±1 VDC
Response	100μ sec
Temp. Range	−20°C to +70°C
Temp. Coef.	0.1% F.S./°C
Size	1 x 1¾ x 9

AAC

American Aerospace Controls Inc.

131 VERDI STREET, FARMINGDALE, NEW YORK 11735 □ (516) 694-5100

CURRENT SENSORS BIDIRECTIONAL

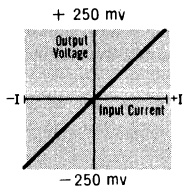
Bidirectional current sensors are used to sense either D.C. currents whose polarity or direction of flow may reverse or A.C. currents within the response capabilities of the device. The electrically isolated output signal duplicates the current wave form. Because of their fast response characteristics, these sensors may be used for pulse measurements and controls.

928

FAST RESPONSE

Current Range
Amps DC or AC Peak

±150
±100
± 50
± 25



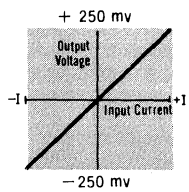
Output Volts	0 to 250 mv
Response	1 μs
Accuracy	±2% F.S.
Temp. Coef.	0.1%/°C
Excitation	15 VDC
Size	1 x 1¾ x 2 1/16

910

FAST RESPONSE
ECONOMY

Current Ranges
Amps DC or AC Peak

± 300
± 200
± 150
± 100
± 50
± 25



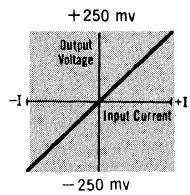
Output Volts	0 to ±250 mv
Response	5 μs
Accuracy	±2% F.S.
Excitation	15 VDC
Temp. Coef.	0.15% F.S./°C
Size	1 x 1¾ x 2 1/16

909

HIGH CURRENT
REMOVABLE YOKE

Current Ranges
Amps DC or AC Peak

±2500
±1500
±1000
± 750
± 500
± 250
± 150



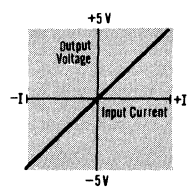
Output Volts	0 to 250 mv
Response	200 μs
Accuracy	±2% F.S.
Temp. Coef.	0.15% F.S./°C
Excitation	24-32 VDC
Size	1 9/16 x 3¼ x 4⅝

905 and 925

HIGH ACCURACY
HIGH OUTPUT

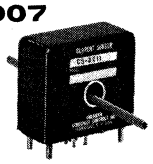
Current Ranges
Amps D.C.

905	925
± 2.0	± 50
± 1.0	± 20
± 0.5	± 10
± 0.2	± 5
± 0.1	



Output	0 to ±5 VDC
Response	50 ms
Accuracy	±1% F.S.
Excitation	±15 VDC
Temp. Coef.	.04% F.S./°C
Size	2 x 2 9/16 x 2⅞

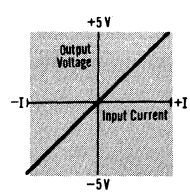
907



FAST RESPONSE
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±150
±100
± 50
± 25



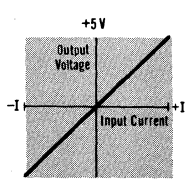
Output Volts	0 to 5 VDC
Response	100 μsec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S./°C
Size	1 x 1¾ x 2 1/16

927

MEDIUM CURRENT RANGES
HIGH OUTPUT

Current Ranges
Amps DC or AC Peak

±1000	±200
± 750	±150
± 500	±100
± 300	± 50
± 250	



Output Volts	0 to ±5 VDC
Response	100 micro sec
Accuracy	±2% F.S.
Excitation	±15 VDC
Temp. Coef.	0.15% F.S./°C
Size	2 x 2 9/16 x 2⅞

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American Aerospace Controls Inc.

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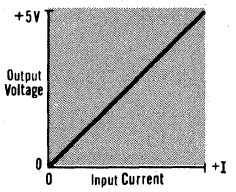
CURRENT SENSORS A.C.

A broad line of "pass thru hole type" A.C. current sensors are available for measurement or control of current at standard line frequencies or over a broad frequency spectrum. The sensors produce a high level D.C. signal output that is electrically isolated from the current line. Power dissipation is negligible and economy models of these sensors may be used as replacements for shunts.

1004

60 TO 400 Hz

Current Ranges Amps AC rms	
100	5
50	2
20	1
10	

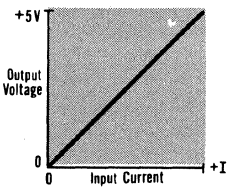


Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½% F.S.
Accuracy	±2% F.S. Max.
Excitation	Self Excited
Frequency	50 to 400 Hz
Temp. Stability	0.1% F.S. /°C
Size	2 x 2 1/16 x 2 7/8

1003AM1 and 1003AM2

60 Hz ECONOMY

Current Ranges Amps AC rms	
AM1	AM2
100	250
50	200
20	150
10	
5	

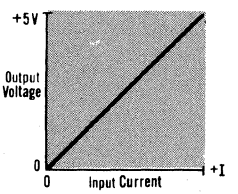


Output Volts	0 to 5 VDC
Response	150 ms
Repeatability	½%
Accuracy	± 2% F.S.
Excitation	Self Excited
Temp. Stability	0.1% F.S./°C
Size (AM1)	1 x 2 1/16 x 2
Size (AM2)	1 3/16 x 2 7/8 x 2½

1001

HIGH CURRENT REMOVABLE YOKE

Current Ranges Amps AC rms
2500
1500
1000
750
500
250
150



Output Voltage	0 to 5 VDC
Frequency Range	50 Hz to 2000 Hz
Accuracy	±2.5% FS
Temp. Stability	.15% F.S. /°C
Excitation	24-32 VDC
Response	50 ms
Size	1 1/16 x 3 1/4 x 4 5/8

A.C. CURRENT CONTROLLERS

A.C. Current Controllers are adjustable devices that detect a set current level and produce a relay closure or opening when the set current level is exceeded. These ruggedly built industrial control devices utilize a current to voltage "thru hole" toroidal transformer to sense the line current. The (CT) current transformer's output is fed to a control box which contains the signal conditioning circuitry and relay. Uses include overload and underload detection, ground fault monitoring, power failure, etc.

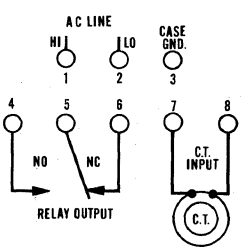
850

60 Hz INDUSTRIAL

Settable Input Current Ranges Amps 60 Hz	
0 to 2	0 to 20
0 to 5	0 to 50
0 to 10	0 to 100

Options

Time Delay — .5 sec. to 5 sec. 400 Hz operation. Solid state output.



Output	Relay 10 Amp SPDT
Line Voltage	115 VAC or 220 VAC
Line Frequency	50 to 60 Hz
Burden	3 Watts
Set Point	Adjustable 10% to Full Scale
Repeatability	2% F.S.
Reset	Automatic
Response	500 ms

851

SELF EXCITED RELAY ENCLOSED

Settable Input Current Amps 60 Hz	
10-12	50-60
12-15	60-75
15-20	75-100
20-25	100-125
25-30	125-150
30-40	150-200
40-50	200-250

Normally open Relay is activated When Input Current exceeds set point.

Output	Relay .5 Amp SPST
Frequency	47-63 Hz
Set Point	Adjustable through-out Range
Repeatability	±0.5% Max. Current
Reset	Automatic, 20% below set point
Response	300 ms

AAC

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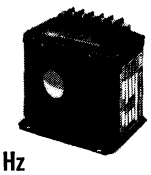
WATT TRANSDUCERS A.C.

A.C. Watt transducers are used for measurement or control of A.C. power. These low insertion devices provide a high level linear D.C. output. Models are available covering real watts (VA times Power Factor) and Volt Amps (VA).

411 and 413

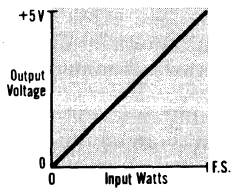


60 Hz
115 and 230 VAC

Kilowatt Ranges
0-1 to 0-100

Current Ranges Amps
0-10 to 0-500

Voltage Ranges VAC
80 to 150 and 160 to 300



Output 411 Output 413	0 to 100 mV DC 0 to 5V DC
Excitation	Self Excited
Accuracy	2% F.S.
Power Factor	0 to ±1
Response	400 ms
Temp. Coef.	.15%/°C
Size	3 7/16 x 4 1/8 x 2 5/16

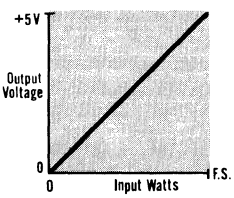
412 and 414

400 Hz
115 and 200 VAC

Kilowatt Ranges
0-1 to 0-80

Current Ranges Amps
0-10 to 0-500

Voltage Ranges VAC
80 to 150 and 140 to 260



Output 412 Output 414	0 to 100 mV DC 0 to 5V DC
Excitation	Self Excited
Accuracy	2% F.S.
Power Factor	0 to ±1
Response	400 ms
Temp. Coef.	.15%/°C
Size	3 7/16 x 4 1/8 x 2 5/16

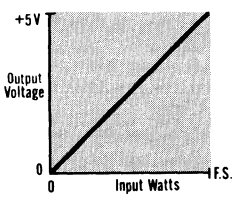
411 M1 and 413 M1

60 Hz
440 VAC

Killowatt Ranges
0-4 to 0-200

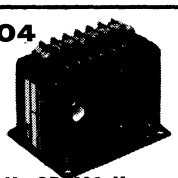
Current Ranges Amps
0-10 to 0-500

Voltage Ranges
320 to 560 VAC



Output 411 MI Output 413 MI	0 to 100 mV DC 0 to 5V DC
Excitation	Self Excited
Accuracy	2% F.S.
Power Factor	0 to ±1
Response	400 ms
Temp. Coef.	.15%/°C
Size	3 7/16 x 4 1/8 x 2 5/16

404

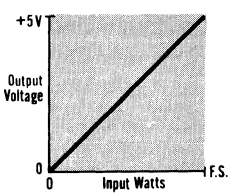


60 Hz OR 400 Hz
VA TRANSDUCER

Current Ranges AC rms
0-10 to 0-500 Amps

Voltage Ranges
115 Volts (60 to 170)
220 Volts (110 to 330)
440 Volts (220 to 660)

Wattage Ranges
0-1 KW to 0-200 KW



Output	0 to 5 VDC
Accuracy	2% FS
Excitation	Self Excited
Response	50 ms
Temp. Coef.	.15%/°C
Size	2 1/4 x 2 13/16 x 3 1/2

WATT TRANSDUCERS D.C.

American Aerospace Controls' D.C. watt transducers are used to measure power in a D.C. circuit. The sensors feature pass thru hole construction and zero insertion loss as well as electrical isolation of the current cable. The units generally respond in the micro second region and produce a linear D.C. output proportional to power input.

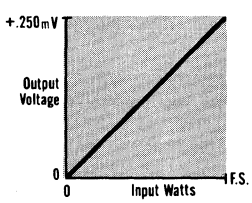
407

FAST RESPONSE
ECONOMY

Current Ranges
0-10 to 0-300 Amps

Voltage Ranges
0-12 to 0-240 Volts

Wattage Ranges
0-120 W to 0-60 KW



Output	0-250 mv DC
Accuracy	2% FS
Response	5 μsec
Temp. Range	−35°C to +70°C
Temp. Coef.	.15%/°C
Size	1 x 1 3/4 x 2 1/16

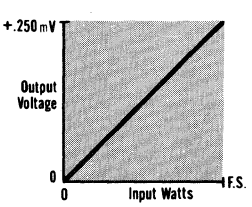
401

HIGH CURRENT
REMOVABLE YOKE

Current Ranges
0-150 to 0-3000

Voltage Ranges
0-20 to 0-150

Wattage Ranges
0-3 KW to 0-450 KW



Output	0 to 250 mv
Accuracy	2.5% FS
Response	200 μsec
Temp. Range	−25°C to +75°C
Temp. Stability	0.15%/°C
Size	1 1/16 x 3 1/4 x 4 5/8

AAC

American Aerospace Controls Inc.

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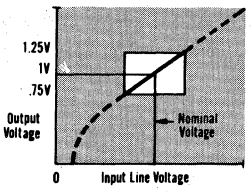
VOLTAGE MONITORS A.C.

American Aerospace Controls' fast response A.C. line voltage monitors provide an isolated D.C. output voltage proportional to the A.C. RMS line voltage. The monitors respond within ½ cycle of the A.C. line voltage frequency and are very useful in protecting computer systems from program destroying transient line voltages or for detecting momentary power failures.

101 and 102

FAST RESPONSE D.C. OUTPUT

Line Voltage Range Volts rms AC	
101	
90-150	60Hz
180-300	60Hz
102	
90-150	400Hz
155-260	400Hz



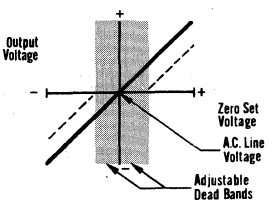
Output Voltage	1 VDC for Nominal Line Voltage
Output Scale Factor	10 mv/Volt
Excitation	Self Excited
Response	Within ½ Hz
Accuracy	2%
Size	2¼ x 2¼ x 3¾

Series 103 line voltage monitors feature adjustable zero suppression and adjustable high and low limit dead bands permitting accurate detection of those out of limit voltage levels of consequence to a particular system. Both 60 Hz and 400 Hz models may be selected.

103 and 104

FAST RESPONSE SUPPRESSED ZERO

Line Voltage Ranges Volts rms AC	
90-150	60 Hz
180-300	60 Hz
90-150	400 Hz
155-260	400 Hz



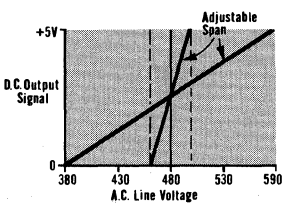
Output Scale	10 MV/Volt
Accuracy	±2% F.S.
Excitation	Self Excited
Response	Within ½ Hz.
Temp. Coef.	0.1%/°C.
Size	3 x 3½ x 4¼

105

FAST RESPONSE – 60 Hz SUPPRESSED ZERO

Line Voltage
480 Volts 60 Hz

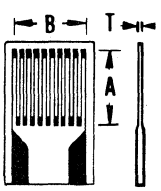
Adjustable Span
480 V ±10V to
480 V ±100V

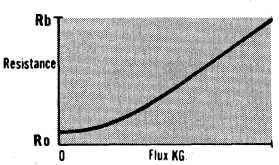


Output Volts	0 to 5 VDC
Accuracy	±2% F.S.
Excitation	Self Excited
Response	With ½ Hz
Temp. Coef.	0.1%/°C
Temp. Range	−40°C to +85°C
Size	2¼ x 2¼ x 3¾

MAGNETORESISTORS

Magnetoresistors are magnetic flux sensitive resistors that change resistance proportional to an applied magnetic field. They are useful for flux measurements, D.C. position sensors, pick-offs, and many other electronic functions. **The MRA type elements are useful for cryogenic applications. The MRI-type elements are general purpose high sensitivity elements.**

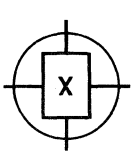


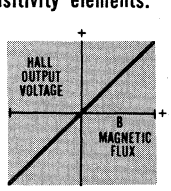


Model No.	Size — Inches A	B	T	Available Resistances At 0 Flux & 25°C Ro Ohms	Sensitivity Rb/Ro 3 KG.	10 KG.
MRA-11	1/16	1/16	.004	1 Ω to 200 Ω	1.05	1.35
MRA-12	1/8	1/8	.004	1 Ω to 1000 Ω	1.05	1.35
MRA-13	1/4	1/4	.004	1 Ω to 2000 Ω	1.05	1.35
MRA-14	1/2	1/2	.004	1 Ω to 3000 Ω	1.05	1.35
MRI-101	3/16	3/32	.010	100 Ω	2	7
MRI-201	1/8	1/8	.010	200Ω	2	7
MRI-251	3/16	3/32	.010	250Ω	3	10
MRI-501	1/8	1/8	.010	500 Ω	3	10

HALL EFFECT GENERATORS

Hall effect generators are magnetic flux sensitive elements that produce a polarity sensitive output voltage proportional to the applied magnetic field intensity and direction under constant current excitation. Applications include proximity detectors, brushless D.C. motors, magnetic card readers, current probes, Gauss meters, etc. **The HA Series are suitable for cryogenic applications while the HI Series are general purpose high sensitivity elements.**





Model No.	Size — Inches Length	Width	Thickness	Magnetic Flux Range	Rated Control Currents	Output Sensitivity at Rated Control Current
HA-11	9/32	1/8	.006	5 KG.	20 MA	.5 MV/KG.
HA-12	9/16	1/4	.006	5 KG.	100 MA	1 MV/KG.
HA-13	1	1/2	.006	5 KG.	200 MA	4 MV/KG.
HI-1	.10	.125	.020	20 KG.	15 MA	12 MV/KG.
HI-5	.10	.10	.030	0.1 KG.	10 MA	400 MV/KG.

Call us first for your control needs

We specialize in engineering and manufacturing of custom controls.

The type of control you're looking for is probably like one that we've designed and built before.

Our 17 years of experience can save you valuable time and design effort, since many circuits and designs we've developed are readily adaptable to other applications.

We specialize in sophisticated packages which meet military specifications or extreme environments and controls for commercial/industrial uses.

Our complete product capabilities are too extensive to list; shown below are our major areas of expertise.

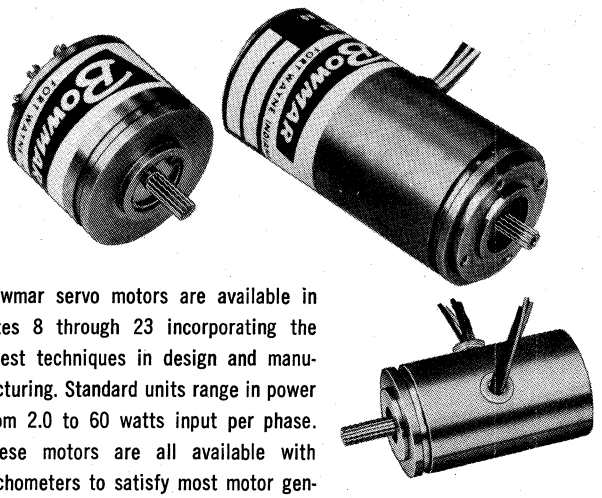
CONTROLS	Compact solid-state analog and digital units for . . . turbine engine start, run, and shutdown command . . . RPV launch, steering, destruct, and recovery systems . . . electro-mechanical actuator positioning and synchronization.
DETECTORS/SENSORS/ SENSING RELAYS	Voltage, current, frequency, temperature and light-sensing for . . . jet engine speed warnings . . . aircraft cargo smoke detection . . . power phasing . . . over-current protection.
TIMING DEVICES	Time delays from microseconds to hours for . . . missile arming and launching . . . parachute deployment . . . commercial and military system sequencing . . . satellite programming . . . high-noise surroundings.
CONVERTERS/INVERTERS	DC/DC, AC/DC, DC/AC conversion for . . . computer systems . . . geophysical survey equipment . . . integrated circuits . . . radar and sonar power.
POWER SUPPLIES	Multiple and single output units, using high-speed switching, in custom configurations for . . . computer, military, and industrial applications.
FLASHERS/DIMMERS	Solid-state short-circuit-proof flashers and high-efficiency dimmers.
SPECIAL ITEMS	An inventory of proven circuits and packages . . . directly suitable for new applications, or . . . adaptable with slight modifications to fit the most exacting requirements.

AUTRONICS CORPORATION

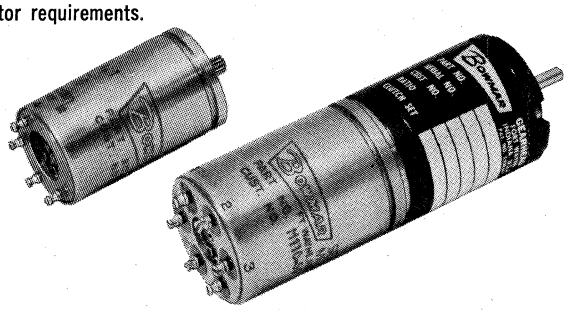
180 North Vinedo Avenue Pasadena, California 91107 (213) 681-3545 TWX (213) 449-2854

BOWMAR® ELECTROMECHANICAL CONTROLS

SERVO MOTORS, STEPPER MOTORS AND MOTOR GENERATORS

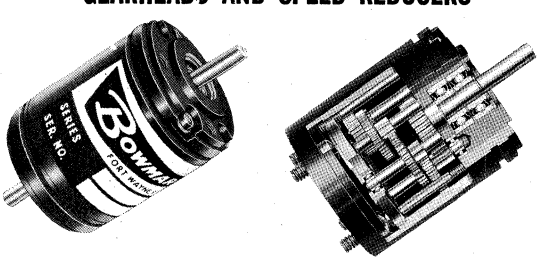


Bowmar servo motors are available in sizes 8 through 23 incorporating the latest techniques in design and manufacturing. Standard units range in power from 2.0 to 60 watts input per phase. These motors are all available with tachometers to satisfy most motor generator requirements.



Bowmar permanent magnet and variable reluctance stepper motors are available in sizes 8 through 23 providing stepping angles of 15°, 30°, 45° and 90°. Standard voltages cover the range of 18 to 28 VDC with speeds up to 900 steps per second.

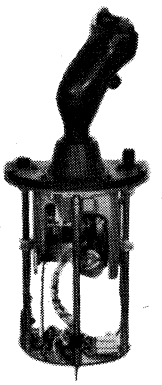
GEARHEADS AND SPEED REDUCERS



Standard gearheads are available in sizes 8 through 18. Specials in larger sizes are custom designed. Variations available include multiple shafts, concentric shafts, square designs and clamp or screw mountings. Bowmar Electroshift® gearchangers permit multiple ratio selection within a single gearhead.

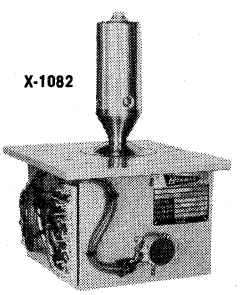
JOYSTICK CONTROLS

The X-Y Control handle is capable of 60° conical movement providing corresponding rotation of two synchros. The handle protrudes 7″ above mounting surface but is capable of being stowed and locked to a height of 4″ and provides for five distinct switching functions. Switch on mounting plate provides for additional switching, light panel displays positions and functions of this switch. Unit contains relays, transformer and diodes for additional radar interfacing. Unit excluding handle is 4 x 6 x 8 inches.

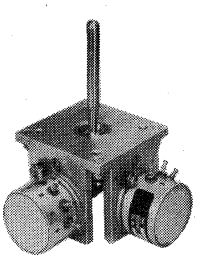


AM-3501

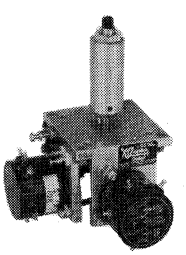
X-1082



Movement of handigrip in any direction produces corresponding rotation of potentiometers or other precision control components in both X and Y coordinates depending on stick position. The stick features a dead man thumb switch on top and may be positioned at any point in a 54° vertical cone. When released, the stick self-centers. Enclosure is 5¼ x 3¼ x 5¼ inches. IMMEDIATE DELIVERY with standard Size 9 potentiometers.



X-2438

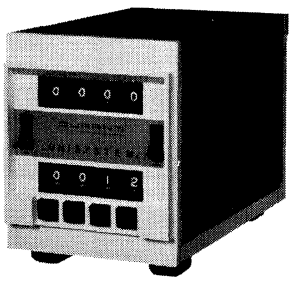


AM-3244

Two-axis control is provided by deflection of 1½″ fingersticks (std.) in a 57° cone of rotation. 1:6 sector gears operate precision control components mounted on outside of 1½ x 1½ x 1¼ inch enclosure. Small size and light weight (3 oz.) are especially advantageous for airborne uses and compact instrument panels. Self-centering stick is standard, with or without safety interlock switch provision. IMMEDIATE DELIVERY with standard Size 9 potentiometers in both axes.

BOWMAR INSTRUMENT CORPORATION
8000 Bluffton Road, Fort Wayne, Indiana 46809 • Tel.: (219) 747-3121 • TWX: 810-332-1510

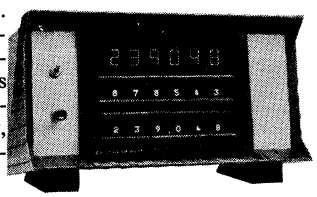
Everything in Count/Control.



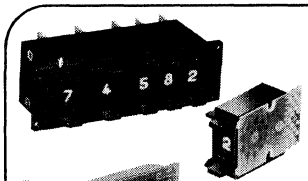
Unisystems:
Fast, accurate, and exceptionally reliable, ideal for most predetermined count / control applications. Pushbutton predetermined number settings and front panel reset, operation, speeds up to 1800 counts per minute.

ELECTROMECHANICAL CONTROL

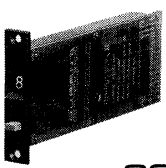
Electronic Controls:
HTL circuitry assures greater immunity to industrial noise. Two predetermining count levels provide application versatility. Brilliant LED displays provide readout even in brightly lighted locations. 10 AMP, 125 Volt relay output for application control versatility.



ELECTRONIC CONTROL



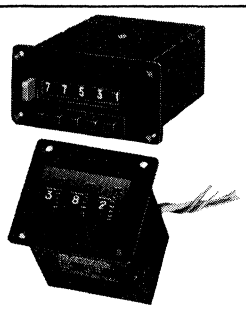
Selector switches:
Pushbutton actuation, one button adds the other subtracts. Modular design provides multi-switch flexibility. Decimal, BCD, BCO, or other codes available. Gold alloy contacts assure long life operation.



Decade Counters:
The Unipulser II decade counter is complete with its own drive input, transfer and reset circuit, and eleven line output for control or electrical readout. Predetermined, adding or subtracting, plus remote reset, pushbutton reset, or non-reset models.

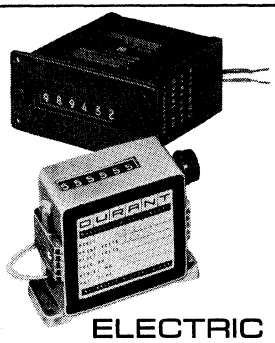
CONTROL MODULES

Predetermined Electric Counters:
A variety of models to choose from, including a 5 figure pushbutton model. Dependable, easy to install, simple to operate predetermined control for batching, testing and production control.



ELECTRIC CONTROLS

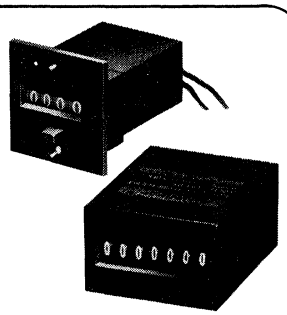
Everything in Counting Instruments.



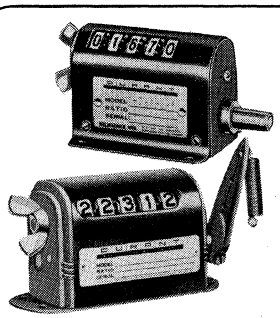
Electric counters:
A full range of dependable electrical counting instruments to satisfy all counting applications. Available in six or seven figures, pushbutton or remote reset, base or panel mounting in all popular AC and DC voltages. Hundreds of different models available.

ELECTRIC COUNTERS

Miniature Electric Counters:
Compact units available in four, six or seven figures, measures as little as 1" x 1.593" x 2.187". Available in a wide variety of mounting and voltage configurations, pushbutton reset or non-reset models standard.



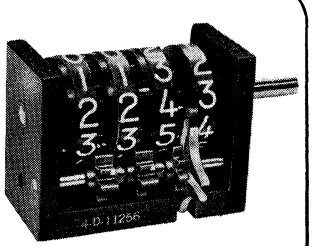
MINIATURE ELECTRIC COUNTERS



Stroke or Rotary counters:
Rugged mechanical counters featuring die cast frames, Delrin wheels, recessed windows, and stainless steel shafts insure dependable long life operation. Easy to read figures, simple installation and maintenance free years of service.

MECHANICAL COUNTERS

Instrument Counters:
High speed counters for indicating, metering devices, and scientific instruments offers a wide choice of figures, rotation, and wheel graduations. High strength, light weight materials provide accurate, dependable, operation with a minimum of size.



INSTRUMENT COUNTERS

Durant Digital Instruments

905 South 12th Street, Watertown, Wisconsin 53094
Phone: 414-261-4070, TWX 910-260-3713

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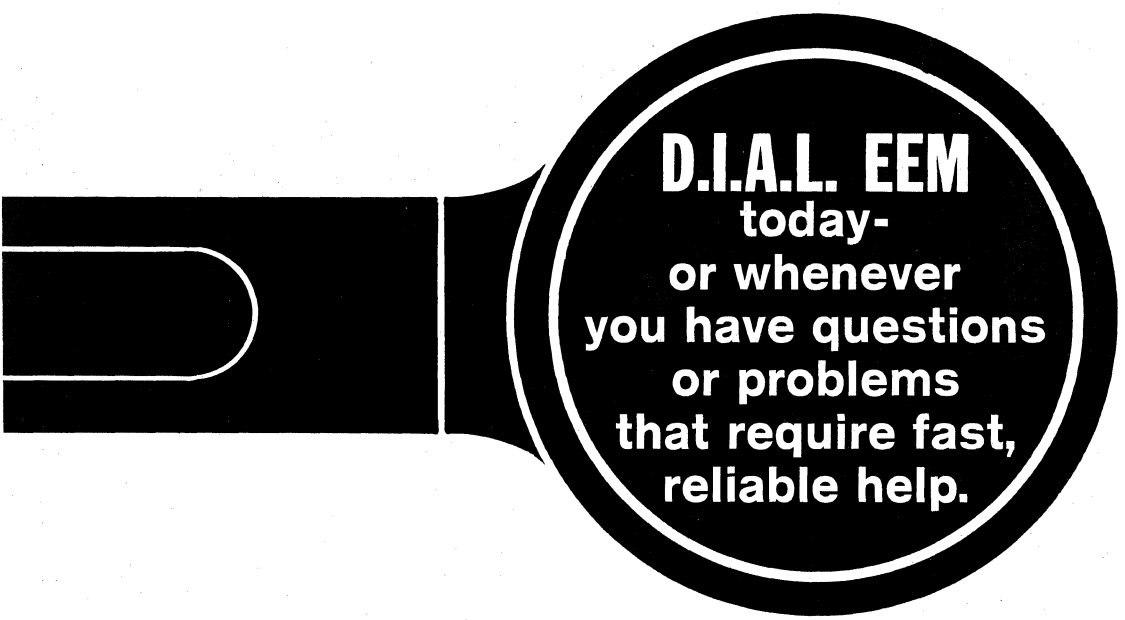

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Keeping you better informed.

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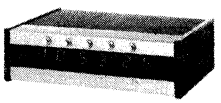
ESE DIGITALS *For computer age timing, counting and measuring.*

ES 112 Digital Clock:
A six digit, 12 hour clock. Set to the second. Solid state, MSI components with printed circuit board. No moving parts. Silent, seven segment tubes. Built to last a lifetime. Three setting controls: Fast Advance, Slow Advance, Hold. **$90.00**

Dimensions: 2¾" x 8" wide x 5⅝" deep.
Case: Choice of Etched Aluminum or Walnut.
Electrical: 117 VAC 50/60 Hz 10 W max.
Options: R B P C K

ES 124 Digital Clock: Same clock specifications as ES 112 except displays up to 24 hours, and has provisions for 50 or 60 Hz operation. **$90.00**

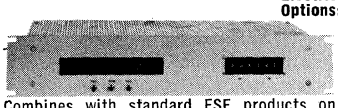
ES 500 Combination Six Digit Clock/Timer:
A 12 hour clock or timer. 5 controls: Start, Stop, Reset, Fast Advance, Slow Advance. Runs continuously to 12:59:59. Advances to 1:00:00 and continues as clock unless stopped or advanced. Same start, stop, and reset action as ES 400. **$120.00**



Dimensions: 2¾" x 8" wide x 5⅝" deep.
Case: Etched Aluminum
Electrical: 117 VAC 60 Hz 8 W max.
Options: R B P K

ES 510 Sixty minute timer:
A four digit timer (59:59). Start, stop and reset controls (Single pole, momentary, push-button). Runs continuously unless stopped or reset. If stopped, display holds time reading. When restarted continues with next count from last displayed figure. Reset while running or stopped. Returns display to all zeros. **$100.00**

Dimensions: 2¾" x 6" wide x 5⅝" deep.
Case: Etched Aluminum
Electrical: 117 VAC 60 Hz 8 W max.
Options: R B P Y Q K

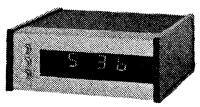


ES 750 thru 769 Programmers:
Combines with standard ESE products on etched aluminum, 19" relay rack mounting panel (3½" high). Single pole form A contact closure (1 Amp contact rating) for length of time program matches time
If control function involves count other than timing, products can be adapted. In most cases we provide interface between count input and event to be displayed.

Thumbwheel Programmer System	Patchboard Programmer Systems*
ES 750/ES 112 & one 6 digit program $265	ES 760/ES 112 & one 6 digit program $220
ES 751/ES 124 & one 6 digit program $265	ES 761/ES 124 & one 6 digit program $220
ES 752/ES 500 & one 6 digit program $295	ES 762/ES 500 & one 6 digit program $250
ES 753/ES 112 & two 4 digit programs $315	ES 763/ES 112 & two 4 digit programs $235
ES 754/ES 124 & two 4 digit programs $315	ES 764/ES 124 & two 4 digit programs $235
ES 755/ES 500 & two 4 digit programs $345	ES 765/ES 500 & two 4 digit programs $265
ES 756/ES 510 & one 4 digit program $250	ES 766/ES 510 & one 4 digit program $225
ES 757/ES 300 & one 4 digit program $285	ES 767/ES 300 & one 4 digit program $260
ES 758/ES 510 & two 4 digit programs $300	ES 768/ES 510 & two 4 digit programs $240
ES 759/ES 300 & two 4 digit programs $335	ES 769/ES 300 & two 4 digit programs $275

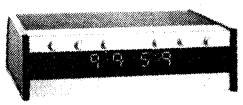
*An economy approach to providing the same programming functions as thumbwheel programmers listed.

ES 400 Three Digit Ten Minute Timer:
Three controls (Start, Stop, Reset). Runs continuously unless stopped. Displays up to 9:59. If stopped, display will hold time reading. Reset returns display to all zeros. Can be reset while running or stopped. If reset while running, timer will continue to run. **$75.00**



Dimensions: 2¾" x 6" wide x 5⅝" deep.
Case: Etched Aluminum
Electrical: 117 VAC 60 Hz 8 W max.
Options: R B P K

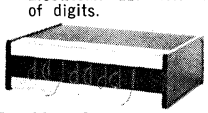
ES 300 One hundred minute up/down timer:
Four digit, one hundred minute timer (99:59) with six momentary push-button controls: Count Up, Count Down, Stop, Minutes Advance, Seconds Advance, Reset. Minutes and Seconds can be advanced simultaneously or independently, to pre-set for a specified countdown. Preset time will be automatically held until the timer is started. Counting can be activated up or down from that point or set back to zero. When "Stop" control is pressed, the four digit display is held. Counting direction (up or down) can be changed or time can be reset to zero without stopping the count. Continue to register elapsed time beyond the zero setting unless stopped. **$135.00**



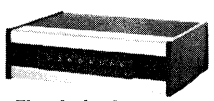
Dimensions: 2¾" x 8" wide x 5⅝" deep. **Case:** Etched Aluminum
Electrical: 117 VAC 60 Hz 10 W max. **Options:** R B P Y Q K

ES 702 thru 718 Programming Units:
Includes comparator circuitry. User provides BCD information to compare to program. When info agrees with program, a single pole form A relay contact closure occurs (1 Amp contact rating). Contact closure is maintained for length of time external BCD information agrees with program.

Dimensions: 2¾" x 8" wide x 5⅝" deep
Case: Etched Aluminum
Electrical: 117 VAC 60 Hz — Power requirements vary with number of digits.



Patchboard
ES 702 — 2 Digits $64.00
ES 703 — 3 Digits $69.00
ES 704 — 4 Digits $74.00
ES 705 — 5 Digits $78.00
ES 706 — 6 Digits $82.00
ES 707 — 7 Digits $88.00
ES 708 — 8 Digits $92.00



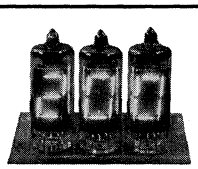
Thumbwheel
ES 712 — 2 Digits $110.00
ES 713 — 3 Digits $120.00
ES 714 — 4 Digits $130.00
ES 715 — 5 Digits $140.00
ES 716 — 6 Digits $150.00
ES 717 — 7 Digits $165.00
ES 718 — 8 Digits $180.00

Standard Options
. . . on many ESE digital products, allows a wide range of adaptability from the standard product line:
NOTE: When ordering, add these letter designations to the basic part number.
EXAMPLE:

ES 400	R	P	B
Basic Part Number	Remote Connector	Panel Mount	BCD Output

Designation:	Function:
R	Remote Connector
B	Parallel BCD Output (TTL)
P	Panel Mount
Y	Relay Closure
Q	Solid State Outputs
C	Crystal Time Base
K	Kit Available

ES 900 Series Modular Display Units



Priced from $15.00 to $79.00

A prototype tool for custom digital instrumentation. Each module consists of a printed circuit board, a seven segment incandescent tube and decoder driver (7447). Many modules feature other TTL devices, as listed, to provide the following additional functions:
- Latch (7475)
- Decade Counter (7490)
- Programmable Up/Down Counter (74192)

A single 5V supply is the only power required for all modules.

Single Digit Modules — Vertical mounting board — Connector included.

	Height	Width	Depth
ES 901	2"	.5"	2"
ES 902/(7475)	2"	.5"	2"
ES 903/(7475) (7490)	2"	.5"	2"
ES 904/(7475) (74192)	2"	.5"	2"
ES 905/(7490)	2"	.5"	2"
ES 906/(74192)	2"	.5"	2"

Multiple Digit Modules — Horizontal mounting — Connector optional.

	Height	Width	Depth
ES 912/2 Digits	1.75"	1.8"	3.75"
ES 913/3 Digits	1.75"	2.7"	3.75"
ES 914/4 Digits	1.75"	3.6"	3.75"
ES 915/5 Digits	1.75"	4.5"	3.75"
ES 916/6 Digits	1.75"	5.4"	3.75"
ES 917/7 Digits	1.75"	6.3"	3.75"
ES 918/8 Digits	1.75"	7.2"	3.75"
ES 922/2 Digits/(7475)	1.75"	1.8"	3.75"
ES 923/3 Digits/(7475)	1.75"	2.7"	3.75"
ES 924/4 Digits/(7475)	1.75"	3.6"	3.75"
ES 925/5 Digits/(7475)	1.75"	4.5"	3.75"
ES 926/6 Digits/(7475)	1.75"	5.4"	3.75"
ES 927/7 Digits/(7475)	1.75"	6.3"	3.75"
ES 928/8 Digits/(7475)	1.75"	7.2"	3.75"

	Height	Width	Depth
ES 932/2 Digits/(7475) (7490)	1.75"	1.8"	3.75"
ES 933/3 Digits/(7475) (7490)	1.75"	2.7"	3.75"
ES 934/4 Digits/(7475) (7490)	1.75"	3.6"	3.75"
ES 935/5 Digits/(7475) (7490)	1.75"	4.5"	3.75"
ES 936/6 Digits/(7475) (7490)	1.75"	5.4"	3.75"
ES 937/7 Digits/(7475) (7490)	1.75"	6.3"	3.75"
ES 938/8 Digits/(7475) (7490)	1.75"	7.2"	3.75"
ES 942/2 Digits/(7490)	1.75"	1.8"	3.75"
ES 943/3 Digits/(7490)	1.75"	2.7"	3.75"
ES 944/4 Digits/(7490)	1.75"	3.6"	3.75"
ES 945/5 Digits/(7490)	1.75"	4.5"	3.75"
ES 946/6 Digits/(7490)	1.75"	5.4"	3.75"
ES 947/7 Digits/(7490)	1.75"	6.3"	3.75"
ES 948/8 Digits/(7490)	1.75"	7.2"	3.75"
ES 952/2 Digits/(7475)(74192)	1.75"	1.8"	3.75"
ES 953/3 Digits/(7475)(74192)	1.75"	2.7"	3.75"
ES 954/4 Digits/(7475)(74192)	1.75"	3.6"	3.75"
ES 955/5 Digits/(7475)(74192)	1.75"	4.5"	3.75"
ES 956/6 Digits/(7475)(74192)	1.75"	5.4"	3.75"
ES 962/2 Digits/(74192)	1.75"	1.8"	3.75"
ES 963/3 Digits/(74192)	1.75"	2.7"	3.75"
ES 964/4 Digits/(74192)	1.75"	3.6"	3.75"
ES 965/5 Digits/(74192)	1.75"	4.5"	3.75"
ES 966/6 Digits/(74192)	1.75"	5.4"	3.75"

KITS: Our K series kits allow you to build ESE digitals at much less than the price of an assembled unit. Includes illustrated instructions, parts list, schematic and parts. No special tools needed. Kits can be factory assembled for an additional charge.

Twelve Hour Digital Clock: ES 112K — All features of ES 112. **$46.95** plus opt. alum. case **$7.50**/walnut **$12.00.**

Twenty Four Hour Digital Clock: ES 124K — Same as the ES 112 except tells time through 23:59:59. **$46.95** plus opt. alum. case **$7.50**/walnut **$12.00.**

I D REMINDER: ES 200K — Opt. to ES 112/124 Reminds operator 9 min. 45 sec. passed since last ID. Mounts on ES 112/124 board. Silent LED flash and opt. audio alarm. Kit **$9.95**/assembled **$14.95.**

Crystal Time Base: ES 201K — Opt. addition to ES 112K, ES 124K, or ES 500K. Mounts on board. Accuracy .002%. **$25.00.**

Digital Multimeter: ES 210K — Sensitive, accurate, bipolar. Automatic polarity indicator. Displays ohms, volts or amps in five ranges. 100 Microvolts to 500 V. 100 Milliohms to 1 Megohm. 100 Nanoamps to 1 Amp. Optional probe. **$77.00** plus **$12.50** case.

40 MHz Digital Frequency Counters: ES 220K — 5 Digit line freg. time base (1 KHz resolution). **$69.50** plus **$10.00** case.

ES 221K — 6 Digit crystal time base (100 Hz resolution). Not damaged by high power transmission levels. One cable connection to trans. output. Pot for sensitivity adjustment. **$109.50** plus **$10.00** case.

ESE DIGITALS
10418 La Cienega • Inglewood, Ca. 90304
(213) 772-6176

Design Analog Computers with Micro-Magnetics...

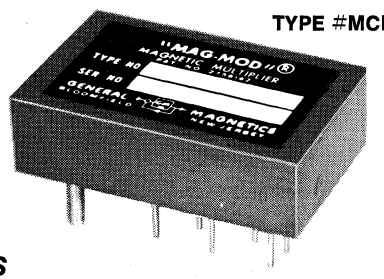
Magnetic Analog Multiplier DC x AC = AC Output

Product Accuracy ±½% Of All Theoretical Values Over The Full Military Temperature Range of —55°C To +125°C

OXO = O ± 2MV

OVER TEMPERATURE RANGE OF —55°C TO +125°C NO EXTERNAL TRIM POTENTIOMETERS REQUIRED TO OBTAIN SPECIFIED ACCURACY

TYPE #MCM 1351-2



FEATURES

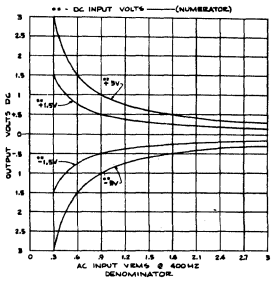
- Product accuracy is specified in % of reading for all output analog voltage product points over the full military temperature range instead of % of full scale error giving superior results for small values.
- Distortion free output AC wave over entire dynamic range regardless of temperature
- Linearity, product accuracy, and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- Analog product accuracy, wave quality and phase stability allow dual multiplier assemblies to be matched in amplitude within 1% of point of each other and 0.1° phase error over the temperature range
- Package size, power supply voltages and electrical specifications may be altered at no extra cost.

SPECIFICATIONS

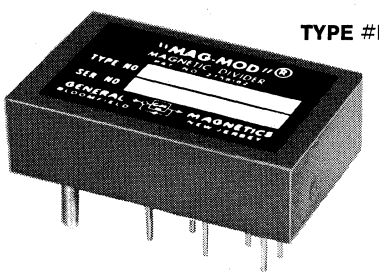
Transfer equation: E = XY/3
X & Y input signal ranges: 0 to ± 3V Peak
Maximum static and dynamic product error: ½% of point or 2 MVRMS, whichever is greater, over entire temperature range
Maximum zero point (X = 0, Y = 0): 2 MVRMS over entire temperature range
Input impedance: X = 10K; Y = 10K
Full scale output: 3 VRMS
Output impedance: Less than 50 ohms
X input band width: ± 0.5db, 0 to 200 hertz
Y input band width: ± 0.5db, 20 hertz to 1000 hertz
Operating temperature range: —55°C to +125°C
Storage temperature range: —70°C to +125°C
Zero point drift over temperature range: ± 1MVRMS maximum
DC power: ± 15V unless otherwise required @ 20 ma
Overall dimensions: 1.8" x 1.1" x 0.5"
Weight: Approximately 1 oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

Magnetic Analog Divider DC ÷ AC = DC Output

Division Accuracy ±1% Of All Theoretical Values Of Quotient Or 2MV Whichever Is Greater, Over A 100:1 Denominator Range



TYPE #MDM 1355-4



FEATURES

- Linearity, division accuracy and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- Package size, power supply voltages and specifications may be altered at no extra cost
- Accuracy specified in terms of absolute (theoretical point) not full scale
- Wide denominator ranges can be accommodated
- No external trim potentiometers required to obtain specified accuracy.

SPECIFICATIONS

Transfer equation: $Eo = \frac{0.3X}{Y}$

Division accuracy: 1% of all theoretical quotient points or ± 2MV whichever is greater over the temperature range
Input impedance: X = 90K; Y = 50K
Full scale output: 3V DC
X & Y input ranges: X = 0 to ± 3V DC
Y = 0.03V RMS to 3.0V RMS
400 Hz ± 10%
Output impedance: Less than 10 ohms
Bandwidth: 10 Hz at Y = 0.3V RMS
Operating temperature range: —55°C to +125°C
Storage temperature range: —70°C to +125°C
DC power: ± 15V @ 30 ma
AC reference: 6V RMS 400 Hz ± 10%
Overall dimensions: 2.2" x 1.3" x 0.5"
Weight: Approximately 1 oz.
Case material: High permeability Nickel Alloy
Terminals: Glass to metal hermetic seal pins

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GM INC.

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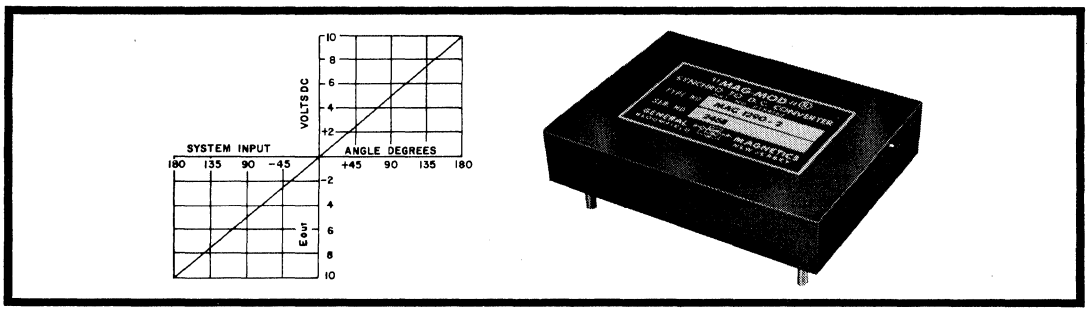
135 Bloomfield Ave., Bloomfield, New Jersey 07003 - Tel. (201) 743-2700

...for Unlimited Life and Superior Performance

Solid State 3 Wire Synchro To Linear D.C. Converter

MAC 1290-2 ACCURACY 1% OVER ENTIRE TEMPERATURE RANGE



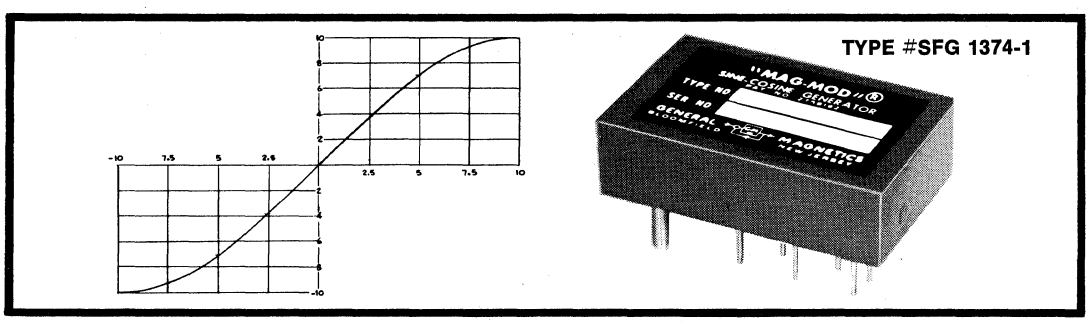
FEATURES

- Develops a DC output voltage linearly proportional to a synchro angle over a ± 180° range
- Completely solid state with all of the inherent advantages over a mechanical system such as:
  - High reliability (since there are no moving parts)
  - Light weight — 30 ozs. (approximate)
  - Small size
- Three wire inputs isolated from ground
- Package size may be altered at no extra cost
- Output short circuit protected
- Units can be altered to accept different line to line voltages or different operating frequencies at no extra cost
- Not affected by reference voltage or power supply variations

SPECIFICATIONS

Transfer equation: E = ± 1V/± 18°
Accuracy: ± 1% over temperature range
Input: 11.8V, 400 Hz line to line 3 wire synchro voltage
Full scale output: ± 10V DC (± 180°)
Output impedance: Less than 10 ohms
Output ripple: Less than 2 millivolts RMS
Input impedance: 10K minimum line to line
Reference: 26V ± 10% 400 Hz (Unit can be altered to accommodate 115V if available at no extra cost)
Operating temperature range: −25°C to +85°C
Storage temperature range: −55°C to +100°C
DC power: ± 15V ± 1% @ 100ma (approximate)
UNIT CAN BE MODIFIED FOR ± 360° OPERATION

Sine-Cosine Function Generator



FEATURES

- Provides a two quadrant sine function with better then 1% accuracy
- Excellent temperature stability
- Scaled for ± 10V input and output
- Operates from conventional ± 15V power supplies
- No external offset adjustments required
- Terminal provided to allow four quadrant operation
- Hermetically sealed package

SPECIFICATIONS

(AT +25°C UNLESS OTHERWISE NOTED)
DC accuracy: ± [0.1% + 0.6% × E_{IN}/10V]
DC accuracy over the complete temperature range: ± [0.25% + 0.75% × E_{IN}/10V]
Input impedance (pin 1): 9.3KΩ
Input voltage range (pin 1): ± 10V DC
Rated output — voltage: ± 10V DC
Rated output — current: ± 5ma
Output impedance: 1Ω
Frequency response for 1% accuracy: DC to 3kHz
Temperature range: −25°C to +85°C
(Full mil-spec temp. range units available on request)
Power requirements: ± 15V @ 30ma max.
Accuracy drift vs. power supply: ± 10MV/V
Size: 2.750 x 1.600 x 0.475

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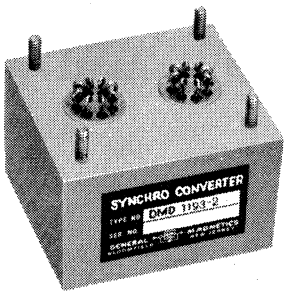
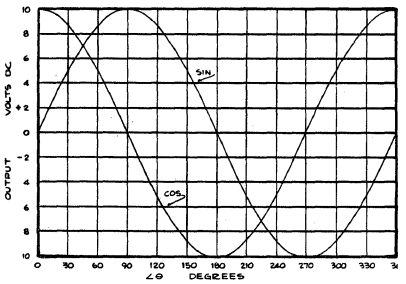
Solid State Sine-Cosine Synchro Converter

This new encapsulated circuits converts a 3-wire synchro input to a pair of d-c outputs proportional to the sine and cosine of the synchro angle.

- Complete solid state construction.
- Occupies a volume of only 3.2 cu. in. (Single Channel)
- Operates over a wide temperature range.





Typical Specifications
Type DMD 1193-3
Dual Channel Synchro Converter

ACCURACY — Overall conversion accuracy 6 minutes.
AMBIENT TEMPERATURE:
RANGE — Operating —40°C to +100°C
Storage —62°C to —125°C
APPLICATIONS — Analog computers
Flight systems
Fire control
Guided missiles

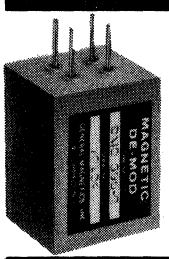
	TERMINAL	FUNCTION	
HEADER A	1	S1	SYNCHRO INPUT #1
	2	S3	11.8 V RMS ±10% L-L 400 Hz ±5% REFERENCE
	3	S2	
	4	R2	115 V RMS ±5% @
	5	R1	400 Hz ±5%
	6	+15 V DC	
	7	DC GROUND	
	8	−15 V DC	
HEADER B	1	S1	SYNCHRO INPUT #2
	2	S3	11.8 V RMS ±10% L-L 400 Hz ±5%
	3	S2	
	4	SINE	OUTPUT #1
	5	COSINE	10 V DC FULL SCALE OUTPUT
	6	SINE	OUTPUT #2 10 V DC FULL SCALE OUTPUT
	7	DC GROUND	
	8	COSINE	OUTPUT #2 10 V DC FULL SCALE OUTPUT

DUAL CHANNEL SYNCHRO CONVERTER General Magnetics Model DMD 1193-2 provides two (2) completely independent sine-cosine synchro converter circuits in one package. Overall conversion accuracy is six (6) minutes. Temperature range is —40°C to +100°C.

This new General Magnetics circuit converts a 3 wire synchro input to a pair of d-c outputs proportional to the sine and cosine of the synchro angle. The circuit features complete solid state construction, occupies a volume of only 3.2 cubic inches and operates over a wide temperature range. Overall conversion accuracy defined by the tangent of the angle whose sine and cosine are generated is six (6) minutes. Models are available with both single and dual channel outputs.

Solid State Magnetic Demodulators

FREQ. RANGE 20 Hz to 100 KHz



G/M MAGNETIC DEMODULATORS are solid state circuits for converting phase reversing AC signal voltages into phase detected polarity reversing DC voltages; the amplitude and polarity of the DC output are directly proportional to the phase and amplitude of the AC signal.

High reference impedance resulting in very small reference power requirements.
Output as high as ±10 v. DC in present units.
Unit operation frequencies; 20 Hz to 100 KHz.
Operation over wide environmental range.
Very low DC offset null voltages (as low as 0.1% of full scale).
Signal and reference terminals may be isolated.
Low output impedance.
Small physical size.

TYPE NUMBER	DMD 1012-1	DMD 1017-1	DMD 1028-1	DMD 1040-1	DMD 1066-1	DMD 1133-1
REFERENCE						
A. Voltage	115 V	115 V	15 V	115 V	115 V ±10%	115 V
B. Frequency	60 Hz	400 Hz	50 to 60 Hz	400 Hz	400 Hz	400 Hz
C. Impedance	> 50 K	> 5 K	≈ 5.1 K	> 100 K	> 40 K	> 100 K
SIGNAL						
A. Voltage Range	0-1 V	0-10 V	0-10 V	0-3.2 V	0-10 V	0-2.5 V
B. Frequency	60 Hz	400 Hz	50 to 60 Hz	400 Hz	400 Hz	400 Hz
C. Impedance	10 K ±10%	> 10 K	≈ 3 K	> 3 K	> 15 K	> 200 K
OUTPUT						
A. Maximum Output	±0.5 V ±5%	±3 V ±5%	±10 V ±5%	±5 V ±5%	±1.0 V ±5%	±1.0 V ±5%
B. Load	25 K ohms	2 K ohms	10 K ohms	50 K ohms	1 K	10 K
C. Linearity	±1% fs	±1% fs	±1% fs	±1% fs	± 1% fs	±1% fs
D. Frequency Response	—	40 Hz	—	—	N.S.	> 30 Hz
E. Ripple	No Filter	< 150 mv	< 400 mv	No Filter	< 40 mv	< 30 mv
F. Null	< 10 mv	< 10 mv	< 15 mv	< 10 mv	< 4 mv	< 4 mv
AMBIENT TEMP. RANGE	—30°C to +85°C	—30°C to +71°C	—10°C to +55°C	—30°C to +85°C	—55°C to +90°C	—40°C to +68°C
PHYSICAL SIZE	1 X 1 X 2.5	1 X 1 X 2.5	1.9 X 1.25 X 2.9	1 X 1 X 2.5	1.6 X 0.8 X 0.6	1 X 1 X 2.5
D.C. POWER	+15 V	+28 V	+15 V	No	±10 V	+24 —32 V

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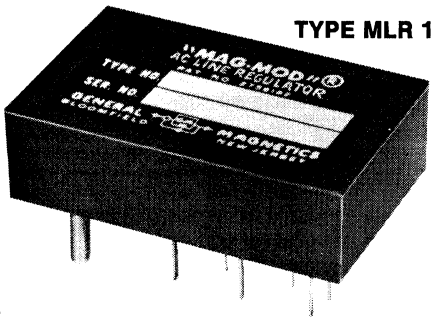
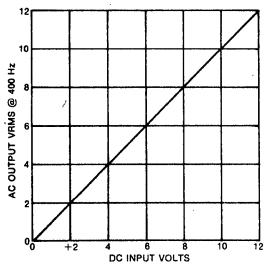
Precision A.C. Line Regulator

Solid State Ultra Stable



TYPE MLR 1384-1



FEATURES:

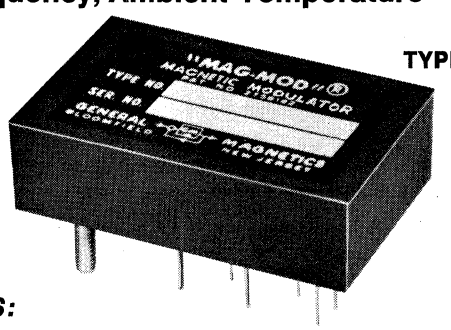
- No Tuned Circuits
- Excellent Temperature Stability
- Operates from Conventional ±15V Power Supplies
- Hermetically-Sealed Package
- 0.1% Total Regulation
- Output Distortion Less Than 1%
- Small Size — Lightweight — Rugged
- Output Amplitude Level Programmed By a DC Signal

SPECIFICATIONS:

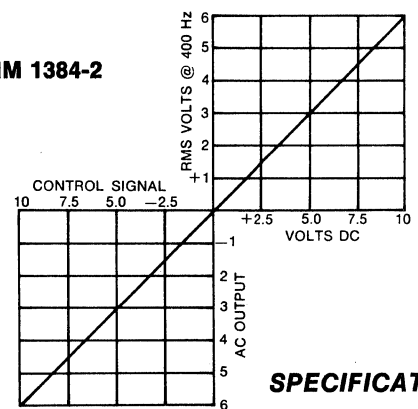
- **AC Input:** 26V ±20% @ 400 Hz or 115V ±20% @ 400 Hz ±20%
- **AC Input Resistance:** 10K (Min) — 26V Input
  30K (Min) — 115V Input
- **DC Power:** ±15V @ 15 MA Max
- **Output:** Set at any level from 0 to 12V Rms 400 Hz
- **Load:** 5K
- **Regulation:** 0.1% — Load ±20% and Line ±15%
- **Output Variation with Temperature:** 0.1% Max
- **DC Set:** Level Signal 0 to +12V
- **DC Set:** Level Signal Input Resistance 100K Min
- **Phase Shift:** 2° Max
- **Overall Dimensions:** 1.5 x 1.1 x 0.5 inches

Precision Magnetic Modulator

Phase, Gain, Zero Point, Null Insensitive to Variations in AC Line, DC Power, Line Frequency, Ambient Temperature



TYPE IMM 1384-2



FEATURES:

- Four Quadrant Operation — over 80DB dynamic range per quadrant
- Distortion free output AC wave over entire dynamic range regardless of temperature
- Linearity, and zero point virtually unaffected by temperature changes
- Magnetic circuit not sensitive to nuclear radiation
- All units are hermetically sealed and completely shielded from external electric or magnetic fields
- Gain, linearity, wave quality, and phase stability allow dual modulator assemblies to be matched in amplitude within 1% of point of each other and 0.1° phase error over the temperature range
- Dynamic specifications unaffected by years of continuous operation and storage
- Package size, power supply voltages and electrical specifications may be altered at no extra cost
- Output gain response curve completely independent of AC line variation

SPECIFICATIONS:

- **AC Reference:** 26 VRMS 400 Hz
- **DC Power:** ±15V at 10 ma
- **Linearity:** 0.1% f.s. or 1 MVRMS whichever is greater
- **Null:** 5 MVRMS maximum
- **Output Range:** 0 to 6 VRMS
- **Load:** 2K ohms minimum
- **Wave Quality:** 0.5% maximum distortion
- **Output Phase Angle:** Zero ° ±0.1° (380-420 Hz)
- **Overall Dimensions:** 1.5 x 1.1 x 0.5 inches
- **Output Isolated**
- **Temperature Range:** —55°C to +100°C
- **Weight:** 1.25 Oz.
- **Case Material:** High permeability nickel alloy
- **Terminals:** Glass to metal hermetic seal pins

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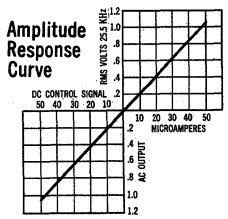
'Mag Mod' Micro-miniature Magnetic Modulators

... Design Analog Computers with Micro Magnetics

Withstands High Intensity Nuclear Radiation



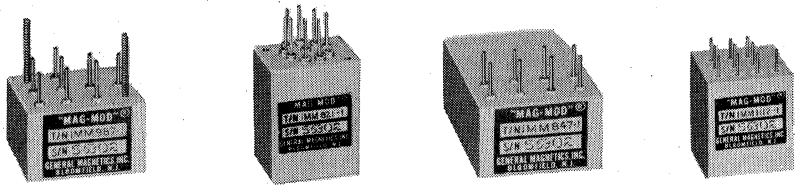
Typical Performance Data — Model 748-3

- **Output distortion as low as 1%**
- **Electrical zero point and gain, repeatability and stability over the entire service life**
- **Extremely broad bandwidth**
- **Carrier frequencies as high as 5 MHz**
- **Input signal current resolution better than 0.001 μa**
- **Low milliwatt power consumption**

Circuit Isolation — DC to AC Sinusoidal Conversion and Amplification

"MAG MODS" PROVIDE FOUR QUADRANT OPERATION, extreme stability with negligible change of phase, gain and zero position over a wide temperature range. Design is simple, featherweight and rugged — with no vacuum tubes, semiconductors or moving parts to limit life.

MICRO MAGNETIC MODULATORS FEATURE an essentially drift-free circuit with superior phase and gain stability over wide environmental ranges. All the ruggedness, dependability, wide dynamic range and stability that are characteristic of the larger magnetic modulators are engineered into this new magnetic circuit. MICRO "MAG MODS" are shock and vibration proof, provide infinite standby and service life. The micro modulators below are typical; for specifications on other models request literature.



TYPE NUMBER	IMM 987-1	IMM 821-1	IMM 847-1	IMM 1112-1
Reference Carrier Voltage and Frequency	115 V 400 Hz	3 V RMS @ 96 KHz	5 V @ 800 Hz	3.5 V RMS @ 1 MHz
Input Control Signal Range	0 to ±150 μa DC	0 to ±100 μa (DC to 1000 Hz.)	0 to ±200 μa DC	0 to ±3 ma DC (DC to 200 KHz)
DC Resistance of Input DC Signal Winding	3 Inputs — 4.5 K each	150 ohms	12.5 K ohms	1000 ohms
AM Phase Reversing AC Output Range	0 to 5 V RMS @ 400 Hz	0 to 0.6 V RMS @ 96 KHz	0 to 1 V RMS @ 800 Hz	0 to 3 V RMS @ 1 MHz
Differential Gain RMS mv. AC Output/ua DC Sig. Input	33 mv RMS/μa DC	6 mv RMS/μa	5 mv RMS/μa DC	1 V RMS/ma DC
AC Output Null (Noise Level) RMS	25 mv RMS	20 mv RMS Max.	5 mv RMS	30 mv RMS
Output Impedance	1.2 K ohms	7.5 K ohms	10 K ohms	3 K ohms
External Load	25 K ohms	100 K ohms	50 K ohms	50 K ohms
Excitation (Carrier Winding) Impedance	200 K ohms	115 ohms	12 K ohms	800 ohms
Zero Point Drift over Temp. Range Referred to DC Input Terminals	±0.2 μa DC	±0.2%	±0.5 μa DC	±0.5%
Hysteresis in Percent of Max. Input DC Signal	±0.2%	±0.2%	±0.4%	±0.5%
% Harmonic Distortion in Output Wave	10%	5%	10%	3%
Temperature Range	−55°C to +80°C	0°C to +100°C	−55°C to +100°C	−55°C to +85°C
Frequency Response	DC to 100 Hz	DC to 1000 Hz	DC to 200 Hz	DC to 200 KHz
Overall Dimensions (in inches)	.550 X .750 X .550	0.562 X 0.40 X .750	1 3/16 X 1 3/16 X ½	0.4 X 0.5 X 0.6
Type of Mounting	2-56 Studs	Printed Circuit Board	Printed Circuit Board	Printed Circuit Board 1/10" Grid
Approximate Weight (in ounces)	0.3 ounce	0.12 ounce	0.2 ounce	0.1 ounce

"MAG MODS" conform to MIL-T-27A and MIL-E-5400 Specifications

Prime Components in Solid State Design—The "MAG MOD" family of Magnetic Modulators has proven to be the most reliable module circuit block in aircraft and space vehicle flight control systems developed to date. They are universally accepted and in use in many military and commercial products where reliability is a price factor. Request literature.

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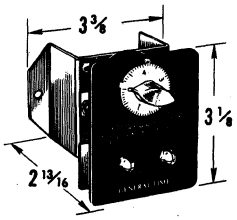
Series DA Time Delay Timers, Rear Mounting



Type DA11. Manually adjustable by knob. Apply wherever delay, interval or repeat cycle timing functions are required (repeat cycle requires two units). Internal clutch engages and disengages when motor is energized and de-energized. Resets to start position when power is removed. SPDT switch rated 20 amps. 125 or 250 VAC resistive; solder lug terminals. Min. setting 0 sec. Repeat accuracy ±¾ of 1% of total time range. 5 watt motor. 120 VAC, 60 Hz. U/L listed. Weight 1½ lbs.

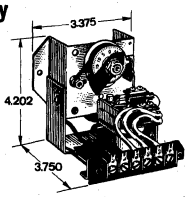
Type DA21. Same as DA11 but with locknut adjustment to eliminate tampering. When ordering, specify model number, voltage, frequency.

MFR'S DC NO. 697644					
Item No.	Model No.	Item No.	Model No.	Max. Time Setting	Max. Reset Time
00790	DA11-036			5.7 sec.	0.25 sec.
00715	DA11-031	00805	DA21-001	14 sec.	1.0 sec.
00730	DA11-032	00815	DA21-002	57 sec.	1.5 sec.
00745	DA11-033	00825	DA21-003	4.5 min.	15 sec.
00760	DA11-034	00835	DA21-004	9.5 min.	120 sec.

Net Each, Lots of

1-4	5-9	10-24	25-49	50-99	100-249	250 & over
$19.35	$18.40	$17.40	$16.45	$15.45	$14.50	$13.55

Series BN Adjustable Reset Timers — Built-in Relay



Rear mounting; interval or delay timing. Built-in relay, adjustable time range. Apply to machine tools, production and processing equipment or other operations requiring a compact, dependable unit for direct control of electrical loads.

BN22 (Delay) Rear Mount chassis or back panel mount. Locknut setting adjustment for time period changes.

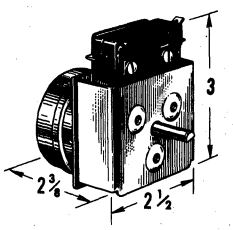
REAR MOUNTING

MFR'S DC NO. 697644						
Item No. Delay	Model No.	Time Setting Max.	Time Setting Min.	Max. Reset Time	Dial Grads Major	Dial Grads Minor
00245	BN22-001	13.5 sec.	0.7 sec.	0.5 sec.	1 sec.	0.5 sec.
00275	BN22-004	9.5 min.	30 sec.	12.0 sec.	1 min.	5.0 sec.

Net Each, Lots of

1-4	5-9	10-24	25-49	50-99	100-249	250 & over
$27.40	$26.05	$24.65	$23.30	$21.90	$20.55	$19.20

Series AB Hand-Set Interval Timers



Rotation energizes the load and timing motor, which are de-energized on release; when motor drives timer to zero. Setting can be changed during cycle without damage. Mount behind panel, using three equally spaced .180″ dia. tapped holes on .562″ radius. Setting shaft, ¼″ dia. flatted to .156″ for ½″. Flat is located 180° from "0" time. SPDT switch rated 25 amps at 125 or 250 VAC resistive. Timing motor rated 3.5 watts at 120 VAC, 60 Hz. Spade terminals, ¼″. UL Recognized. Weight 1 lb. When ordering, specify model number, voltage and frequency.

MFR'S DC NO. 697644					
Item No.	Model No.	Time Range	Item No.	Model No.	Time Range
00005	AB51-001	1 min.	00055	AB51-006	2 hrs.
00015	AB51-002	6 min.	00075	AB51-007	6 hrs.
00025	AB51-003	15 min.	00085	AB51-008	8 hrs.
00035	AB51-004	30 min.	00095	AB51-010	12 hrs.
00045	AB51-005	60 min.	00105	AB51-016	24 hrs.

Net Each, Lots of

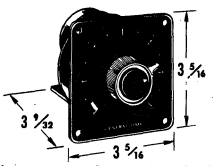
1-4	5-9	10-24	25-49	50-99	100-249	250 & over
$ 8.80	$ 8.40	$ 7.95	$ 7.50	$ 7.05	$ 6.60	$ 6.20

Accessories

Model No. AT5-901 — Dial. Net Each $1.15
Model No. 55-121 — Knob. Net Each ..... .30

Check Factory for Price and Delivery of other voltages and time ranges.

Series DP11 Panel Mounting Reset Timer



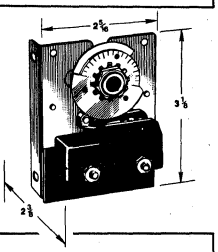
Adjustable time range by simple pointer knob. Apply wherever delay, interval or repeat cycle timing are needed (repeat cycle requires two timers). Readout of elapsed time by pointer in center of knob. Unit resets to start position when power is removed. SPDT switch rated 10 amps, 125 or 250 VAC resistive. Timing motor rated 5 watts max. 120 VAC, 60 Hz. Repeat accuracy ±1% of total time range. Screw terminals. Size: 3⅜″ square x 3³⁄₃₂″ deep, behind panel. Requires 3⅜″ dia. mounting hole cut. When ordering, specify model number, voltage and frequency.

MFR'S DC NO. 697644						
Item No.	Model No.	Time Setting Max.	Time Setting Min.	Max. Reset Time	Dial Grads. Major	Dial Grads. Minor
00915	DP11-007	6 sec.	0.3 sec.	0.5 sec.	1 sec.	1.0 sec.
00855	DP11-001	15 sec.	0.8 sec.	1.0 sec.	1 sec.	0.2 sec.
00905	DP11-006	30 sec.	1.5 sec.	1.5 sec.	5 sec.	0.5 sec.
00865	DP11-002	60 sec.	3.0 sec.	1.5 sec.	10 sec.	1.0 sec.
00875	DP11-003	5 min.	0.2 min.	15 sec.	1 min.	0.1 min.
00885	DP11-004	10 min.	0.4 min.	120 sec.	1 min.	0.2 min.

Net Each, Lots of

1-4	5-9	10-24	25-49	50-99	100-249	250 & over
$23.50	$22.30	$21.15	$19.95	$18.80	$17.60	$16.45

Series RG21 Repeat Cycle Timers



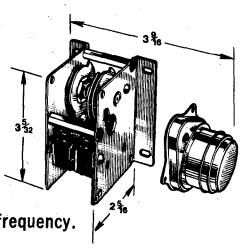
Cam-actuated, single switch timers for rear mounting. Run continuously, repeating a set cycle of make-break switching operations as long as motor is energized. Also operates a single time cycle. Cam adjustable from 7° min. to 169° max. (±3%). SPDT switch rated 20 amps resistive. Timing motor 3.7 watts max., 120 VAC, 60 Hz. Solder lug terminals. 6″ leads. U/L listed. Weight: 1 lb.

MFR'S DC NO. 697644					
Item No.	Model No.	Time Range	Item No.	Model No.	Time Range
01610	RG21-090	7½ sec.	01660	RG21-095	10 min.
01620	RG21-091	15 sec.	01670	RG21-096	15 min.
01630	RG21-092	30 sec.	01680	RG21-097	30 min.
01640	RG21-093	1 min.			
01650	RG21-094	5 min.			

Net Each, Lots of

1-4	5-9	10-24	25-49	50-99	100-249	250 & over
$14.90	$14.20	$13.45	$12.70	$11.95	$11.20	$10.45

Series RE62 Repeat Cycle Multi-Cam Timers



Same specifications as RG21, except 2 to 6 switches may be actuated during cycle. Run continuously, repeating set cycles of multiple switching operations as long as motor is energized. Complete unit requires one motor and one or more switch stacks. Spanner wrench included to adjust cams. Two-switch unit size: 2¾″ H x 3³⁄₃₂″ W x 3⅜″ D; add 1⁄16″ to depth for each additional switch. When ordering specify switch stock model number, drive motor type-number, voltage and frequency.

SWITCH STACKS

MFR'S DC NO. 697644								
Item No.	Model No.	Switch	1-4	5-9	10-24	25-49	50-99	100-249*
01585	RE62-091	2	$13.85	$13.15	$12.45	$11.75	$11.05	$10.40
01590	RE62-092	3	18.50	17.60	16.90	15.75	14.80	13.85
01595	RE62-093	4	23.15	22.00	20.85	19.70	18.50	17.35
01600	RE62-094	5	28.30	26.85	25.45	24.05	22.65	21.20
01605	RE62-095	6	32.95	31.30	29.65	28.00	26.35	24.70

DRIVE MOTORS — Order one with switch stacks for complete unit.

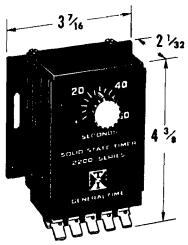
MFR'S DC NO. 697644					
Item No.	Model No.	Time Range	Item No.	Model No.	Time Range
01220	MP10-390	7½ sec.	01270	MP10-395	10 min.
01230	MP10-391	15 sec.	01280	MP10-396	15 min.
01240	MP10-392	30 sec.	01290	MP10-397	30 min.
01250	MP10-393	1 min.	01300	MP10-398	1 hr.
01260	MP10-394	5 min.	01320	MP10-400	10 sec.

Net Each, Lots of

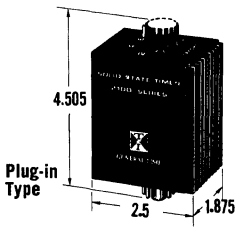
1-4	5-9	10-24	25-49	50-99	100-249*
$ 7.20	$ 6.85	$ 6.45	$ 6.10	$ 5.75	$ 5.40

***For larger quantities consult your distributor or the factory.**

Solid State Timers



Rear Mount Type



Plug-in Type

Versatile standard timers meet the broadest range of applications. Plug-in or Rear Mount types; for delay, interval, or D.O.D. (delay on de-energization) timing modes. **Features:** Exceptional repeat accuracy; transient protection; eleven time ranges; isolated outputs; AC or DC input; low operating temperature and no first cycle effect. UL and CSA recognized. **Repeat Accuracy:** ±2% of set point under constant voltage and temperature; under 1 second, a constant of ±20 msec applies. **Temperature Range:** −10° C to +55° C ambient.

How To Order

SPECIFY SERIES: Series 2111 Plug-in Type or Series 2211 Rear Mount Type: DELAY Mode Timer. Delay period starts on application of voltage. At end of set delay, integral relay energizes. When input voltage is removed, the output relay de-energizes and timer resets.

Series 2112 Plug-in Type or Series 2212 Rear Mount Type: INTERVAL or D.O.D. Mode Timer. For these modes; input voltage is supplied to timer always with interval mode, on closure of a momentary or sustained switch, integral relay energizes the load for time period selected; at the end of timing period, the relay de-energizes and load is removed from line. In D.O.D. mode, on closure of a control switch, the output relay energizes; timing period begins when control switch is opened; at end of timed interval, the relay de-energizes.

ADD INPUT SUFFIX: Suffix-**1P** for 117 volts AC/DC, 50/60 Hz and 3.5 watts max.; e.g., 2111-**1P**.

ADD OUTPUT SUFFIX: e.g., 2112-1P-**F**.

Suffix	Type	Volts	Amps & Load	Contacts
-F	With Relay	117 VAC 117 VAC 28 VDC	10 A resistive; 5 A induct. 2.5 A resistive 10 amps resistive	DPDT

ADD TIME RANGE (FINAL) SUFFIX: e.g. 2112-PF-118. Minimum reset time, 300 msec for lower third of time bank on Type 2111: 100 msec, all others.

Suffix	Time Setting		Suffix	Time Setting	
	Max.	Min.		Max.	Min.
-001	1 sec.	.10 sec.	-060	60 sec.	3.0 sec.
-003	3 sec.	.15 sec.	-118	3 min.	9.0 sec.
-005	5 sec.	.25 sec.	-130	5 min.	15.0 sec.
-010	10 sec.	.50 sec.	-160	10 min.	60 sec.
-015	15 sec.	.75 sec.	-190	15 min.	90 sec.
-030	30 sec.	1.50 sec.			

SERIES 2111-1PF — Relay output, 117V AC/DC, 8-pin plug.

Item No.	Time Range Suffix	Net Each, Lots of 1-4	5-9	10-24	25-49	50-99	100-249*
01860	-001	$22.95	$22.35	$21.80	$20.65	$18.35	$17.20
01865	-003	22.95	22.35	21.80	20.65	18.35	17.20
01867	-005	22.95	22.35	21.80	20.65	18.35	17.20
01870	-010	22.95	22.35	21.80	20.65	18.35	17.20
01872	-015	22.95	22.35	21.80	20.65	18.35	17.20
01875	-030	22.95	22.35	21.80	20.65	18.35	17.20
01880	-060	22.95	22.35	21.80	20.65	18.35	17.20
01885	-118	22.95	22.35	21.80	20.65	18.35	17.20
01890	-130	23.95	23.25	22.65	21.45	19.15	17.95
01895	-160	28.95	28.30	27.70	26.25	23.55	22.40
01900	-190	30.50	29.80	29.05	27.60	25.00	23.55

SERIES 2112-1PF — Relay output, 117V AC/DC, 11-pin plug.

02040	-001	$26.95	$26.20	$25.60	$24.25	$21.55	$20.00
02045	-003	26.95	26.20	25.60	24.25	21.55	20.00
02047	-005	26.95	26.20	25.60	24.25	21.55	20.00
02050	-010	26.95	26.20	25.60	24.25	21.55	20.00
02053	-015	26.95	26.20	25.60	24.25	21.55	20.00
02055	-030	26.95	26.20	25.60	24.25	21.55	20.00
02060	-060	26.95	26.20	25.60	24.25	21.55	20.00
02065	-118	26.95	26.20	25.60	24.25	21.55	20.00
02070	-130	27.95	27.10	26.45	25.05	22.35	20.75
02075	-160	33.35	32.30	31.45	29.85	26.95	25.15
02080	-190	34.90	33.75	32.80	31.10	28.10	26.20

SERIES 2211-1PF — Relay output, 117V AC/DC, 8-spade terminals

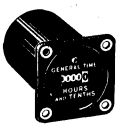
02235	-001	$23.65	$23.00	$22.45	$21.30	$18.90	$17.70
02240	-003	23.65	23.00	22.45	21.30	18.90	17.70
02245	-005	23.65	23.00	22.45	21.30	18.90	17.70
02250	-010	23.65	23.00	22.45	21.30	18.90	17.70
02255	-015	23.65	23.00	22.45	21.30	18.90	17.70
02260	-030	23.65	23.00	22.45	21.30	18.90	17.70
02265	-060	23.65	23.00	22.45	21.30	18.90	17.70
02270	-118	23.65	23.00	22.45	21.30	18.90	17.70
02275	-130	24.70	23.94	23.35	22.10	19.75	18.50
02280	-160	29.80	29.15	28.55	27.25	24.25	23.05
02285	-190	31.40	30.70	29.95	28.45	25.75	24.25

SERIES 2212-1PF — Relay output — 117V AC/DC — 10-spade terminals.

02455	-001	$27.75	$27.00	$26.35	$24.95	$22.20	$20.60
02460	-003	27.75	27.00	26.35	24.95	22.20	20.60
02470	-010	27.75	27.00	26.35	24.95	22.20	20.60
02475	-015	27.75	27.00	26.35	24.95	22.20	20.60
02480	-030	27.75	27.00	26.35	24.95	22.20	20.60
02485	-060	27.75	27.00	26.35	24.95	22.20	20.60
02495	-130	28.75	27.90	27.25	25.80	23.00	21.35
02500	-160	34.35	33.25	32.40	30.75	27.75	25.90
02505	-190	35.95	34.75	33.80	32.05	28.95	27.00

***For larger quantities consult your distributor or the factory.**

Hermetically Sealed Military Type Indicator

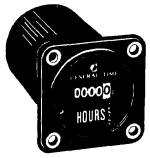


A very small, lightweight running time meter for wide application in military equipment. 7010-004 meets Mil specification requirements per Mil-M-7793 Mil-Std-Ms-28053-5 solder terminals. Life tested over 78,000 hours. Driven by synchronous hysteresis motor. Readout four hour digits plus tenths. Temperature range −55° C to +85° C. Round case 1¾" square bezel. 2³⁹⁄₆₄" deep, barrel diameter 1½", four mounting holes on 1⅛" centers. 115 volts, 400 Hz. + 60 Hz. Shipping weight: ¾ lb.

Item No.	Model No.		Net Each, Lots of 1-4	5-9	10-24	25-49	50-99	100-249*
01210	7010-004	115v 400Hz	$41.14	$39.08	$37.03	$34.97	$32.91	$30.86
01215	7010-010	115v 60Hz	41.14	39.08	37.03	34.97	32.91	30.86

Elapsed Time Indicators

EF27



ED

EF13

ER30

Wide variety of meters available for any application where accurate time readings are required. All are synchronous motor driven. Round, square bezel, panel mount and rear mount available. Can be resettable or non-resettable, and readout is digital with a range of five figures plus tenths; in hours and tenths or minutes and tenths. All units operate at 120 VAC, 60 Hz. Operating temperature, −12° C to +55° C. Registers hours and tenths unless otherwise noted. U/L Recognized.

Mfr's Model No.†	Bezel	Depth	Dia. of Units	Max. Motor Rating W	Leads or Terminals
EF13 NR	2⅞" rd.	1⁵¹⁄₆₄"	2¹⁷⁄₆₄"	2.5	6" leads
EF27 NR	2⅞" sq.	1²³⁄₃₂"	2.077"	5.0	6" leads
ED71 NR	1¾" sq.	2³⁷⁄₆₄"	1¹⁷⁄₃₂"	2.5	11¼" leads
ED72 NR	1¾" sq.	2³⁷⁄₆₄"	1¹⁷⁄₃₂"	2.5	Solder
EN30 NR	3" sq.	3⅝"	1¹⁷⁄₃₂"	3.7	8-32 studs
ER30 R	3" sq.	3⅝"	2²³⁄₃₂"	3.7	8-32 studs
ER35 R	3½" rd.	3⅝"	2²³⁄₃₂"	3.7	8-32 studs
EN35 NR	3½" rd.	3⅝"	2²³⁄₃₂"	3.7	8-32 studs

†NR indicates non-reset; R, reset type.

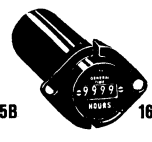
MFR'S DC NO. 697644 Item No.	Model No.	Net Each, Lots of 1-4	5-9	10-24	25-49	50-99	100-249*
01050	EF1333†	$11.00	$10.45	$ 9.90	$ 9.35	$ 8.80	$ 8.25
01070	EF1335	11.00	10.45	9.90	9.35	8.80	8.25
01085	EF2733†	12.95	12.30	11.65	11.00	10.40	9.75
01100	EF2735	12.95	12.30	11.65	11.00	10.40	9.75
01010	ED7112	25.70	24.40	23.15	21.85	20.55	19.25
01030	ED7212	27.90	26.50	25.10	23.70	22.30	20.95
01135	EN3012	19.60	18.60	17.60	16.65	15.65	14.70
01160	EN3512	19.60	18.60	17.60	16.65	15.65	14.70
01170	ER3020†	28.40	26.95	25.55	24.15	22.70	21.40
01180	ER3022	28.40	26.95	25.55	24.15	22.70	21.40
01200	ER3522	28.40	26.95	25.55	24.15	22.70	21.40

†Registers minutes and tenths.

Subminiature Elapsed Time Indicators and Events Counters

95C

95B



16B

B16C

Units conform to MIL-M-7793D standards. MS numbers are referenced below where applicable. Square and round case units with four digit readout and operation indicators. AC units 400 Hz 115 and 26 Volts, nom. Watts .75 DC units 23 to 29 Volts, max. av. power 60 MW. Events counters 23-29 V DC, 1.5 watts max. power consumption, count rate 20 CPS.

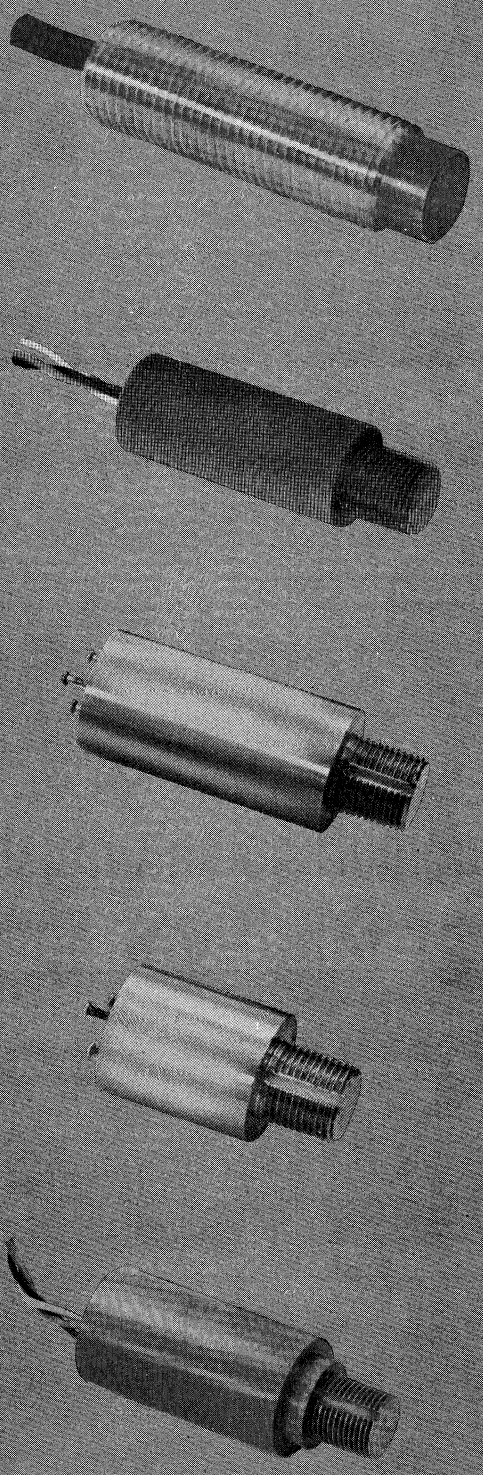
ELAPSED TIME INDICATORS — Square Case — Max. Hrs. 9999 Mil. Spec. Reference	Model Code Number	Volts	Hz	Mounting	Temp. Range*	Dimensions	Wt.
MS17322-6 MS17322-6A MS27651	95C8CE 95C8CE-50 95C8CE-200	115 V, AC	400	Fixed Flange, ¼" Pos.	0 A A	.500 ± .015 Square	.75 oz.
MS17322-8 MS17322-8A	95C8A 95C8A-50	115 V, AC	400	No Flange	0 A	1.047 1.094 L	.50 oz.
MS17322-10	95C8C2	115 V, AC	400	Movable Flange	A		
MS27651-05C	95C8CE-6	115 V, AC	400	Fixed Flange, ¼" Pos.	A	Plus 7⁄₃₂" Term.	.75 oz.
MS27650-05C	25C8CE-6	26 V, AC	400	Fixed Flange	A		
NA	25C8A	26 V, AC	400	No Flange	A		.50 oz.
ROUND CASE — Max. Hrs. 9999							
MS17322-2 MS17322-2A	95B8CE 95B8CE-50	115 V, AC	400	Fixed Flange, ¼" Pos.	0 A	.650 .690 Dia.	1.0 oz.
MS17322-4 MS17322-4A	95B8A 95B8A-50	115 V, AC	400	No Flange	0 A	1.760 Max. L	.75 oz.
MS17322-9	95B8C2	115 V, AC	400	Movable Flange	A	Plus ¼" Ref. Terminals	1.0 oz.
NA	25B8CE	26 V, AC	400	Any Flange	A		
NA	25B8A	26 V, AC	400	No Flange	A		.75 oz.
MS17321-2 MS17321-4 MS17321-9	16B8CE-70 16B8A-70 16B8C2	28 V	DC	Fixed Flange, ¼" Pos. No Flange Movable Flange	−55° C to +100° C	.650 .690 Dia. 2.082 Max. L Plus .312 Term	1.75 oz. 1.50 oz. 1.75 oz.
EVENTS COUNTERS — Square Case — Max. Readout 9999							
NA NA NA	B16C8A B16C8CE B16C8C2	28 V	DC	No Flange Fixed Flange, ¼" Pos. Movable Flange	−65° F to +257° F	.500 ± .015 Sq. 1.047 1.094L Plus 7⁄₃₂" Term.	.75 oz.

Note *A = −65° C + 125° C 0 = −55° C +85° C

Model Type	Net Each, Lots of 1-4	5-9	10-24	25-49	50-74	75-99	100-149	150-249*
95C and 25C	$ 42.00	$ 35.00	$ 29.00	$23.00	$21.00	$19.50	$17.75	$17.00
95B and 25B	42.00	35.00	29.00	23.00	21.00	19.50	17.75	17.00
16B	128.00	124.00	120.00	99.00	87.00	85.00	77.00	77.00
B16C	68.00	53.00	43.00	35.50	32.75	30.00	27.50	25.00

***For larger quantities consult your distributor or the factory.**

SPEED INDEPENDENT MAGNETIC PICK-UPS



The ISC*Magnetics family of Magnetic Pick-Ups are devices having output voltage amplitudes that are independent of the rate of change to the external magnetic field. This characteristic results in a device ideally suited for use in a multitude of static as well as dynamic sensing applications.

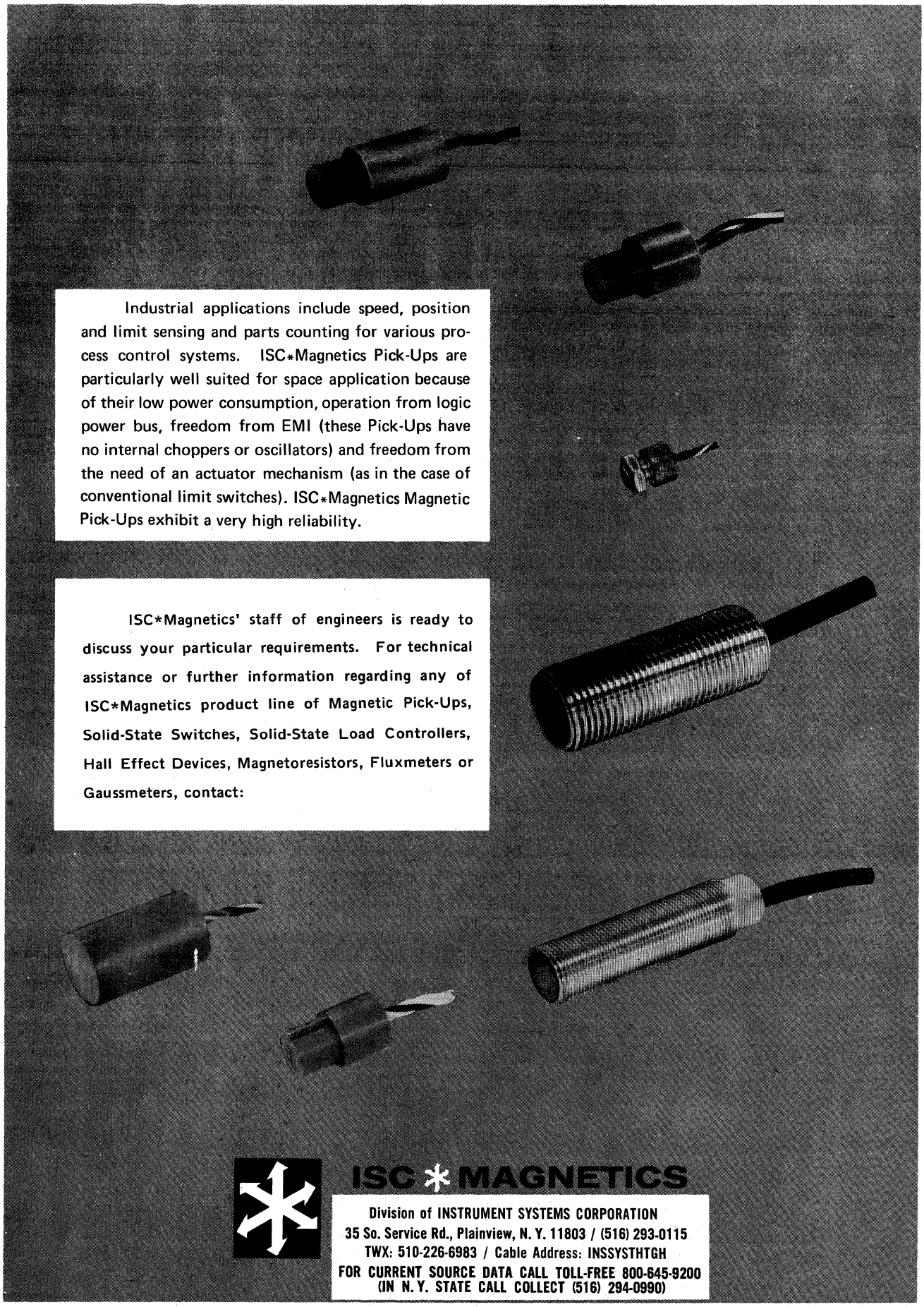
The applications for ISC*Magnetics Magnetic Pick-Ups encompass the limited environment of computer peripheral equipments, the rugged environment of internal combustion engines, as well as the extreme reliability requirement of aerospace. New variations are being developed in answer to new potential applications.

Computer applications include sensing of indexing marks for the drive mechanisms in card readers, magnetic tape memories, and the paper roll drive and character selection in printers, as well as contactless limit switching. Economically priced, these units can be used in many applications previously employing photo sensors.

Transportation applications include wheel speed sensing (for skid-controlled braking systems), ignition system timing, vehicle sensing (traffic control). Ruggedly constructed, suitable for vehicle axle mounting and operable from noisy and widely varying power sources, these units simplify many designs.

PATENTS PENDING

ALL MAGNETIC PICK-UPS ARE SHOWN ACTUAL SIZE



Industrial applications include speed, position and limit sensing and parts counting for various process control systems. ISC*Magnetics Pick-Ups are particularly well suited for space application because of their low power consumption, operation from logic power bus, freedom from EMI (these Pick-Ups have no internal choppers or oscillators) and freedom from the need of an actuator mechanism (as in the case of conventional limit switches). ISC*Magnetics Magnetic Pick-Ups exhibit a very high reliability.

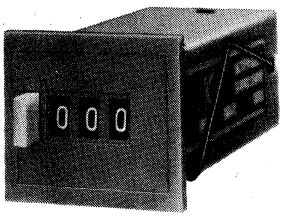
ISC*Magnetics' staff of engineers is ready to discuss your particular requirements. For technical assistance or further information regarding any of ISC*Magnetics product line of Magnetic Pick-Ups, Solid-State Switches, Solid-State Load Controllers, Hall Effect Devices, Magnetoresistors, Fluxmeters or Gaussmeters, contact:

ISC * MAGNETICS

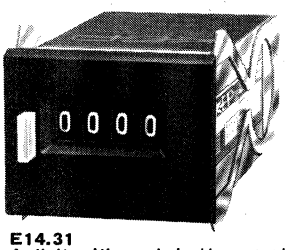
Division of INSTRUMENT SYSTEMS CORPORATION
35 So. Service Rd., Plainview, N. Y. 11803 / (516) 293-0115
TWX: 510-226-6983 / Cable Address: INSSYSTHTGH
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

ADDING-TOTALIZING COUNTERS

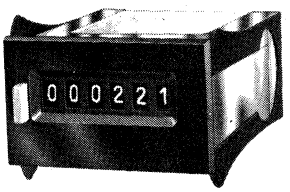
These high performance totalizing counters are designed for long life-250 Million counts and accuracy-even at speeds up to 50 counts/sec. They can be supplied for any voltage in 5 mounting styles with many options.



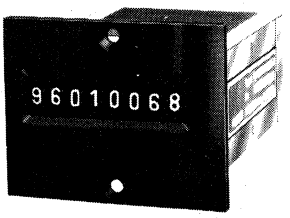
M13.21
3 digit pushbutton
4 digit w/o reset
Electric reset not available
Has single stud for rear mtg.



E14.31
4 digit with push button reset
Electrical reset optional



E16.31
5 or 6 digit with PB Reset
Electrical reset optional
5 or 6 digit with no reset



E18.10
7 or 8 digit w/o reset

HOW TO ORDER: The basic catalog number i.e. M13, E14 through E18 plus EVS13, 15 and 25 followed by

Immediate delivery on all items- Please call us collect for assistance.

1st NUMBER E16.31

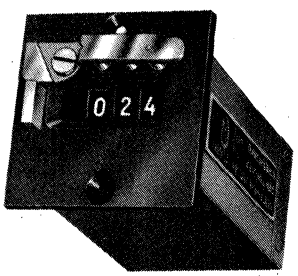
0- Small faceplate rear mounting
1- Large faceplate panel mounting with 2 screws
2&3- Flanged faceplate spring clip (See M13.21) or snap in (See E14.31). Mount with no screws showing
5- Behind the panel mounting

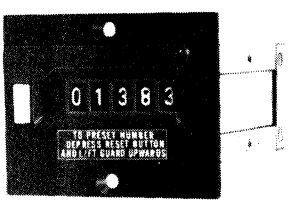
2nd NUMBER E16.31

0- No Reset at all (See E18.10)
1- Manual Reset Push Button
2- Electrical reset only
3- Manual & Electrical reset

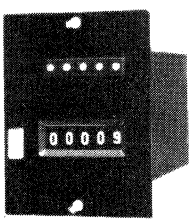
FOLLOWED BY:
Count Speed Required: 10, 25, 40, 50, 75 per second & Voltage Required

PREDETERMINING COUNTERS

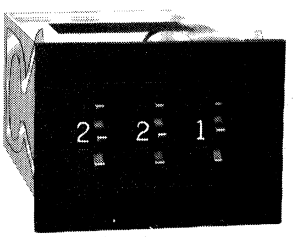




EVS13.11 **EVS15.13**
These two predetermining counters count down from the manually preset number to operate a built-in SPDT switch as the number wheels pass from all zeros to all 9s. Manual or optional electrical or automatic reset returns wheels to preset number and counter is ready to start again. Numbers are preset by holding in reset button, lifting locking bar and indexing up number wheels to preset position with small rod supplied or by built in pushbuttons.

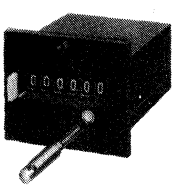


EVS25.13
This counter operates just like the two at left except that it has a presignal-SPDT switch-set at the factory to operate a fixed number of counts before the final number of counts before the final or end SPDT switch is operated.

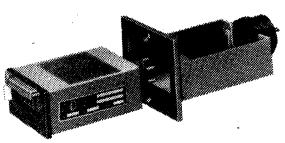


TW-3
For use where batch size or preset number is changed frequently. Operator manually sets in thumb wheels to preset no. The counter wheels then count down to actuate a SPDT 5 amp switch at 0. Preset number must be then set in again. Adding version permits starting at any number and counting up.

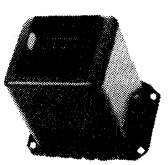
Some Optional Features



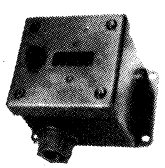
Spade key reset to prevent against unauthorized reset.



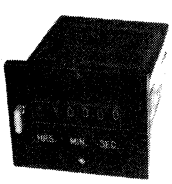
Plug-in mounting provides easy removal



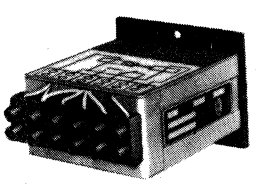
AE Surface Mounting Case



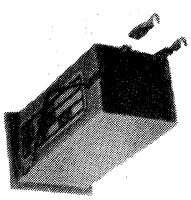
Nema 4 Water-tight & weather proof. Nema 7 explosion proof also available



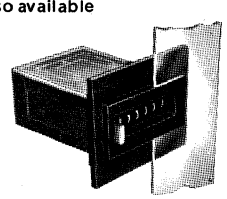
Special number wheels read out in time, money and reverse colors.



Standard insulated screw terminals on all E series counters



Quick disconnect terminals or solder terminals are standard on the M13 option on E series



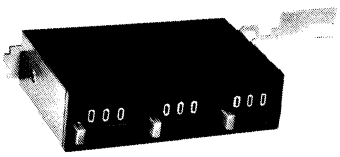
Behind panel mounting available on E16 or EVS15.

KESSLER-ELLIS PRODUCTS
121 FIRST AVE. ATLANTIC HIGHLANDS, N.J. 07716 (201) 291 - 0501

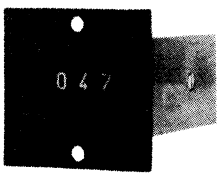
Pneumatic Counters Available

Low Cost Moderate Performance Miniature Counters

These counters will serve in applications where count speeds up to 20 per second and life up to 50 million are required. Electrical reset is not available. All models at any voltage are in stock for quick delivery.

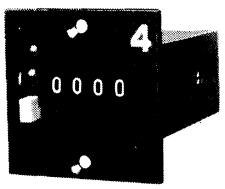


ER-303-01
Rear mounted
type ER-303-01
3 digits with reset.
3 or 4 digits w/o reset

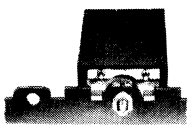


ER-313-01
3 digits with reset
3 or 4 digits w/o reset

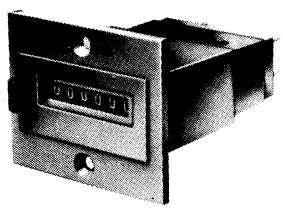
ER-303-01P
Plug-in rear connections
3 digits with reset
3 or 4 digits w/o reset



ER-414-01
Frame size 4
4 digits with reset
5 or 6 w/o reset



Rear View

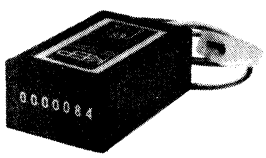


ER-616-01

HOW TO ORDER

ER=Series Designation

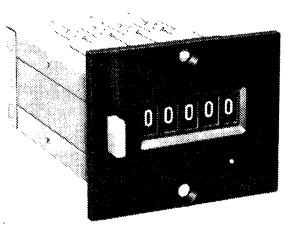
1st Digit =	#3 Handles 3 digits with reset - 4 digit w/o reset #4 Handles 4 digits with reset - 5 or 6 digits w/o reset #6 Handles 5 and 6 digits with reset #7 Handles 7 digits without reset
2nd Digit =	Mounting Style 0 - Stud Mount at rear 1 - Panel Mount with 2 screws 2 - Spring Clip mount - No screws
3rd Digit =	Number of digits required on counter
4th Digit =	Is always 0
5th Digit =	0 No Reset 1 Reset
6th Digit =	P denotes Plug-in Mounting



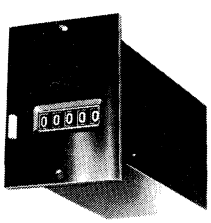
ER-707-01
7 digit non reset

ADD SUBTRACT COUNTERS

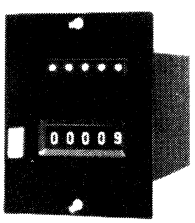
These rugged units have proved extremely reliable for differential counting-they are all in stock for fast delivery



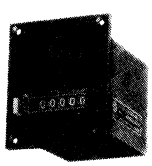
ED15.11
Available with or without manual or electric reset. Count speed 10, 25, 40/sec.



ED25.11
Provides zero switch output with or w/o manual resets



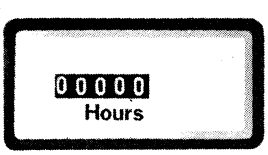
EDVS25.11
Add subtract predetermining. Output switch point may be changed in the field.



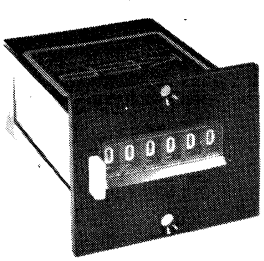
EDA 15
Add subtract counter. Provides 10 line or BCD electrical read out.

ELAPSED TIME METERS

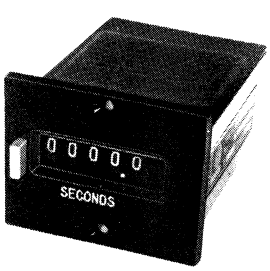
Accurate long life and attractive styling are features of these units



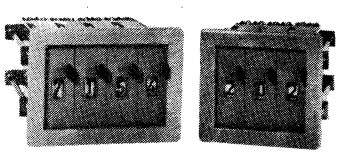
Type B2 for 110 or 220VAC. 60 HZ or 50 HZ. Attractive rear mounting. Hours only



ETH16.11
110V 60 HZ with or without electrical and manual reset. Available in hours or minutes



EZ16.11
Stop clock reads seconds and 10ths directly from 50 or 60 HZ line.



Digital Clock. Individual decade counters record any combination of days, hours, minutes, seconds with 10 line or BCD read out.

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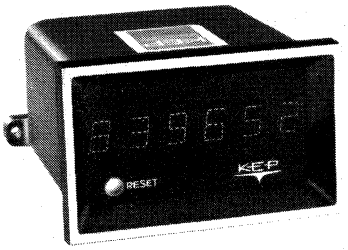
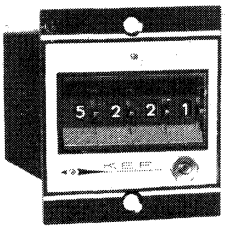
121 FIRST AVE. ATLANTIC HIGHLANDS, N.J. 07716 (201) 291 - 0501

Pneumatic Counters Available

ELECTRONIC COUNTERS



3, 4, 5 or 6 digit Type EC16 electronic totalizer. This counter for industrial and control use features small size high readability and noise immune accuracy.

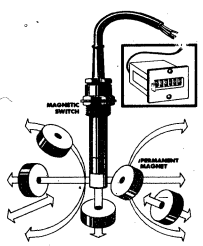


Predetermining type F2EL3 2,3,4, or 5 digits with or without visual display. This all solid state counter has instant recycling, is noise immune and highly reliable. Note small size.

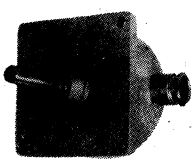
LIST OF REPRESENTATIVES

Los Angeles:	Gordon Anderson 213-352-2289
Chicago:	Lincoln-Hodges 313-297-3810
San Francisco:	Bill Berry 415-343-2773
Denver:	Ken Palmer 303-255-9961
Boston:	Gilway Sales 617-465-7568
Detroit:	Pitcher-Poulin 313-582-5450
New Jersey:	Robert L. Dalton 201-291-0500
Rochester:	Louis Marchese 716-342-5335
Cleveland:	Richard Henry 216-886-2404
Atlanta:	Electro Mech 404-256-4414
Philadelphia:	W. Reeves 215-566-6709
Houston:	Roger Martin 713-462-4077

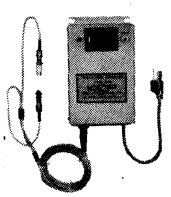
PULSERS AND COUNTER DRIVERS



A wide variety of magnet operated reed switches in stock. They operate without the friction and wear associated with cam and switch combinations. The model KRS-9 at left is frequently used to drive counters.



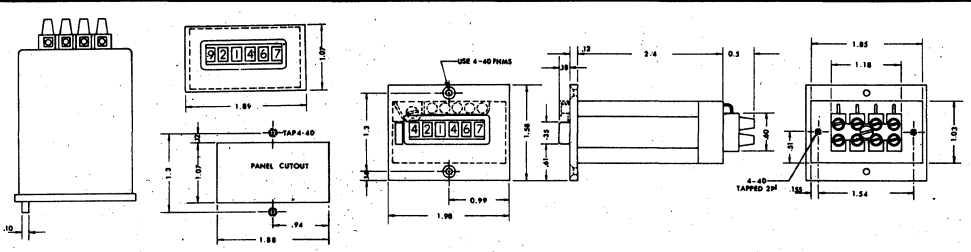
Rotary pulser type GM-1 generates 1,3,5, 10, 100 pulses per revolution



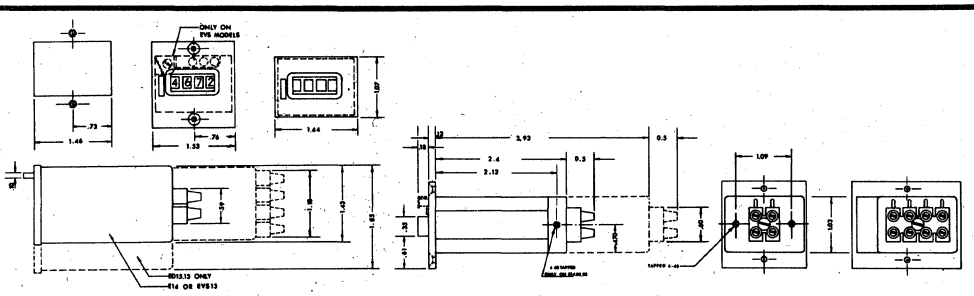
Photoelectric counter detects and counts moving objects. Available with any of the counters listed.

All Products are in stock for immediate delivery. For further information please telephone collect at the factory Call our local representative.

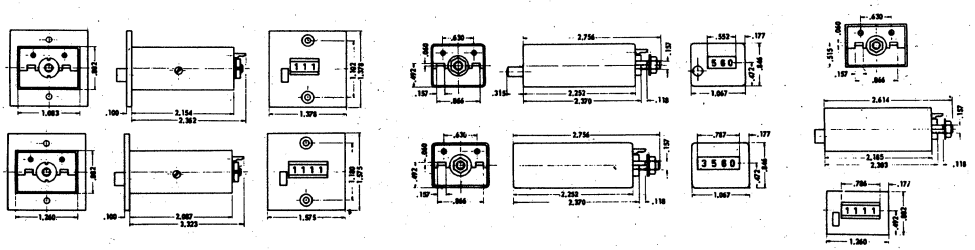
(E16, EVS15, ED15)



(E14, EVS13, ED15.13)



(ER3, ER4m13)



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LOGITEK, INC.

ELECTRONIC SENSORS & CONTROLS

MILITARY • INDUSTRIAL

POWER MONITORS
FREQUENCY SENSORS
VOLTAGE SENSORS

Logitek's comprehensive line of time-delay relays and voltage-, frequency- and phase-sensors utilize the most advanced design and manufacturing techniques for accuracy and long-term reliability – provide uncompromising performance in rigorous military, aerospace and industrial systems.

PHASE SENSORS
SOLID STATE FLASHERS
TIME DELAY RELAYS

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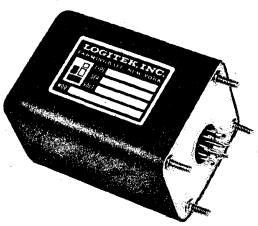
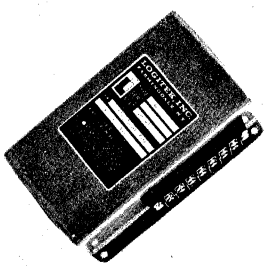


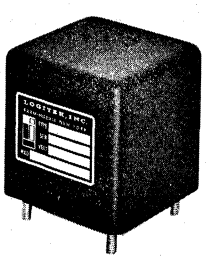


POWER MONITORS

Logitek Power Monitors are used to sense voltage, frequency and phase characteristics of single or three-phase power lines, allowing normal operation of system loads when the power line characteristics are within predetermined limits. In the event that either voltage (any phase) or frequency is not within specification limits, or the phase sequence is other than ABC, the relay de-energizes to operate alarm indicators or system shut-down contactors.

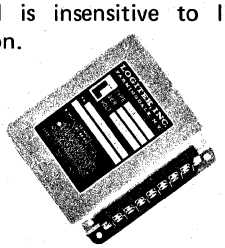
TYPE	MILITARY	INDUSTRIAL
	PMA, PMD, BPM400	WMA
Input Voltage	28 VDC, 120/208 Vrms 4 Wire WYE, 1ϕ	120, 208, 230 Vrms 4 Wire WYE, Delta, 1ϕ
Input Frequency	60/400 Hz	50/60/400 Hz
Sense Voltage	As Required*	As Required*
Sense Frequency	As Required*	As Required*
Accuracy	±1%, ±5%	±1%
Phase Sequence	ABC	ABC
Time Delay (Pick-up & Drop-out)	250 MS To 10 Sec*	250 MS To 10 Sec*
Relay Contacts	DPDT, 3PDT	3PDT
Contact Rating	2 Amp, 10 Amp	10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

*Factory set.



AC VOLTAGE SENSOR

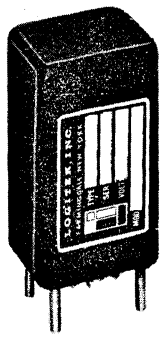
Logitek Voltage Sensors are used to sense voltage on single or three-phase power lines, allowing normal operation of system loads when the voltage characteristics are within predetermined limits. In the event that the voltage (any phase) is not within specification limits the relay de-energizes to operate alarm indicators or system shut-down contactors. Voltage sensing is accomplished with the use of an "RMS" type detector and is insensitive to line distortion.



TYPE	MILITARY	INDUSTRIAL
	VAA, VAD, VS	EAA, LVS-1
Input Voltage	28 VDC, 120/208 Vrms 4 Wire WYE, 1ϕ	120, 208, 230 Vrms 4 Wire, WYE, Delta
Input Frequency	60/400 Hz	50/60/400 Hz
Sense Voltage	As Required*	As Required*
Accuracy	±1%, ±5%	±1%, ±2%
Phase Sequence	--	--
Time Delay Pick-up & Drop-out)	250MS To 10 Sec*	250 MS To 10 Sec*
Relay Contacts	DPDT, 3PDT	DPDT, 3PDT
Contact Rating	2 Amp, 10 Amp	10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

*Factory set.

DC VOLTAGE SENSOR



These Voltage sensors are used primarily as D.C. voltage monitors to provide alarm or power disconnect when the voltage is beyond pre-determined limits. They may be used to operate a power disconnect contactor or to provide signal voltage to a control panel warning light, and are designed so that normal voltage transients do not falsely trigger alarms or cause equipment shut down.

TYPE	MILITARY	INDUSTRIAL
	VDA,VDD,DVB	ES-1, ES-2
Input Voltage	120/208VAC, 28VDC	28VDC, 120VAC
Input Frequency	60/400Hz	60/400 Hz
Sense Voltage	To 200 VDC	To 200 VDC
Accuracy	±1%, ±5%	±1%, ±5%
Time Delay (Pick-up & Drop-out)	250 MS To 10 Sec*	250 MS To 10 Sec*
Relay Contacts	DPDT	DPDT
Contact Rating	2 Amp, 10 Amp	2 Amp, 10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

Factory set.

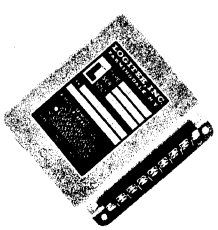
FREQUENCY SENSOR

Logitek Frequency Sensors are used in those applications where electrical systems must be de-energized, and/or alarm devices activated when the power line frequency departs from normal range of operation.

TYPE	MILITARY	INDUSTRIAL
	FAA, FAD, FS	HZA, FS-1
Input Voltage	120 Vrms, 28 VDC	120, 208, 230 Vrms
Input Frequency	60/400 Hz	50/60/400 Hz
Sense Frequency	As Required*	As Required*
Accuracy	±1%, ±5%	±1%, ±2%
Time Delay (Pick up & Drop-out)	250 MS To 10 Sec*	250 MS To 10 Sec*
Relay Contacts	DPDT, 3PDT	3PDT
Contact Rating	2 Amp, 10 Amp	10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

Factory set.

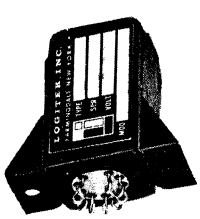
PHASE SEQUENCE SENSOR



Logitek Phase Sequence Sensors are used to protect three-phase loads, particularly rotating components, from the damage that could occur as a result of phase reversals or absence of any phase. Contacts may be used to disconnect the load or to operate alarm circuits or both.

TYPE	MILITARY	INDUSTRIAL
	PAA, PAD, PVA	PHA, LPS-1
Input Voltage	28VDC, 120/208 Vrms, 4 Wire WYE	120, 208, 230 Vrms 4 Wire WYE, Delta
Input Frequency	60/400 Hz	50/60/400 Hz
Sense Voltage	Lower Limit, PVA only, Externally Adj.	--
Phase Sequence	ABC	ABC
Relay Contacts	DPDT, 3PDT	3PDT
Contact Rating	2 Amp, 10 Amp	10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

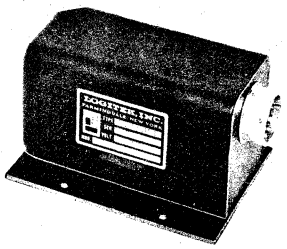
TIME DELAY RELAY



Logitek, Inc. Time Delay Relays were designed primarily for applications where precise time intervals for equipment control are required. They maintain a high degree of performance, reliability and accuracy while exposed to very severe environments. Under these rugged conditions, Logitek timers continue to satisfy their specified accuracy requirements over their operating life. Industrial type time delay relays are available with an adjustment knob on top of the unit. Adjustment ranges are available as specified below.

TYPE	MILITARY	INDUSTRIAL
	DI, DO, DOT, DOC, DMN1, DMN2	TI, TOT, TOC, TO TDR-1, TDR-2
Input Voltage	28 VDC	28 VDC
Timing Range	50 MS to 300 Sec*	100 MS to 300 Sec**
Accuracy	±10%, ±5%, ±2%	±10%
Repeatability	±1%	±1% at 25°C
Inverse Voltage	To 60 Volts	To 60 Volts
Relay Contacts	DPDT	DPDT
Contact Rating	2 Amp, 10 Amp	10 Amp
Temperature	-55°C to +125°C	-10°C to +70°C

Factory set or externally adjustable.



SOLID STATE FLASHERS

Designed to provide impulses to aircraft instrument panel warning lights or position lights. These units meet or exceed all requirements of military airborne or ground support equipment.

TYPE	F659	F580	F945	F670	MS27710	MS24577 -2A
Input Voltage	28 VDC	28 VDC	28 VDC	28 VDC	28 VDC	28 VDC
Flash Rate	80,85,120 Per Min.	80,120 Per Min.	80,85,120 Per Min.	120 Per Min.	85 Per Min.	80 Per Min.
Flash Ratio	1:1, 2.4:1	1:1, 2.4:1	1:1, 2.4:1	1:1	2.4:1	2.4:1
Output Current	2.5 Amp	500 MA	500 MA/Ohm	2 Amp/ Channel	2.5 Amp	5 Amp
Channels	1	1	4	10	1	1
Inverse Voltage	To 60 Volts	To 60 Volts	To 60 Volts	To 60 Volts	Per MiLF 26301	Per MiLF 26301
Temperature	-55°C to +125°C	-55°C to +85°C	-55°C to +85°C	-55°C to +85°C	-55°C to +71°C	-55°C to +71°C

REPEAT CYCLE TIMER

Type RT repeat cycle timers are used in those applications where a solenoid or other electromechanical device must be activated repeatedly. Type RT may be adjusted for different timing intervals of "off" time and "on" time by adjustment of the associated potentiometers on top of the unit.

TYPE	INDUSTRIAL
	RT
Input Voltage	28 VDC
Rate	50 MS To 100 Sec*
Accuracy	±10%
Contact Form	DPDT
Contact Rating	2 Amp
Temperature	-10°C to +70°C

**Screwdriver adjust on top of unit. 4 Ranges*

INTERVAL TIMER

Type DT interval timers are used in those applications where a piece of electromechanical equipment must be operated for a precise interval of time after a pre-determined time delay. Upon application of input power to the type DT timer a delay time (TD) is initiated (delay (TD) is adjusted by the potentiometer on top of unit). At the conclusion of this delay time the relay contacts transfer and remain transferred for a given period of time (this delay (to) is adjusted by the potentiometer on top of the unit.)

TYPE	INDUSTRIAL
	DT
Input Voltage	28 VDC
Timing	50 MS To 100 Sec*
Accuracy	±10%
Contact Form	DPDT
Contact Rating	2 Amp
Temperature	-10°C to +70°C

**Screwdriver adjust on top of unit. 4 Ranges*

Timer-Programmers and Timers by MATRIX CORPORATION (DATAPROFITS DIVISION)

Quantachron "C"

A solid-state "cam" timer-programmer for use where frequent program changes are desired in the time and sequence control of automatic equipment.

Convenient front panel controls can be quickly set to determine the closing and opening times of switches in multiple output circuits for automatic, multi-stage machines or processes.

Number of Channels: 10 standard.

Timing Accuracy: 1% of cycle time (40-140°F).

Cycle Time: Standard cycle time is 0.5 to 10 seconds. Optional cycle time multiplier extends range to 1000 sec.

Settability: 100 increments per cycle, digitally settable from front panel.

Output Contact Configuration: 10 amp DPDT.

Input Power: 120 VAC ±10%, 50-60 Hz.

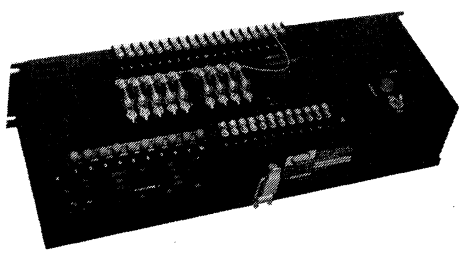
Operating Modes: Slave Mode: (Standard) Each cycle is initiated by external switch closure. When cycle is complete, Quantachron "C" will wait for another switch closure to begin the next cycle. Once the cycle has been initiated, the external switch has no further effect until the cycle is completed. Master Mode: (Optional) Once started, the Quantachron "C" continues to recycle automatically. As soon as one cycle is completed, the next one is automatically begun. Manual Mode: (Standard) 100 closures of the "jog" switch causes the Quantachron "C" to step through one complete cycle.

Reliability: High threshold integrated circuit logic, stiffly regulated power supply and special protection and isolation circuits are used to make the Quantachron "C" uniquely suitable for reliable operation in even the "noisiest" locations.

Dimensions: 19″w x 7″h x 13″d.

Mounting: Standard 19″ cabinet or bench mount.

Literature: Write for Bulletin "C."



Quantachron II

A solid-state "cam" timer-programmer for use where frequent program changes are not required in the time and sequence control of automatic equipment.

Programming is handled by a tamper-proof pre-wired plug-in program card. The program can be changed by plugging in a different program card.

Number of Outputs: 10 or 16.

Timing Accuracy: 1% of cycle time (40-140°F).

Cycle Time: 0.5 seconds to 10 seconds.

Outputs: 1 amp, solid-state triac or relay.

Input Power: 120 VAC 50-60 Hz.

Programming: Plug-in card contains the desired program. The program can be changed by changing the program card.

Operating Mode: Repeat Cycle: (continuous recycling) (standard). Dual mode repeat cycle and single cycle operation optional.

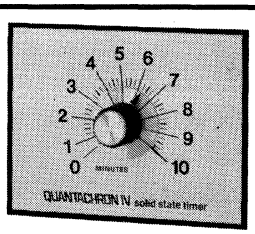
Controls: Power ON/OFF, power pilot light, output indicator lights (indicate when an output is energized).

External Control Inputs Optional: Manual/Auto and JOG, Reset, Hold, Matrix Switch, Interlocks.

Reliability: High-threshold integrated-circuit logic, stiffly regulated power supply, and special protection and isolation circuits are used to make Quantachron II uniquely suitable for reliable operation even in the "noisiest" locations.

Dimensions: 17″w x 5″h x 6″d.

Literature: Write for Bulletin II.



Quantachron IV

An Adjustable 10-Minute Solid State Timer with 1% Linearity

Input Voltage: 110 V ±10% AC, 50-60 Hz.

Input Current: Less than 150 MA.

Switching Voltage: 110 VAC 50-60Hz.

Switching Current: From .35 amps to 6 amps, depending on output triac used.

Time Adjustment Range: 40 seconds to 10 minutes. Other models to 2.5 hours.

Linearity of Adjustment: ±1% maximum non-linearity.

Mechanical Travel of Adjustment for Linear Time Calibrations: 275°.

Total Mechanical Travel: 295° ±3°.

Repeatability: 0.5%.

Reset: Instantaneous by external reset switch.

Dial: Decorative calibrated dial available.

Size: 3″ x 5″ x 1″ printed circuit card.

Mounting: Mounted by ⅜″ potentiometer mounting bushing or 6-32 screws.

Literature: Write for Bulletin Q4.

See Volume 1 for data on our low level scanners and switches.

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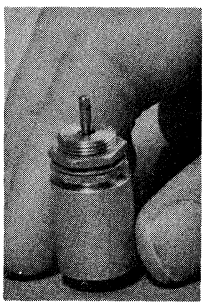
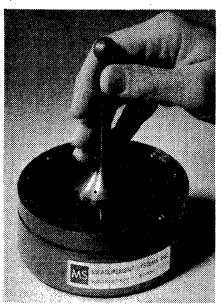
Respond to finger pressure on stiff stick, with no deflection. Isometric controls permit higher tracking accuracy, reduced fatigue, shorter training. Operator-hand control combination has dynamic range over 1000:1 in any direction, plus fast response independent of amplitude.



Model 469B, 2-axis Fingertip Joystick. Low priced. Versatile 15/32" threaded mounting adaptable to decorative bezels or rubber boot environmental seal.

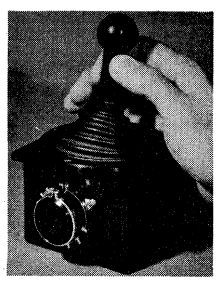


Model 435, 2-axis Hand Control Joystick. AC and DC output, plus grip and switching function versions available.

Model 1500-2, Grip with thumb operated 2-axis control. Mounted or hand-held with flexible cable. Tracking almost unaffected by G-loading, turbulence, vehicle bounce. Small cross-section grip shape ideal for hand-held operation.

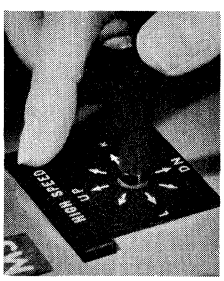
DISPLACEMENT CONTROLS

Potentiometer joysticks and track balls for high accuracy, 2-axis positioning tasks. Switching type joysticks offer two speed control modes. Commercial or military environments.



Model 541, Gimbal Joystick, a 2-axis displacement control for severe environments. Smooth full-gimbal motion with as low as 1 lb. force applied to joystick.

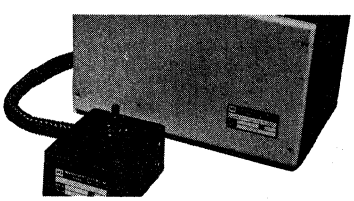
Model 628 Trackball. 4½" square. 2¼" deep, with 3" dia. ball. Uses optical or magnetic encoders. Select outputs of quadrature square waves, TTL, compatible pulse trains or potentiometer.



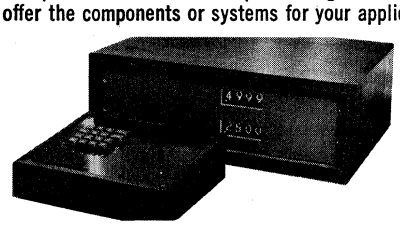
Model 571, Direct Digital Output Joystick Switch, incl. 2-axis pulse generator for pulse trains at 20pps and 200pps. Medium accuracy manual positioning in 2-axis system. 4 direction lines. DTL, TTL compatible.

MOTOR CONTROL PRODUCTS

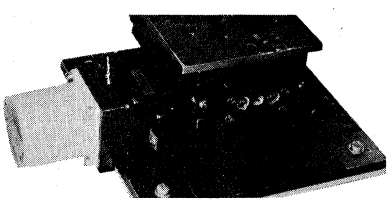
Positioning of work tables to precision of .0001 inch can be achieved readily with our control products. Whether the positioning task is contouring, or setting X-Y coordinates we offer the components or systems for your application.



Model 2000 Series 2-axis Pulse Motor Drive, Power Supply. All switching and logic functions to drive 2 bifilar stepping motors.



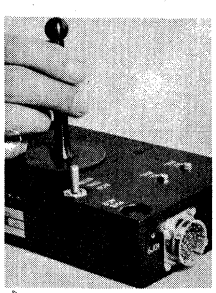
Model 2600, 2-axis 4 digit Numeric Display and Keyboard Entry Module. Nixie display counts driving pulses showing position of X-Y table to 1 step in 10,000. **Keyboard Model 2500** presets number, seen on 4-digit display, entering number into pulse motor drive.



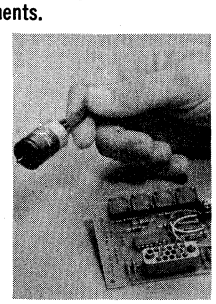
X-Y Table w. Pulse Motors. Complete 2-axis positioning. Model shown has 2" travel in .0001" steps. MS will mate motor controls to your table; match electronics to your application for optimum system performance.

SPECIAL PRODUCTS

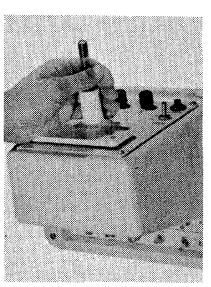
Reduce specification complexity and system costs by ordering a special control subassembly to your requirements.



Model 438 Control with operational amplifiers and control switches in slim profile (1¾" deep). Output of control as high as ±40vdc. Balance and gain controls provided.



Model 465-G18, with 2-axis amplifier. Gain, balance adjustments. ±10V DC signal level output on single circuit card. For commercial, industrial or severe environment, military jobs.



Model 435-G82 Joystick and Control Panel. Aided tracking network, deadman palm switch, variable tracking parameters. Waterproof cast aluminum housing has special hi-accuracy tracking telescope circuit controls.

MS MEASUREMENT SYSTEMS, INC.
523 WEST AVE., NORWALK, CT. 06850 • PHONE: 203/838-5561

*Design features of these controls under Patent #3270260 and #3454920, other patents applied for.

TIMING SYSTEMS AND COMPONENTS

Take advantage of NAPCC's years of specialized timing and control experience to aid in solving your design problems. We can help in three ways. First, through the application of a broad range of standard motors, relays, indicators or timers, some of which are described below. Second, by customizing or adapting these standard components to your special requirements. And third, by designing and engineering these components into complete timing or control systems to your specifications. Our application engineers are at your service. Call today. Or write for literature.

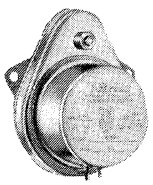
A.W. HAYDON CO. PRODUCTS

NORTH AMERICAN PHILIPS CONTROLS CORP.

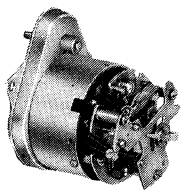
A NORTH AMERICAN PHILIPS COMPANY
Cheshire, Conn. 06410 • (203) 272-0301

MOTORS

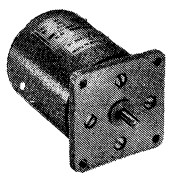
For timing, drive and control applications



SYNCHRONOUS MOTORS Torque to 200 oz-in. Reversible and dual speed. Range of voltages. Output speeds from 700 rpm to 1 rpd or slower. PM construction. Fast start/stop.



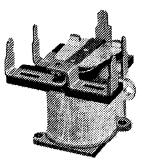
DC MOTORS PM. Ironless rotor. No cogging. Chronometrically governed motors available. Range of voltages. Speeds from 2700 rpm to 1/144 rpm.



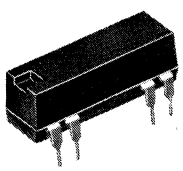
PM STEPPER MOTORS Pulse and logic. Logic circuit and variable speed drives. Voltages include 5V operation. Step rates to 1200 steps/sec. Pull-in rates to 16,000 steps/sec.

RELAYS

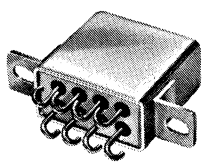
For industrial and military applications



ELECTROMECHANICAL RELAYS Ratings 3-10 amps. AC or DC operation. Designs available up to 6PDT. Selection of contact materials including silver, silver cadmium oxide, palladium, gold alloy.



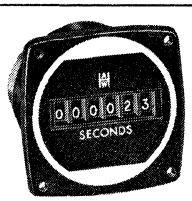
REED RELAYS Miniature. Direct interface with RTL, HNIL, DTL or TTL logic. Dry or mercury wetted. Multiple contacts. Magnetic latching types also available.



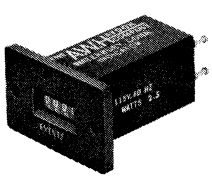
MILITARY RELAYS Crystal can or communications types. Meet applicable sections of MIL-R-5757 and MIL-R-6106. Up to 6PDT, 2 amp contacts and DPDT, 10 amp contacts. All welded construction.

INDICATORS

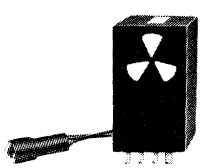
For monitoring time, events, operations



ELAPSED TIME INDICATORS Commercial, industrial, military. NEMA standard to microminiature sizes. AC or DC. Up to 6 digits. Wide range of mounting styles.



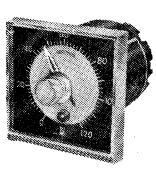
EVENTS COUNTERS Microminiature. Up to 6 digits, non-resettable; 5 digits, resettable. Pushbutton reset. AC or DC. Commercial and military models.



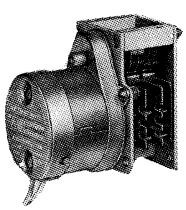
FAULT INDICATORS "BITE" (Built-In-Test-Equipment), Round, rectangular and ball types. Detect transient and permanent faults. Remain in fault memory condition until reset.

TIMERS

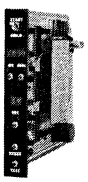
For time measurement, control, or time input



TIME DELAY RELAYS AND INTERVAL TIMERS Broad line. AC or DC. Electromechanical and electronic. Industrial and military types. Fixed or adjustable delay times.



REPEAT CYCLE TIMERS Low cost AC or DC electromechanical and electronic types. Loads to 25 amp. Up to 10 switches. Range of cycle times.



TIME CODE GENERATORS Broad selection of electronic or electromechanical models in IRIG or other specified codes. Bench, rack or plug-in types. AC or DC. High accuracy.

WRITE FOR LITERATURE. NORTH AMERICAN PHILIPS CONTROLS CORP. Cheshire, Conn. 06410 • (203) 272-0301

PROCESS CONTROL MODULES

North Hills

ELECTRONIC INTEGRATORS

Compute time-integral of sensor outputs; output pulses drive external 24 V electro-mechanical totalizing counters (8 W max.). Full-scale output pulse rate field-settable with high resolution between 100 and 50,000 counts/hour.

Model No.	Input	Output
IV-100-X*	Process control currents	No count for less than min. current
IV-110	0 to 10 V	No count for -V
IV-200	−10 V to +10 V	Dual outputs for up-down counter
IV-201	−10 V to +10 V	Count ignores input polarity

* -1 = 1-5 mA, -2 = 4-20 mA, -3 = 10-50 mA.

ALARMS / SWITCHES

Trip when input parameters (frequency, speed, dc voltage, dc current) cross preset limits. Provide both electrical signal and Form C relay contact closure for alarm and on-off control applications.

- Gold-alloy relay contacts for switching dry circuit to 1A loads.
- No relay chatter.
- Fail-safe for power and signal interruption.
- Adjustable hysteresis.

FREQUENCY / SPEED MODELS SERIES FM-10

Accept arbitrary waveform frequency information from speed transducers, generators, etc., 0.1 to 200 V peak input level; 0.1 MΩ input impedance; respond in two cycles of input frequency. Full-scale trip frequency field-settable with high resolution between 40 and 10,000 Hz.

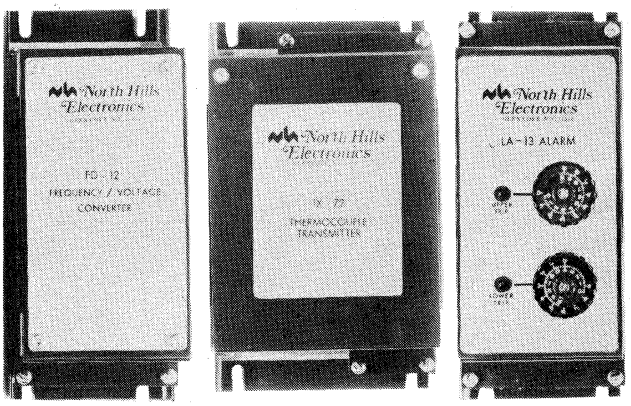
Model No.	No. of Preset Limit Frequencies	Trip Indication When Input Frequency Is
FM-10	1	Below limit
FM-11	1	Above limit
FM-12	2	Outside range between limits
FM-13	2	Below low and above high limit

VOLTAGE / CURRENT MODELS LA-10

Accept mV, V, process control current inputs. Trip level set by Kelvin-Varley divider in steps of 10% and 0 to 10% continuous vernier. Alarm status indicated by LED monitor light. Single-ended or differential input. Instrumentation-type high stability input amplifier for very high input impedance and common mode rejection.

Model No.	Set Points	Alarm Indication When Input Level Is
LA-11	1	Above limit
LA-12	1	Below limit
LA-13	2	Below low and above high limit

Standard full-scales: mV = 50, 100, 500
V = 1, 5, 10
mA = 5, 10, 20, 50



ISOLATED TRANSMITTERS

Convert various input parameters to process control current outputs. Input, output, power source are dc-isolated from one another.

- Outputs 1-5, 4-20, 10-50 mA at 0 to 30 V load voltage.
- 0.1% accuracy.
- Fast response.
- Wide range offset and span adjustments with high resolution.

VOLTAGE / CURRENT MODELS VX-10

Accept mV, V, process control currents.

Model designation: VX-10-X-Y, where

X = Input code:
1 = 1-5 mA, 2 = 4-20 mA, 3 = 10-50 mA
050 = 50 mV, 110 = 100 mV, 150 = 500 mA
210 = 1 V, 250 = 5 V, 310 = 10 V

Y = Output code:
1 = 1-5 mA, 2 = 4-20 mA, 3 = 10-50 mA

THERMOCOUPLES MODELS TX-10

Accept inputs from Type J (Iron/Constantan), Type K (Chromel/Alumel), Type S (Platinum/Platinum — 10% Rhodium) Thermocouples.

- Built-in cold-junction compensation.
- −10 to 40 mV offset, 10 to 50 mV span ranges.
- Thermocouple burn-out protection.
- >10 MΩ input impedance.

Model designation: TX-10-X-Y

X = Thermocouple code: (J, K, or S)
Y = Output code: 1 = 1-5 mA, 2 = 4-20 mA, 3 = 10-50 mA.

North Hills Electronics, INC. / GLEN COVE, N.Y. 11542 • 516-671-5700

CONVERTERS

North Hills

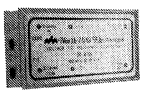
VOLTAGE-TO-FREQUENCY

Complete line of Voltage-to-Frequency Converters for
- A/D conversion.
- Telemetering.
- Electronic integration.
- Process control applications.

All have one-cycle response, excellent linearity down to zero frequency, low TC.

FIXED RANGE SERIES DF-10 AND DF-12

12 models cover full-scale output frequencies from 25 to 100,000 Hz. 0 to 10 V input; >100 MΩ input impedance; 0.02% linearity; zero and full-scale trimmers.



Model DF-10
3.5 x 1.82 x 1 in.
±15 Vdc powered

Model DF-12
3.5 x 8.5 x 2.3 in.
Ac-line powered

DF-10 Model No.	DF-12 Model No.	Freq. Range (Hz)
DF-10-025	DF-12-025	0-25
DF-10-050	DF-12-050	0-50
DF-10-110	DF-12-110	0-100
DF-10-125	DF-12-125	0-250
DF-10-150	DF-12-150	0-500
DF-10-210	DF-12-210	0-1000
DF-10-225	DF-12-225	0-2500
DF-10-250	DF-12-250	0-5000
DF-10-310	DF-12-310	0-10,000
DF-10-325	DF-12-325	0-25,000
DF-10-350	DF-12-350	0-50,000
DF-10-410	DF-12-410	0-100,000

WIDE-RANGE SERIES DF-100

Ac-line operated models with built-in regulated dc supplies; Uni- and bi-polar inputs; 0.02% linearity. Full-scale output frequency field-settable over 250:1 range with high resolution. X represents input level code, Y denotes full-scale frequency range.

Model No.	Input	Output
DF-100-X-Y	0 to +V, Process control currents	Frequency
DF-110-X-Y	−V to +V	Frequency and logic output indicating polarity
DF-120-X-Y	−V to +V	Separate frequencies for + and − inputs

X, Y	Input		Full-scale Freq. Range (Hz)
	Level	Impedance	
1	0 to 10 V	>100 MΩ	0.4 - 100
2	1 to 5 mA	1000 Ω	4 - 1000
3	4 to 20 mA	250 Ω	40 - 10,000
4	10 to 50 mA	100 Ω	400 - 100,000

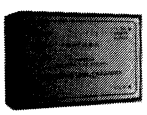
FREQUENCY-TO-VOLTAGE

Line of high-performance Frequency-to-Voltage Converters for
- Tachometry.
- Frequency monitoring.
- Telemetering.
- Control applications.

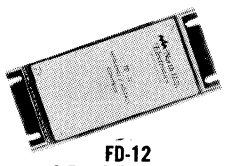
All feature ripple-free outputs and excellent linearity.

STANDARD SERIES FD-10 AND FD-12

8 models cover full-scale input frequencies from 100 to 100,000 Hz. 0.1 to 100 V peak input; 0.1 MΩ input impedance; 0 to 10 V output; 0.02% linearity; negligible ripple; fast response.



FD-10
3.5 x 2.3 x 1 in.
±15 Vdc powered

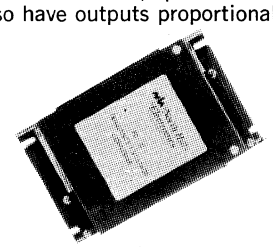


FD-12
3.5 x 8.5 x 2.3 in.
Ac-line powered

FD-10 Model No.	FD-12 Model No.	Freq. Range (kHz)
FD-10-110	FD-12-110	0-0.1
FD-10-125	FD-12-125	0-0.25
FD-10-150	FD-12-150	0-0.5
FD-10-210	FD-12-210	0-1
FD-10-225	FD-12-225	0-2.5
FD-10-250	FD-12-250	0-5
FD-10-310	FD-12-310	0-10
FD-10-325	FD-12-325	0-25
FD-10-350	FD-12-350	0-50
FD-10-410	FD-12-410	0-100

ULTRA-FAST RESPONSE SERIES FD-51

Ac-line operated modules with built-in regulated dc power supplies. Cover 10:1 frequency ranges and are particularly suited for instrumentation at low frequencies when very fast response, negligible ripple, and a high degree of linearity are required. Applications include cycle-to-cycle line frequency monitoring, FM demodulation, speed run-down tests on rotating devices. Also have outputs proportional to period of input frequency.



Input: 1 to 200 V peak; input impedance: 0.1 megohm; output: 1 to 10 V; linearity: 0.02%; negligible ripple.

Model No.	Frequency Range (Hz)
FD-51-110	10 to 100
FD-51-150	50 to 500
FD-51-210	100 to 1000
FD-51-230	300 to 3000
FD-51-110-1	50 to 70
FD-51-150-1	330 to 470

FOR OTHER NORTH HILLS PRODUCTS — SEE EEM SECTIONS 1800 ADJUSTABLE & FIXED COILS; 2000 REED SCANNERS & MATRICES; 4000 PRECISION CURRENT & VOLTAGE SOURCES; 5600 WIDEBAND TRANSFORMERS & HYBRIDS.

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FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

E-CELL (TM) COMPONENTS

First in Micro-Coulometry

● *Timing: Seconds to Months*
● *Integration: 1 to near ∞ events*

NEW! Series 500 for better accuracy at less than half the price!

❶ WHAT IS AN E-CELL DEVICE?

An E-CELL device is a new kind of circuit element that looks like a discrete electronic component but does the work of a complete electro-mechanical assembly. Its main functional part is a center "working" electrode, which is surrounded by an electrolyte. The unit's metallic container also serves as the second ("reservoir") electrode. Functionally, an E-CELL unit is a reversible micro-coulometer. By plating the "working" electrode, it converts electrical current-time integrals (up to several thousand microampere-hours) into equivalent integrals of a mass of metal. Exactly one atom is transferred for each electron impressed on the E-CELL unit. Power drain is normally in the microwatt region. If the "working" electrode is then deplated at a known current, the deplating time will be proportional to the original integral. When a known mass is given as part of the initial condition (i.e. is preplated on the "working" electrode), this same process generates a precise time interval. The unit abruptly changes from a low-resistance to a high-resistance circuit element when its "working" electrode is completely deplated.

❷ HOW DO YOU USE AN E-CELL DEVICE?

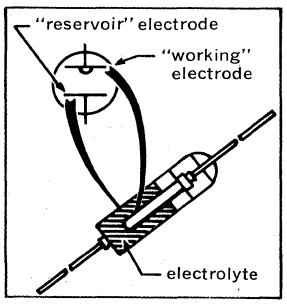
An E-CELL device has two generic functions: integration and timing. In both areas, the device is characterized by: electrical stability; small size; insensitivity to the physical environment; compatibility with the low current and voltage levels of modern circuitry; and the ability to operate over an extremely broad time domain. Compared to conventional mechanical and electro-mechanical devices which perform similar functions, an E-CELL device is much lower in cost.

For integration applications, an uncharged E-CELL unit accepts d-c, periodic, or random inputs in any waveshape — and stores the integral of these on the "working" electrode. To read out the stored value, the mass transfer process is reversed. The measured time to reach the point of the abrupt voltage swing, multiplied by the read-out current, gives a precise value which represents a total count of the stimuli presented to the unit. The Model 300 EDR Digital Readout Instrument provides a convenient means of making these measurements.

Operation in the timing mode is essentially the same as that for integration. The E-CELL unit is pre-charged with a known mass of plating material. In operation, this mass is transferred to the "reservoir" electrode (container) at a constant known rate determined by the current value used. When the "working" electrode has been deplated, an abrupt voltage swing signals that the pre-set time has elapsed. This signal is normally used as a bias transition with semiconductor devices.

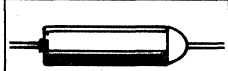
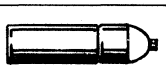
❸ APPLICATIONS

The scope of applications is as broad as counting and timing functions themselves. We have a repertoire of many convenient, economical circuit designs that have been proven in actual field use. Our experienced applications specialists will help you apply E-CELL coulometric techniques to your particular problems. Representative applications: **REPETITIVE TIMING AND CONTROL** Repeat cycle timing for domestic and industrial appliances. **PULSE COUNTING AND MEMORY** Adding and subtracting pulses. Counting events for vending machines, traffic, etc. Confidential memory for security devices. **CURRENT-TIME INTEGRATION** Battery charging controls. Environmental monitoring. Data accumulation. Laboratory integration in physics, chemistry, meteorology, etc. **USE-TIME MEASUREMENT** End-of-life, elapsed time, and warranty indication. Use-accounting for office, automotive, or industrial machines. **TIMING** Ordnance, safing and armng devices. Sonobuoy scuttling. Long delays (months).



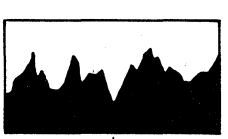
E-CELL Device and Circuit Symbol

E-CELL INTEGRATING AND TIMING COMPONENTS

Type (Actual Size)	Charge μa-hr	Application	Range Accuracy	Physical Characteristics
 Series 560	None	Integrating	10-1000 μa-hr ±2%	Single anode with axial leads. Current range up to 2000 μa. Temperature range −55°C to +71°C. (See Bulletin 500 for additional information.)
	60-1000	Timing	0.1 to 1000 hr ±4%	
 Series 550	None	Integrating	10-1000 μa-hr ±2%	Single anode, plug-in type. Current range up to 2000 μa. Temperature range −55°C to +71°C. (See Bulletin 500 for additional information.)
	60-1000	Timing	0.1 to 1000 hr ±4%	

E-CELL Timing Components with other pre-charges are available on special order.

Specifications subject to change without notice.



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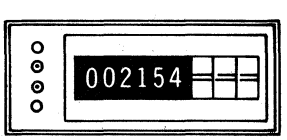
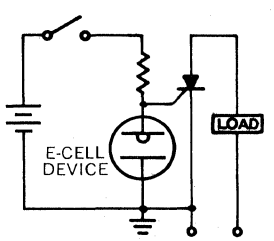
Typical Analog Input Signal

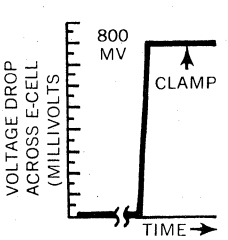
E-CELL Integrator



Model 300 EDR E-CELL Digital Readout Instrument



Typical circuit using E-CELL components.



Typical E-CELL device voltage rise.

E-CELL components and instruments are protected by one or more of the following U.S. patents: 2,744,217; 3,387,288; 3,423,642; 3,423,643; 3,423,644; 3,423,648. Other U.S. and foreign patents pending.

For additional technical information and applications notes, contact:

PLESSEY ELECTRO-PRODUCTS
(FORMERLY BISSETT-BERMAN)

subsidiary of PLESSEY INCORPORATED
3860 Centinela Ave., Los Angeles, Calif. 90066
Tel: (213) 390-3585 • TWX: 910-343-6483

PRECISION TIMER COMPANY, INC.

(203) 399-6253

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PROGRAM TIMERS

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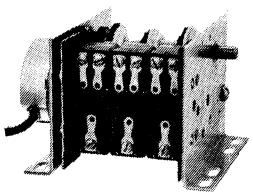

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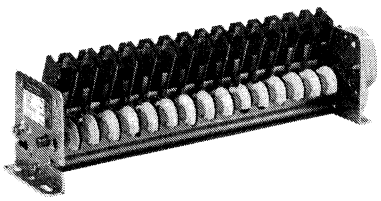
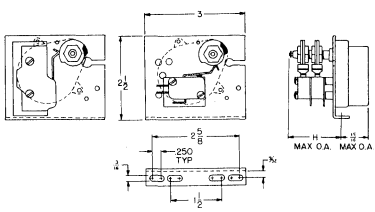
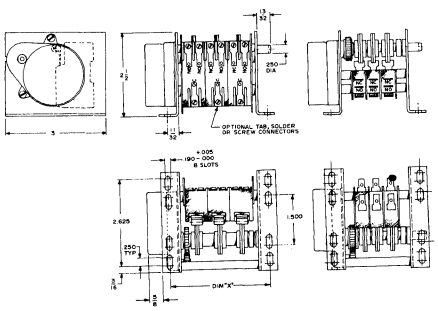


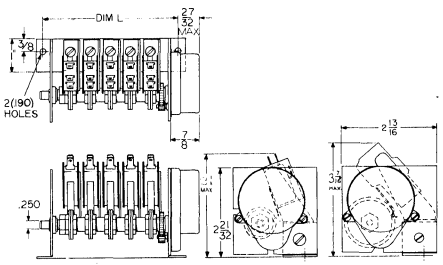
SERIES 115, 116, 120, 121



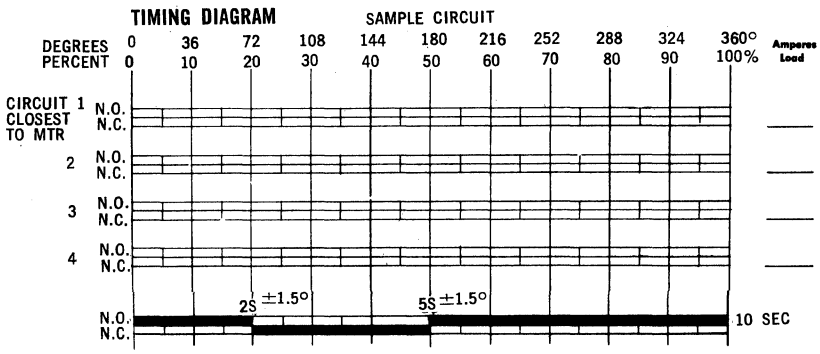
SERIES 130, 131



SERIES 150, 151, 160, 161



- Motor driven multicam recycle timers — single-pole flashers.
- Synchronously rotating camshaft programs switches sequentially when motor is energized.
- May be wired for single-revolution-and-stop operation.
- Available in over 100 stocked and standard speeds (time per camshaft revolution). See Speed Selection Table A.
- Choice of 10, 15, 20, or 25 amperes switch ratings See Switch Selection Table.
- Custom built from huge inventory stocked components on fast delivery.
- Precision timed at factory to your Timing Diagram (also field adjustable).
- Absolute premium quality throughout at competitive low prices.



MODEL SELECTION CHART

Number of Poles	SUB-BASIC SWITCHES "V" 10 Amperes Length Dimen.	"V" 10 Amperes 7/8" CAMS	"V" 10 Amperes 1½" CAMS	SUB-BASIC SWITCHES "W" 15 Amperes 7/8" CAMS	"W" 15 Amperes 1½" CAMS	BASIC SWITCHES "M" 20 Amperes Length Dimen.	"M" 20 Amperes 7/8" CAMS	"M" 20 Amperes 1½" CAMS	"E" 25 Amperes 7/8" CAMS	"E" 25 Amperes 1½" CAMS
1	1 1/32	115-V	116-V	115-W	116-W	1 25/32	115-M	116-M	115-E	116-E
2	1 25/32	115-2V	116-2V	115-2W	116-2W	2 1/32	116-2M	116-2M	115-2E	116-2E
3	2 1/32	115-3V	116-3V	115-3W	116-3W	—	—	—	—	—
1	1¼	120-V	121-V	120-W	121-W	1¼	120-M	121-M	120-E	121-E
2	1⅝	120-2V	121-2V	120-2W	121-2W	—	—	—	—	—
3	—	—	—	—	—	3.00	130-3M	131-3M	130-3E	131-3E
4	3.08	130-4V	131-4V	130-4W	131-4W	3.69	130-4M	131-4M	130-4E	141-4E
5	3.52	130-5V	131-5V	130-5W	131-5W	4.38	—	—	—	—
6	3.95	130-6V	131-6V	130-6W	131-6W	5.06	—	—	—	—
2	2.218	150-2V	160-2V	150-2W	160-2W	2.500	151-2M	161-2M	151-2E	161-2E
3	2.812	150-3V	160-3V	150-3W	160-3W	3.375	151-3M	161-3M	151-3E	161-3E
4	3.406	150-4V	160-4V	150-4W	160-4W	4.250	151-4M	161-4M	151-4E	161-4E
5	4.000	150-5V	160-5V	150-5W	160-5W	5.125	151-5M	161-5M	151-5E	161-5E
6	4.593	150-6V	160-6V	150-6W	160-6W	6.000	151-6M	161-6M	151-6E	161-6E
7	5.187	157-7V	160-7V	150-7W	160-7W	6.875	151-7M	161-7M	151-7E	161-7E
8	5.781	150-8V	160-8V	150-8W	160-8W	7.750	151-8M	161-8M	151-8E	161-8E
9	6.375	150-9V	160-9V	150-9W	160-9W	8.625	151-9M	161-9M	151-9E	161-9E
10	6.968	150-10V	160-10V	150-10W	160-10W	9.500	151-10M	161-10M	151-10E	161-10E
11	7.562	150-11V	160-11V	150-11W	160-11W	10.375	151-11M	161-11M	151-11E	161-11E
12	8.156	150-12V	160-12V	150-12W	160-12W	11.250	151-12M	161-12M	151-12E	161-12E
13	8.750	150-13V	160-13V	150-13W	160-13W	12.125	151-13M	161-13M	151-13E	161-13E
14	9.343	150-14V	160-14V	150-14W	160-14W	13.000	151-14M	161-14M	151-14E	161-14E
15	9.937	150-15V	160-15V	150-15W	160-15W	13.875	151-15M	161-15M	151-15E	161-15E
16	10.531	150-16V	160-16V	150-16W	160-16W	—	—	—	—	—
17	11.125	150-17V	160-17V	150-17W	160-17W	—	—	—	—	—
18	11.718	150-18V	160-18V	150-18W	160-18W	—	—	—	—	—
19	12.312	150-19V	160-19V	150-19W	160-19W	—	—	—	—	—
20	12.906	150-20V	160-20V	150-20W	160-20W	—	—	—	—	—

- Series 120 and 121, at low cost, are available from Factory Stock only in speeds in **Bold Type** in Speed Selection Chart A.
- Series 130, 131, 150, 151, 160, 161 may be ordered at no extra cost with friction clutch, permitting manual override. **Specify.** Dials and Knobs available.
- Series 150, 151, 160, 161 may be ordered with clutch-motor drives and reset mechanisms for use as Multipole Delay Relays. Consult factory.

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DELAY RELAYS

- Times down to zero (transferring load switch) when motor is energized. Resets to set position (fully adjustable) when power to motor is removed.
- Available time ranges 0-5, 0-10, 0-20, 0-30, 0-60, and 0-120 seconds.
- May be wired as Delay Relay or as Interval Timer.

No. of Poles	SUB-BASIC SWITCHES "H" or "L" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "H" or "L" Max. Dimen.	Type M 20 Amp	Type E 25 Amp
1	2.38	400-V	400-W	2.54	400-M	400-E
2	2.87	400-2V	400-2W			
1	2.54	401-V	401-W	2.54	401-M	401-E
2	3.00	401-2V	401-2W			
1	1.05	404-V	404-W	1.05	404-M	404-E
2	1.40	404-2V	404-2W			
1	1.36	405-V	405-W	1.36	405-M	405-E
2	1.71	405-2V	405-2W			
1	1.36	406-V	406-W	1.36	406-M	406-E
2	1.71	406-2V	406-2W			

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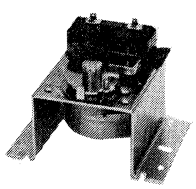
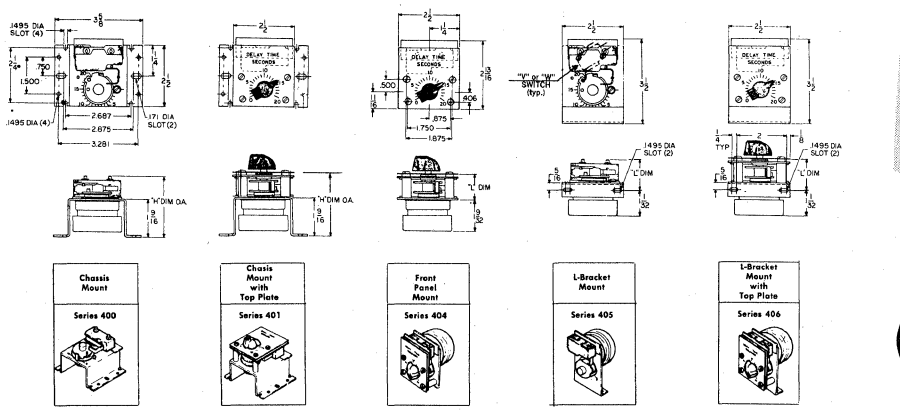
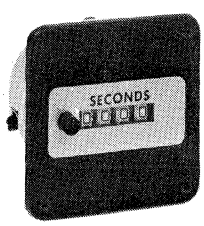




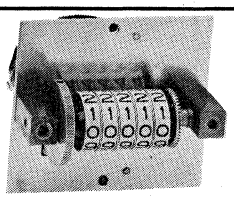
FILE 28020

HOURS METERS



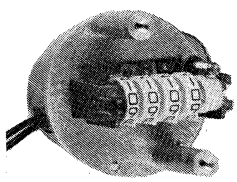
- A fully synchronous recording meter for front panel installation. Commences timing when motor is energized, stops when power is removed. NEMA standard dimensions.
- Extremely accurate. Draws only 3 watts.
- Reset models return to 0000 with touch of pushbutton.
- UL, CSA approved, and listed.
- Supplied with 8″ leads and with mounting hardware.
- Life expectancy many years.

Reset	Reads To	By	Non-Reset	Reads To	By
SR-240-1	999.9 sec.	1/10 sec.	SN-200-1	9999.9 sec.	1/10 sec.
SR-240-2	9999 sec.	1 sec.	SN-200-2	99999 sec.	1 sec.
SR-240-3	99.99 min.	1/100 min.	SN-200-3	999.99 min.	1/100 min.
SR-240-4	999.9 min.	1/10 min.	SN-200-4	9999.9 min.	1/10 min.
SR-240-5	9999 min.	1 min.	SN-200-5	99999 min.	1 min.
SR-240-6	99.99 hrs.	1/100 hrs.	SN-200-6	999.99 hrs.	1/100 hrs.
SR-240-7	999.9 hrs.	1/10 hrs.	SN-200-7	9999.9 hrs.	1/10 hrs.
SR-240-8	9999 hrs.	1 hr.	SN-200-8	99999 hrs.	1 hr.



- For behind-panel and chassis installations, at least possible cost.
- Reset models return to 00000 by rotation of thumbwheel.
- UL, CSA approved, and listed.

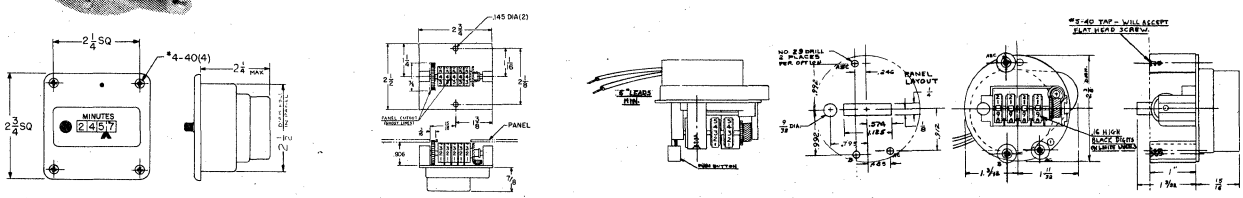
Reset	Reads To	By	Non-Reset	Reads To	By
R-210-1	9999.9 sec.	1/10 sec.	N-210-1	9999.9 sec.	1/10 sec.
R-210-2	99999 sec.	1 sec.	N-210-2	99999 sec.	1 sec.
R-210-3	999.99 min.	1/100 min.	N-210-3	999.99 min.	1/100 min.
R-210-4	9999.9 min.	1/10 min.	N-210-4	9999.9 min.	1/10 min.
R-210-5	99999 min.	1 min.	N-210-5	99999 min.	1 min.
R-210-6	999.99 hrs.	1/100 hrs.	N-210-6	999.99 hrs.	1/100 hrs.
R-210-7	9999.9 hrs.	1/10 hrs.	N-210-7	9999.9 hrs.	1/10 hrs.
R-210-8	99999 hrs.	1 hr.	N-210-8	99999 hrs.	1 hr.



- For behind-panel and chassis installations, at least possible cost.
- Reset models return to 0000 with touch of pushbutton.
- UL, CSA approved, and listed.

Specify:—
Option "A" — Standoffs at "A" and "A"
Option "B" — Standoffs at "B" and "B"
Option "C" — No Standoffs. Customer uses holes "C" and "C"

Reset	Reads To	By
R-240-1	999.9 sec.	1/10 sec.
R-240-2	9999 sec.	1 sec.
R-240-3	99.99 min.	1/100 min.
R-240-4	999.9 min.	1/10 min.
R-240-5	9999 min.	1 min.
R-240-6	99.99 hrs.	1/100 hrs.
R-240-7	999.9 hrs.	1/10 hrs.
R-240-8	9999 hrs.	1 hr.



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PANEL-MOUNT TIMERS

SERIES DPB — DELAY RELAY

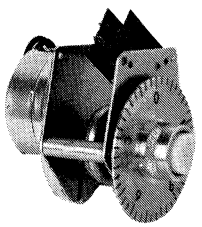
A fully adjustable synchronous motor driven Delay Relay for front panel installation. May be wired as Delay Relay or as Interval Timer. Available in one or two pole models at 10, or 15 ampere switch capacity, in over one hundred time ranges from one second to one month.

Operator selects delay (interval) time by manually setting dial to desired value, which remains fixed until operator readjusts dial to new value, which may be done while motor is energized or reenergized.

Push on button causes clutch to disengage mechanically, permitting timer to back off of load and timer motor switch(es) and permitting spring-powered reset to set position. Removal of finger from button permits clutch to reengage and commences timing cycle (see Table A).

Please advise with your Order, your desired program for second switch of two-pole units.

No. of Poles	SUB-BASIC SWITCHES "X" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "X" Dimen. Max.	20 Amp Type M	25 Amp Type E
1	1.40	DPB-V	DPB-2V	—	—	—
2	1.40	DPB-2V	DPM-2W	—	—	—



SERIES FLR — PROGRAM TIMER

A simple cam program timer for front panel installations, with rotating dial indication of angular position. Synchronously rotating cam shift programs switches sequentially when motor is energized.

Friction clutch permits manual positioning, whether operating or deenergized.

One through five or more poles. Choice of 10, 15, 20, or 25 ampere switches. See Table A for available cam shaft speeds (Time per Cycle).

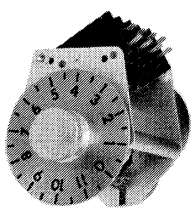
Cams are fully adjustable. Prices include settings to your Timing Diagram. May be wired for single-revolution-and-stop.

Use as programmer, flasher, interruptor, pulse accumulator, delay or interval timer, power operated sequencing or selecting switch, stepping switch, reversing timer.

Specify Series FLR (as shown) for repeat-cycle-construction.

Specify Series INM (similar) for manually settable Interval Timer construction with stop-pin at zero degrees of rotation (off position of Dial).

No. of Poles	SUB-BASIC SWITCHES "X" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "X" Dimen. Max.	20 Amp Type M	25 Amp Type E
1	.83	FLR-V	FLR-W	1.00	FLR-M	FLR-E
2	1.40	FLR-2V	FLR-2W	1.75	FLR-2M	FLR-2E
3	1.40	FLR-3V	FLR-3W	2.50	FLR-3M	FLR-3E
4	2.15	FLR-4V	FLR-4W	—	—	—
5	2.60	FLR-5V	FLR-5W	—	—	—



SERIES DRM — DELAY RELAY

A fully adjustable synchronous motor driven Delay Relay for front panel installation. May be wired as Delay Relay or as Interval Timer. Available in one, two, or three pole models at 10, 15, 20, or 25 amperes switch capacity. Available in Time Ranges 6, 12, 18, 25, 40, 75, 150, 300, and 500 seconds.

Operator selects delay (interval) time by manually setting dial to desired value, which remains fixed until operator readjusts dial to new value, which may be done while motor is energized or deenergized.

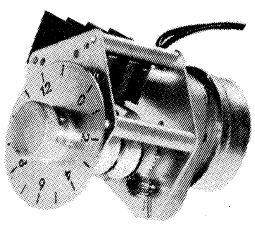
Operation is initiated upon energizing motor which causes timer to "time down" to zero transferring load switch. Timer backs off load switch and resets to set position when motor is deenergized, ready for next usage.

Please advise with your Order, desired relative time program among switches of multi-pole units.

At less cost, order Series DRF if adjustability is not needed. Identical to Series DRM, but delay time is fixed at factory to any value you specify between 0.5 and 500 seconds. No front dial.

FILE E47690A

No. of Poles	SUB-BASIC SWITCHES "X" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "X" Dimen. Max.	20 Amp Type M	25 Amp Type E
1	.83	DRM-V	DRM-W	1.00	DRM-M	DRM-E
2	1.40	DRM-2V	DRM-2W	1.75	DRM-2M	DRM-2E
3	1.71	DRM-3V	DRM-3W	—	—	—



SERIES IPB — INTERVAL TIMER

Yields a precise fixed timed interval upon operation of feather-touch pushbutton.

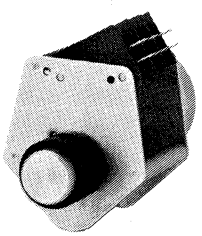
Transfers a snap-action load switch at start of fixed cycle when pushbutton is depressed. Return-transfers this switch at exact end of fixed time cycle. Time Ranges per Table A.

Select your choice among hundreds of available time cycles. Choice of one, two, or three poles. Choice of 10, 15, 20, or 25 ampere switch ratings. Prices of multiple units include timing to your Timing Diagram. Extra poles of multipole units may be within-cycle programmed.

Available on fast delivery from stocked and standard components and subassemblies.

FILE 28020

No. of Poles	SUB-BASIC SWITCHES "X" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "X" Dimen. Max.	20 Amp Type M	25 Amp Type E
1	.83	IPB-V	IPB-W	1.00	IPB-M	IPB-E
2	1.40	IPB-2V	IPB-2W	1.75	IPB-2M	IPB-2E
3	1.71	IPB-3V	IPB-3W	—	—	—



SERIES PER — PERCENTAGE TIMER

Series PER Percentage Timer is a repeat-cycle timer with unique within-cycle adjustability.

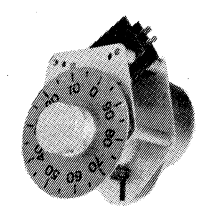
A latching mechanism holds a load switch transferred during an adjustable percentage of each consecutive fixed-time cycle. Each synchronous rotation of timer's camshaft is divided by dial adjustment into "ON" time and "OFF" time of load switch, expressed as percentage of repeat-cycle time.

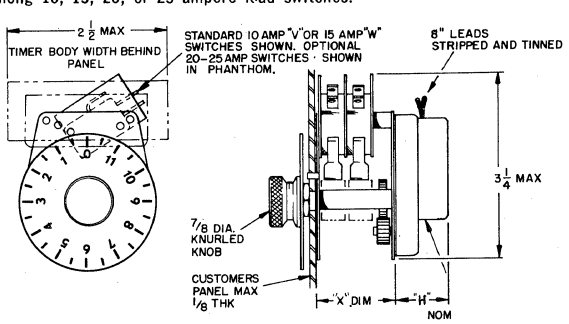
Either side of the single-pole double-throw load switch may be used for controlling "ON" or "OFF" a percentage of repeat-cycle time. Or both sides may be used, for proportioning or metering applications.

Series VPP Variable Pulse Programmer is identical to the above, but also incorporates an additional pole for straight programming functions, thus providing unusual system timing capabilities. Series VPP may be wired for single-revolution-and-stop operation.

Choice among hundreds of operating speeds (see Table A). Choice among 10, 15, 20, or 25 ampere load switches.

No. of Poles	SUB-BASIC SWITCHES "X" Dimen. Max.	10 Amp Type V	15 Amp Type W	BASIC SWITCHES "X" Dimen. Max.	20 Amp Type M	25 Amp Type E
1	1.75	PER-V	PER-W	1.75	PER-M	PER-E
2	1.75	VPP-2V	VPP-2W	—	—	—





Series DPB, FLR, INM, IPB, PER, VPP

- Employ Inductor Motor Type A.
- "H" dimension is 7/8" nominal (1 3/16" for speeds slower than 1 R.P.H.).

Series DRM, DRF

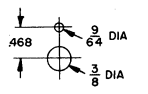
- Employ Hysteresis Clutch Motor Type C.
- "H" dimension is 1 1/4 nominal.
- Construction is left-handed.

Typical Ordering Information

FLR-4V1 — 60 sec. — 120/60 (with Timing Diagram).

Switch Ratings

See "Technical Information" (last page of this ad).



MOUNTING DIMENSIONS

PRECISION TIMER COMPANY, INC.

(203) 399-6253
13 WESTBROOK INDUSTRIAL PARK • WESTBROOK, CONN. 06498

TECHNICAL STANDARDS

SPEED SELECTION TABLE A

For timers employing inductor motor Type A

Seconds: **1**, 1⅕, 1⅓, 1⅖, 1½, 1⅔, 1⅘, **2**, 2⅖, 2½, 2⅔, 2⅘, 3, **3⅓**, 3¾, **4**, 4½, 4⅔, **5**, 5⅓, 5⅗, **6**, 6⅔, 7, 7½, 8, 8⅓, 8⅔, 9, 10, 11¼, **12**, 12½, 13⅓, **15**, 16, 16⅔, 16⅘, 18, **20**, 21, 22½, 24, 25, 26⅔, 28, 30, 33⅓, 36, 37½, 40, 45, 48, 50, **60**, 75, 80, 84, 90, 100, **120**, 135, 150, 160, 168, **180** — and others.

Minutes: **1**, 1¼, 1⅓, 1⅖, 1½, 1⅔, **2**, 2¼, 2½, 2⅔, 2⅘, **3**, 3⅓, 3¾, 4, 4⅕, 4½, **5**, **6**, 6⅔, 7, 7½, 8, 8⅓, 8⅔, 9, **10**, 11¼, 12, 12½, 13⅓, 14, 15, 16⅔, 18, **20**, 24, 25, 26⅔, 28, 30, 33⅓, 40, 45, **60**, 75, 80, 84, 90, 100, **120**, 150, 160, 168, 180 — and others.

Hours: **1**, 1¼, 1⅓, 1⅖, 1½, 1⅔, **2**, 2½, 2⅔, 2⅘, 3, **3⅓**, 4, 5, 6, **8**, 9, 10, **12**, 13⅓, 16, 18, 20, **24** — and others.

Days: **1**, 1¼, **1⅓**, 1⅖, 1½, 1⅔, 2, 2½, 3, 4, **5**, 6⅔, 7, 7½, 10, 12½, 15, 20 — and others.

SWITCH SELECTION TABLE

V-1 — Sub-Basic Type, single pole, double throw — 10 amperes ⅓ horsepower at 125 or 250 VAC — ½ ampere at 125 VDC — ¼ ampere at 250 VDC — 4 amperes at 125 VACL. .187 male tab terminals.

V-2 — Same, .250 male tab terminals.

W-1 — Sub-Basic Type, single pole, double throw — 15 amperes ⅓ horsepower at 125 or 250 VAC — ½ ampere at 125 VDC — ¼ ampere at 250 VDC — 5 amperes at 125 VACL. .187 male tab terminals.

W-2 — Same, .250 male tab terminals.

MA — **Basic Type, single pole, double throw — 20 amperes at 125, 250, or 480** VAC — ¼ horsepower at 125 VAC — ½ horsepower at 250 VAC — ½ ampere at 125 VDC — ¼ ampere at 250 VDC. #6 screw terminals.

MB — Same, solder terminals.

E — Basic Type, single pole, double throw — 25 amperes at 125, 250, or 480 VAC — 1 horsepower at 125 VAC — 2 horsepower at 250 VAC — Pilot duty 750 VA at 125 or 250 VAC. Available only with #8 screw terminals.

ORDERING INFORMATION — NOMENCLATURE

X — FLR — 2 — V — 1 — 20 SEC. — 120/60

- X — Your company's first initial
- FLR — Type of timer
- 2 — No. of poles
- V — Type of switch
- 1 — Type of terminal on switches
- 20 SEC. — Time range or cycle time
- 120/60 — Voltage and frequency

CAM SELECTIONS

Standard ⅞" or 1½" cams (as ordered — see Text) are molded nylon, 180° cut, fully adjustable 360°, mounted in pairs. Specially cut cams to your Order. Our prices **include** setting of cams to your Timing Diagram (please supply with Order where applicable).

MOTOR VOLTAGES AND FREQUENCIES

Motors are stocked in over 50 speeds for 120 volt 60 cycle operation. All other internationally standard voltages and frequencies are available on your Order.

DIALS AND KNOBS

Timers illustrated with dials and knobs, may be ordered bare for use with your own dial or knob arrangements. Shafts are all standard at ¼" diam.

QUALITY

Absolute prime quality materials, components, construction, design, and workmanship throughout and fully warranteed. Maximum usage of corrosion resistant materials throughout. 100% Q. C.

PROCUREMENT INFORMATION

Delivery on most items from stock or quickly available from pre-assembled sub-assemblies. Phone for prices and please ask about our very high quantity discounts. Grouped purchases and Blanket orders welcome. Daily pickups by mail, UPS, and radio-airfreight.

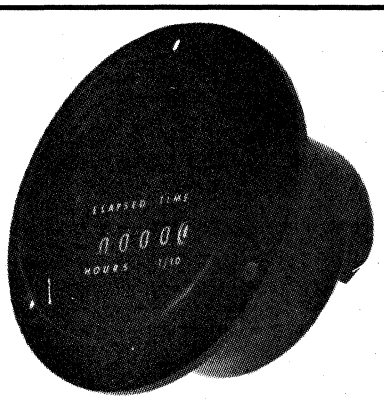
ASK US ABOUT SPECIAL DESIGNS
NO CHARGES FOR ENGINEERING SERVICES

MODEL DC-260-7

DIRECT CURRENT ENGINE HOURS METER

NOW AVAILABLE FROM STOCK

Operates on any DC voltage between 4 and 50 volts DC. Sealed for weather exposed applications, reads to 9999.9 hours within one percent accuracy — mounting hardware and 18 inch leads included.



WHY ALL THE FUSS?

REALLY . . . You don't honestly believe timing mechanisms this simple should cost an arm and a leg and take forever in delivery . . .

NOW DO YOU?

OVER 1,000,000 UNITS IN THE FIELD . . .
office machinery, vending machines, photocopiers, automation equipment, medical equipment, traffic control, lighting and illumination, material handling equipment, data processing ovens, process machinery, conveyor systems.

TRY PRECISION TIMER
FOR A REFRESHING IMPROVEMENT
- — Our Prices Run Well Below Competition.
- — We Deliver in Days — Not Months.
- — Our Quality is Unequalled.
- — Customer Service is our business . . .

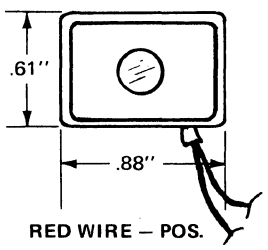
New . . . Exclusive

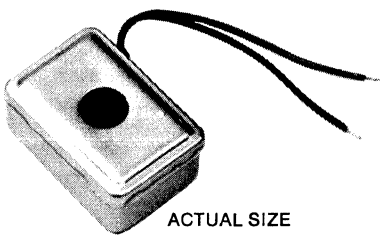
SOLID STATE AUDIO INDICATORS

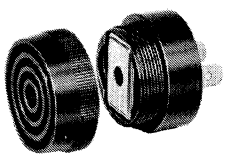
These are highly reliable audio indicators. There are no moving contacts; therefore, problems of arcing, electrical interference or RF noise are eliminated. *Operation:* A semiconductor drives a vibrating reed coupled to a plastic diaphragm; the coil is enclosed in a magnetic pot core. An audible warning is produced as soon as the voltage is applied. Sound output is in the range of 400 Hz to give extra audible penetration.

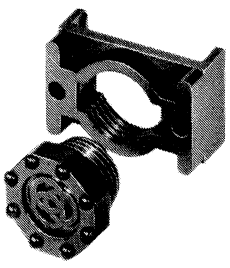
Typical Applications: Automotive and other vehicular warning systems, metal detectors, fume detectors, depth finders, audible tuning devices, monitoring systems, SWR alarm circuits, continuity test sets, timers, medical instrumentation, telephone sensors, home alarm systems and many other devices requiring audible signals. Model GA 100-12 available for low temperature applications to −55°C.

Miniature GA 100 Series









PANEL MOUNTINGS AVAILABLE

SPECIFICATIONS

MODEL	GA 100	GA 100-12
VOLTAGE	*1.5 – 3.0 VDC	**12 VDC
CURRENT	30 mA	25 mA
OUTPUT	†80 db	‡85 db
OPERATING TEMP.	−10° to +55°C	−55° to +55°C
FREQUENCY	400 ± 100 Hz. Rich in harmonics.	
WEIGHT	1/4 Oz.	

**Voltages higher than 3.0 volts—use a potential dividing network.*

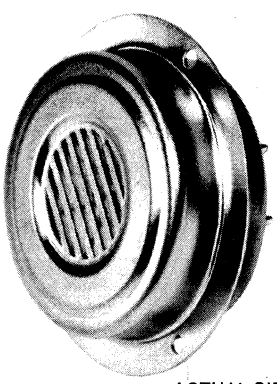
***Voltages higher than 12.0 volts—use a potential dividing network.*

†*At 12.0 inches distance at 3.0 volts; output volume and frequency are reduced with voltage.*

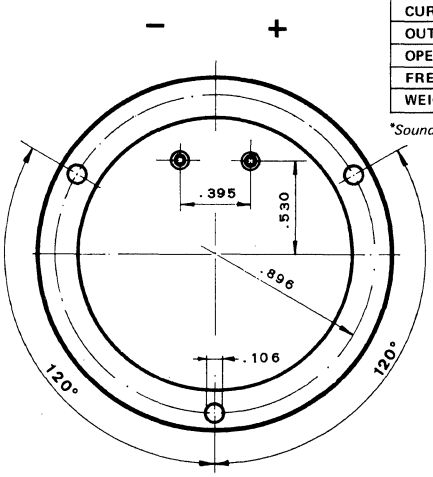
‡*At 12.0 inches distance at 12.0 volts; output volume and frequency are reduced with voltage.*

NOTE: The impedance of the supply source should not be greater than 50 ohms. Alternatively a higher impedance should be decoupled with a large capacitor. Full wave rectified supplies must be smoothed.

Standard GA 200 Series



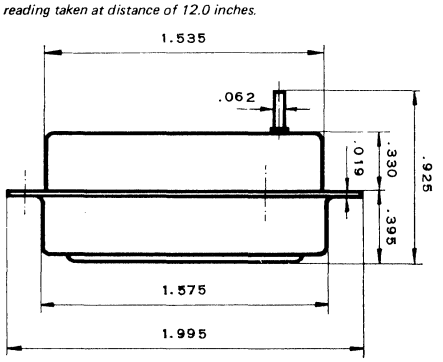
ACTUAL SIZE



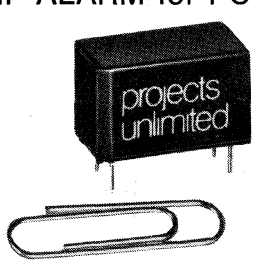
SPECIFICATIONS

MODEL	GA 200/3-12	GA 200/12-28	GA 200/28-48
VOLTAGE	3 – 12 VDC	12 – 28 VDC	28 – 48 VDC
CURRENT	6 – 24 mA	6 – 18 mA	6 – 11 mA
OUTPUT*	70 – 100 db	80 – 90 db	75 – 85 db
OPERATING TEMP.	−10 to +55°C		
FREQUENCY	APPROX. 400 Hz		
WEIGHT	1.5 Oz.		

**Sound output reading taken at distance of 12.0 inches.*



DIP-ALARM for PC board insertion



	DIP 3	DIP 5	DIP 12
DC VOLTAGE	1.5-3	4-8	9-15
CURRENT	30 MA	15 MA	30 MA
OUTPUT		80 db	
OPERATING TEMP.		−55 to +55°C	
FREQUENCY		400 Hz ± 100 Hz	
WEIGHT		.75 Oz.	

*Taken at 12 inches.

These units plug into standard 16-pin DIP socket or PC board on .300" x .700" centers.

Engineering evaluation samples of each product shown are available at nominal cost. Quantity prices and delivery on request. For information on special customized adaptations or designs — such as pulsating beep, or combination buzzer-flasher systems, etc. — contact factory.
Specifications subject to change.

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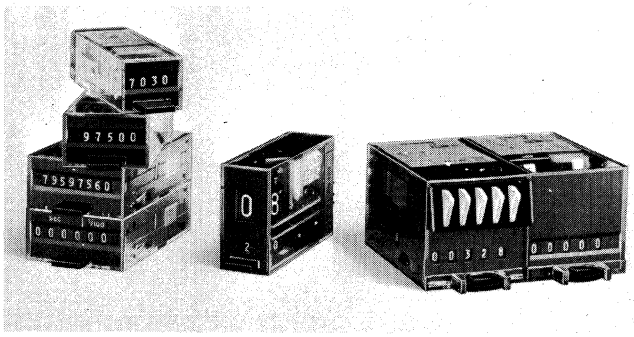
(513) 890-1918 TWX 810-450-2523

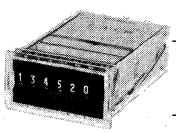
Guide to Sodeco impulse counters

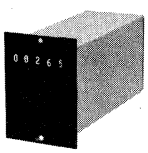
✱The Sodeco R-Series: Up to 200,000,000 counts and speeds to 60 ips

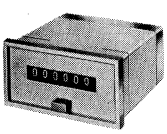


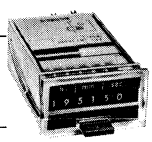
Inside their rugged, clear packages, Sodeco's new R-series impulse counters pack many times the life of any other counter on the market. The most advanced counters you can buy, they're Swiss-engineered for greater precision, quieter operation, no missed counts. Instead of all the usual rattles, vibration and wear associated with standard ratchet mechanisms, our special escapement mechanism keeps them working better longer. Compact plug-in modules with power consumption as low as 0.8W are compatible with the most advanced solid state instruments and systems. Standard ± 15% voltage tolerances and a capacity for operating with a wide variance of pulse waveforms provide a maximum safety margin. For more details on R-Series counters check the asterisked items in the application categories below.

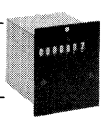
Totalizing Counters

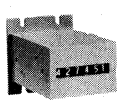










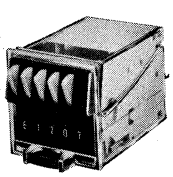


Number of Digits	Counting Speeds (ips)	Type of Reset	Typical Dimensions	Model/Style	Ask for Bulletin No.
3, 4, 5, 6, 8	10, 35, 60	None, Manual, Electric	w — 1.11″ h — 0.95″ d — 2.76″	✱ RG Series	601
6 (models available from 1/10 sec. to hours)	1/10 sec.	None, Manual, Electric	w — 1.11″ h — 0.95″ d — 2.70″	✱ RT Series	1001
5	10	None	w — 1.10″ h — 0.81″ d — 4.49″	TT-11	223
3, 4, 5, 6, 7, 8,	10, 25, 50	None, Manual (toggle)	w — 1.65″ h — 1.22″ d — 4.42″	TCe Series	201
4, 5, 6	10, 25, 50	Electric	w — 1.37″ h — 2.36″ d — 4.42″	TCeF Series	201
4, 5, 6, 7	10, 25	None, Manual	w — 1.38″ h — 2.05″ d — 1.73″	TCeB Series	212
6, 7	10	None, Manual, Electric, Both	w — 5.67″ h — 2.84″ d — 4.30″	EP Series	15602
6 Low Budget:	5	None	w — 5.67″ h — 5.67″ d — 4.90″	EV Series	15603
4, 6 Low Budget:	10	None, Manual	w — 1.65″ h — 1.73″ d — 3.00″	RE Series	14501

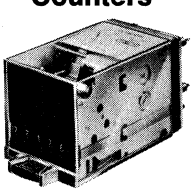
NOTE: Standard Voltages are 12, 24, 110 VDC, 110 VAC throughout. Special voltages available on request.

Other Counters

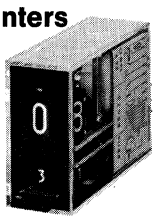
Predetermining Counters ✱



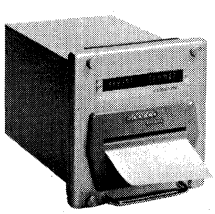
Add/Subtract Counters ✱



Single Digit Counters



Printing Counters



SODECO

A Division of LANDIS & GYR

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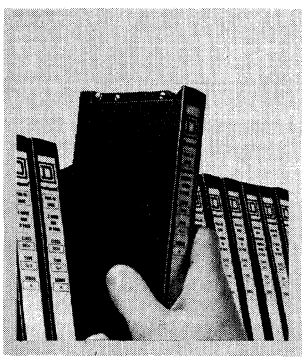
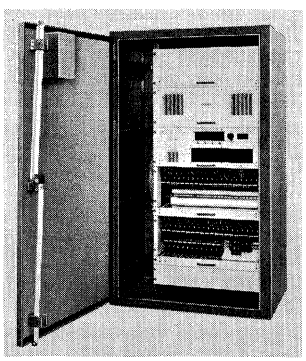
In Canada: 2063 Chartier Street, Dorval 760, Quebec • Phone: (514) 631-9069 Telex: 0525398

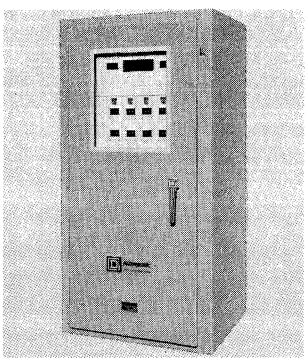
Complete control systems capability.



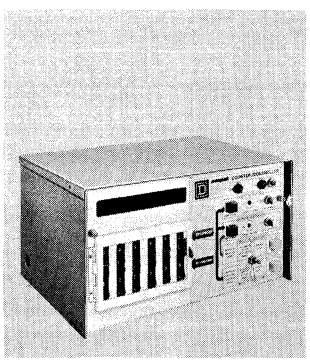
Plug-in NORPAK® is an advanced solid state logic system that provides many convenience and reliability benefits. Plug-in modules are easy to replace. All interconnections are in the back plane but wire changes are still easily accomplished. Plug-in components are protected by a phenolic case that is held in place by two captive screws. Plug-in NORPAK provides maximum design flexibility for fixed sequence control, data storage or counting functions. A complete line of logic functions and accessories are available.



The Program Sequence Controller is an inexpensive solid state controller, quickly and easily programmed to handle a wide variety of control problems. It accepts multiple inputs and produces multiple outputs in any sequence. It is modular in design and expandable to suit most applications. It has up to eight different time delays with individual adjustments. It requires no special programming language and can be programmed for alternate sequences. The Program Sequence Controller can be re-programmed and the modular components can be easily replaced. It can be linked to a computer for monitoring purposes.



NORPAK® Demand Control is the way to reduce monthly electric bills. Savings are generated by limiting the power usage in peak demand intervals throughout the billing period. The limiting is accomplished through automatic load control. Typical controlled loads might be electric furnaces, electric heat, electric boilers, air conditioning, or other loads which, when shed, will not affect user efficiency. NORPAK Demand Controllers are available in two sizes: Commercial, for one controlled load and Industrial (pictured above), for multiple loads.



NORPAK® Solid State Counter/Controller is the economically priced answer to industrial bidirectional counting applications requiring high speed, precision and reliability. It comes completely assembled and ready to work. Plug-in decade modules allow tailoring to the job. Three to six decade versions with in-line readout as standard. Power supply has extra capacity to drive rotary pulse generator circuits or additional NORPAK logic. Solid state amplifiers, rated 1 ampere continuous at 120 volts ac, supply an adjustable timed output pulse of up to one-half second. Table-top, rack or cabinet mounting. Anti-bounce circuits for contact inputs. Both automatic and manual reset.

For specific engineering data on Plug-in NORPAK, the Program Sequence Controller, NORPAK Demand Control, NORPAK Counter/Controller, or Programmable Controllers, contact your nearby Square D field office. Or write, Square D Company, Dept. SA-711, Milwaukee, Wisconsin 53201.

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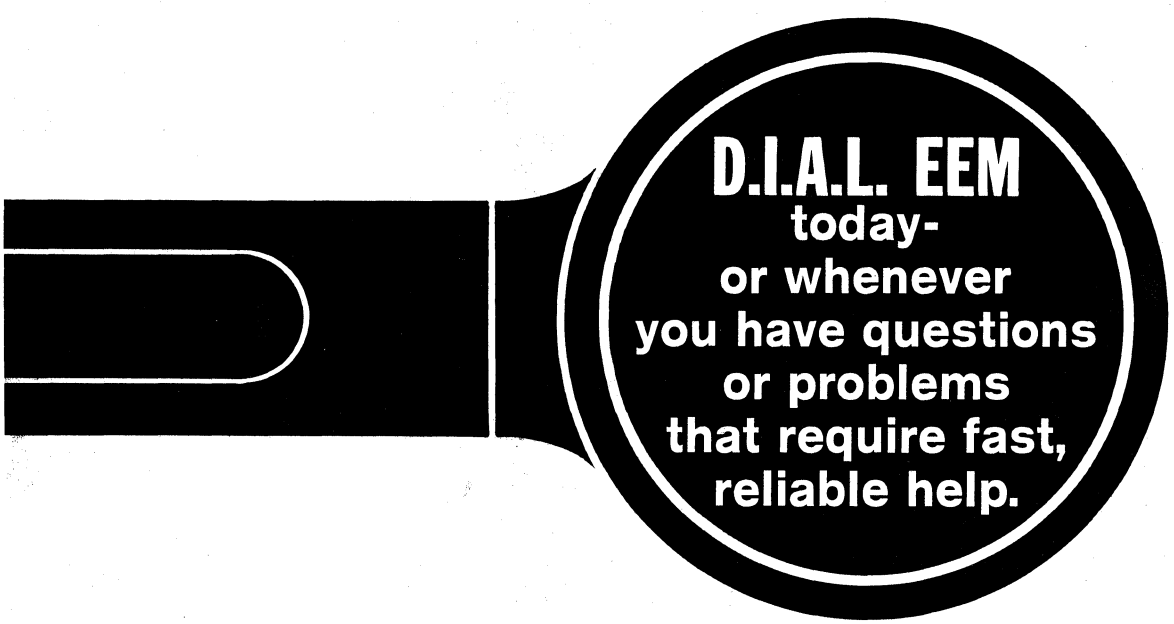
Immediately, our technical operators will tell you where you can find the products and services you need. They will provide you with the name of the supplier in your area, and direct you to the appropriate white pages of EEM for additional product catalog data.

This vital information is yours, at absolutely no cost.



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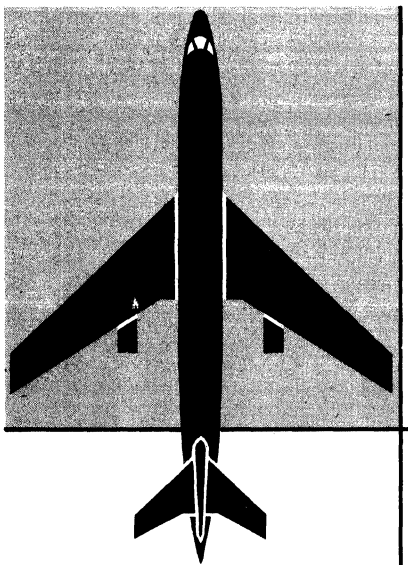
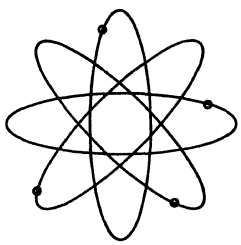
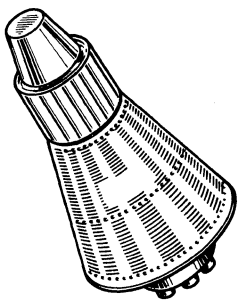
TRIAC ELECTRONIC SYSTEMS
INCORPORATED







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200 Park Avenue, New York, N.Y. 10017
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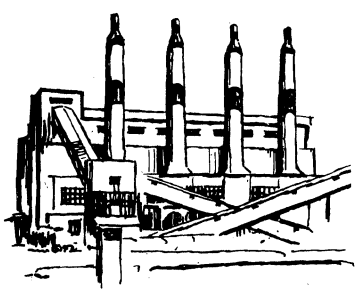
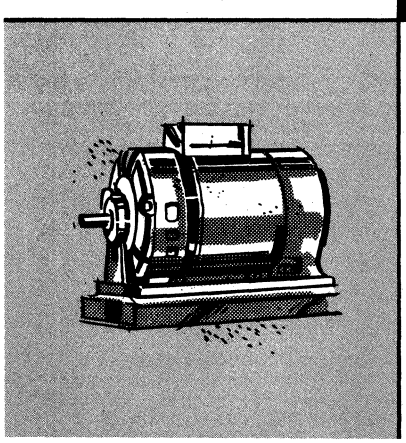
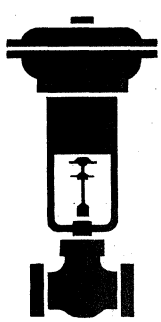
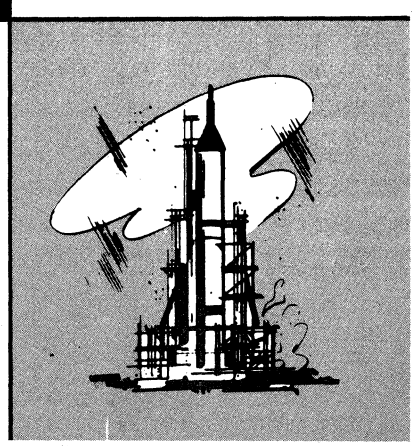


Manufacturer of genuine Thyristor Systems, combining solid state art and electro mechanical components.







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THYRISTOR

THAT IS TRIAC, SCR, UJT, CUJT, SUS, SCS, DIAC, SBS, CSCR, LASCR and LASCS.

Triac Electronic Systems is dedicated to the design and manufacture of genuine thyristor systems used alone or in combination with other solid state art and electro-mechanical systems.

Through a planned program of research and testing, an ever-increasing variety of unique products related to the control and use of electric power are being constantly innovated, modified and improved to maintain today's sophistication and to reduce costs to attractive levels for wide OEM applications. More than 200 products are now available serving industry, agriculture, military and entertainment fields. As one single highly diversified source for most all electronic controls and systems, Triac can assure a complete package from the initial design stage to the finished product more efficiently than "horizontal" suppliers with only 1 or 2 specialized products.

THYRISTOR ELECTRONICS IS PROFITABLE...
THYRISTOR ELECTRONICS IS SOPHISTICATED...
THYRISTOR ELECTRONICS IS FRONTIER...
THYRISTOR ELECTRONICS IS VERSATILE...
THYRISTOR ELECTRONICS IS BIG BUSINESS...

EXPLORE WITH US THE EXCITING WORLD of the THYRISTOR as it may pertain to your profits.

Consider: Your schedule is too short or you need precise custom circuitry or a simple low cost timer module is needed or a complex full system is needed or "old fashioned" components are not serving nor providing exciting sales impetus or you have an excellent idea for an automatic complex machine worth "millions" in a certain field or you wish to check your suppliers price or you wish to replace mechanical parts such as spot welder contactors with solid state or a present supplier is not meeting delivery schedules or indeed you merely wish to chat without obligation about how Triac may serve you now or in the future—then: Please contact us so that you may EXPLORE WITH US THE EXCITING WORLD of the THYRISTOR as it pertains to you.

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Triac ELECTRONIC SYSTEMS INC. manufactures a comprehensive line of THYRISTOR SYSTEMS, SUB SYSTEMS and ANCILLARY DEVICES derived from a broad range of thyristors, used alone or in combination with other solid state components (discrete and/or I.C.), and some hybrid electro-mechanical devices, to provide a variety of A.C. power control and D.C. specialized control from the milliwatt range to 600 amps at 1200 volts.

These products are reliable, versatile and low in cost, and directed towards OEM consumption in industry, agriculture, commerce and entertainment, where economy is essential.

The technology is available today to provide sophisticated functions not available yesterday because of cost or state of the art. We invite you to explore with us the exciting world of the thyristor (TRIAC, SCR, UJT, CUJT, SUS, SCS, DIAC, SBS, CSCR, LASCR and LASCS) as it may pertain to your applications and our product line as follows:

- Power Supplies, Constant VAC, Auto Transformers
- Solid State Relays, Sensitive Relays
- High Current Static Switches
- Zero Voltage Controls
- Phase Controls
- Soft Start and/or Stop (Up ramp, down ramp)
- Over Voltage Crowbars
- Transient Suppressors, Snubber Networks
- Threshold Detectors
- Over Current Breakers
- Motor Speed Controls
- Welding Controls and Timers
- Electronic Precision Timers
- Latching Switches, Memories, Logic Boards
- Shift Registers, Counters, Ring, Preset
- Converters, Inverters, Cyclo-Converters
- Pulse Modulators, Transformers, Triggers
- Lighting Controls
- Traffic Appliances
- Automotive
- Alarm Logic, Boiler Water Level Controls
- Electro Mechanical Hybrids
- Temperature, Pressure Controls
- Steam, Hydraulic, Pneumatic Flow Systems
- Sensors, Probes, Thermistors, Transducers
- Proximity Controls, Sensors

Whatever your requirements, we possess the capacity to innovate, design, develop and manufacture large or small orders, and are equipped to supply prototypes or samples quickly. We would welcome the opportunity to quote on your requirements or merely to discuss your applications and make your acquaintance.

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Triac

These pages contain some general information on thyristors together with product information. We hope this will be useful to you in determining how we can serve you. It should be pointed out that this is merely a guide to disclose our intent. In general, we don't maintain catalog, "off the shelf" inventory, rather, we manufacture to your exact requirement from large inventories of "building blocks." You don't get unnecessary extras and are thus assured of lowest cost and maximum design efficiency. Feel welcome to contact us for assistance and prompt response.

GLOSSARY and GENERAL INFORMATION

THYRISTOR: POWER

A switch that is either on or off (bistable). A semiconductor, solid state switch with no moving parts . . . capable of operating at extreme speeds with excellent electric power capabilities, both voltage and current, under either continuous or high surge conditions. An hermetically sealed switch, silent in operation, static, compact and free from the effects of ambient shock and vibration levels. When correctly chosen and utilized with proper protection, thyristor switches possess practically unlimited operating life even under the most severe environment. Available from ½ amp. to 1,700 amp. steady state and to 14,000 amps. non-repetitive inrush and up to 2,500 volts. Thyristor switches may be turned on with only a few millionths of a watt and a few millionths of a second turn on signal. Thus, for example, one part signal can control ten million parts power. This most amazing characteristic enables the control of very high power circuits by means of inexpensive, low level sensors, such as light sensitive cells, heat sensitive resistors, magnetic sensitive resistors and countless other devices. For many applications, thyristor switches represent the most economical, versatile and reliable means available. Power thyristors are three terminal p-n-p-n regenerative feed back pairs and classified as either unidirectional or bidirectional reverse blocking triodes. More common designations are SCR and TRIAC.

THYRISTOR: CONTROL

A switch that is either on or off and may serve to control a power thyristor or other solid state or electro-mechanical applications. A specific threshold switch that triggers when the control force exceeds the threshold level. A semiconductor, solid state switch with no moving parts operating at high speed and the lowest power levels. Silent, sealed, free from the effects of shock and vibration, extremely low in cost and possessing almost unlimited electronic control application capabilities. Control thyristors are available for every application . . . commercial, consumer, aerospace, industrial and military. Some control thyristors are as follows: 1. PUT, Programmable unijunction. 2. DIAC, Bidirectional diode. 3. LAPUT, Light activated programmable unijunction transistor. 4. SBS, Silicon bilateral switch. 5. SUS, Silicon unilateral switch. 6. ASBS, Assymetrical silicon bilateral switch. 7. LAS, Light activated reverse blocking diode. 8. LASCR, Light activated silicon controlled rectifier. 9. SCS, Reverse blocking tetrode thyristor. 10. LASCS, Light activated silicon controlled switch.

THYRISTOR: HYBRID

Thyristors used in combination with other solid state components either discrete and/or I.C. or with electro-mechanical devices to provide a variety of power controls most efficiently at low cost.

PHASE CONTROL

A system of fast ON-OFF switching of a power thyristor connected between alternating current supply and load providing supply for a controlled part of each cycle. An efficient system for controlling average power to lamps, heaters, motors, transformers, power supplies, etc. A control thyristor, usually a unijunction is used to trigger the power thyristor at the exact time into the phase angle of the AC wave. The power thyristor will then latch into conduction and stay on for the remainder of the half-cycle. Phase control is available from almost zero to full power either half or full wave.

PHASE CONTROL: SYMMETRICAL

Phase control in which the negative and positive portions of the wave are equal thus excluding DC components which could cause problems when phase controlling inductive loads such as transformers, due to saturation of the iron core. It is most important therefore, that applications for inducive loads not use ordinary light dimmer type circuits when symmetrical phase control is indicated.

ZERO VOLTAGE SWITCH

An on-off switch that turns on when AC voltage is near zero at the start of the half cycle and turns off when the voltage is at zero at the end of the half cycle. This technique eliminates radio interference and other noises that are produced from random turn on or off electric loads. This is particularly pertinent where frequent recycling occurs, as for example, heater loads controlled by slow acting thermostat switches. Thyristor systems are ideal for eliminating interference problems due to current interruptions since these systems can only turn off when on state current is at near zero, regardless of power factor. Similarly, they can be made to latch on when the current begins to flow.

PROPORTIONAL CONTROL

Control in which the amount of corrective action is proportional to the amount of error. This control can be achieved either from a control of the phase angle as in phase control or from the fast periodic switching on-off as in zero voltage control. Typical applications are heaters and air conditioners. Important parameters in the design of proportional control systems are: 1. Type of load. 2. Tolerable RFI level. 3. Proportional band. 4. Sensor time constant. 5. Switching period. 6. Differential. Thyristor systems are ideally suited for these applications.

SOFT START-STOP

The gradual application or reduction of line voltage to a motor, transformer or other inductive load in order to limit inrush current, transients or other shock factors resulting from abrupt changes. For example, inrush current to transformers, especially hypersil and those with little "air space," can rise to nine times steady state current. This excessive inrush can cause damage to switches, transformers, etc. An automatic soft start system applies a linear voltage ramp and limits currents to the proper level. Thyristor systems are ideal for this application.

PULSE

A momentary, sharp change in a current, voltage or magnetic field that is normally constant. Thyristors are readily triggered on from pulses of short duration such as those delivered by charged capacitors and unijunction triggers. This characteristic enables easy thyristor isolation by means of pulse transformer. Other advantages are precision control, compactness, control from low energy sources and overall economy.

SENSOR and TRANSDUCERS

A device that senses a change in a physical parameter such as light, temperature voltage, current, etc. and converts the change into a useful input signal for control purposes. One classification is the resistance type . . . that is, the resistance varies with the physical parameter. This includes thermistors, magnistors, light sensitive resistors, etc. A second classification includes energy producing devices such as piezo-electric, electro-dynamic, electro-chemical, photo-electric, thermocouple, etc. All sensors and transducers make excellent primary detecting elements for low cost thyristor control.

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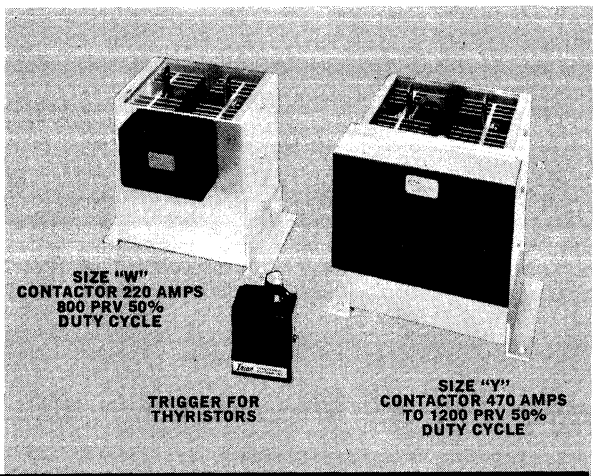
THYRISTOR SYSTEMS: HIGH POWER and LOW POWER, also referred to as Solid State Switch or Contactor.

Available 110 amps to 1,700 amps and 2,500 volts. Peak one-cycle surge inrush forward current up to 17,000 amps. Protected from forward voltage destruction. Transient protected, control voltage 6 to 240 AC. or DC. Available cooling: convection, forced draft or water. Rated for continuous or intermittent duty cycle.

Complete packages ready to use alone or in combination with thyristor controls, such as temperature sensors, light sensors, motor speed transducers, phase control, soft start, zero voltage switch, etc.

Typical Applications: Motor Speed Control, DC Motor Control, Battery Vehicles, Heater Control, Replacements for Mechanical Contactors such as Spot Welders or other severe arcing applications, Light Dimmers, Transformer Switching, Inverters, Transportation Equipment, Military, Induction Heaters, Replacements for Ignitrons, etc.



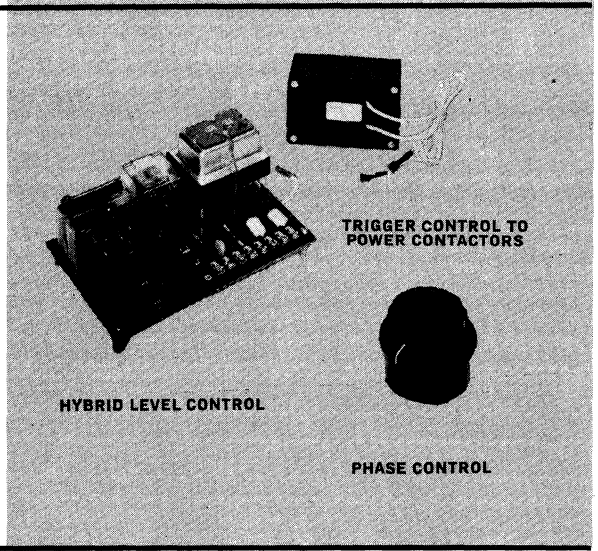
THYRISTOR SYSTEMS: CONTROL

Available for virtually every electronic control function from simple unijunction low cost timer module to the most complex control functions for automation and interface with computer control. These systems are complete or supplied in combination with other solid state art (discrete and/or I.C.) and electro-mechanical devices.

Controlled from primary sensors and transducers the Thyristor System Control in turn controls the Power Thyristor. This provides an almost limitless application versatility to meet your exact design requirements at low cost.

The technology is available today to provide sophisticated functions not available yesterday because of cost or state of the art. Even mundane mechanical devices such as thermostat, for example, can be replaced by lower cost, smaller more reliable thyristor systems in many applications. Whatever your control requirements are, give consideration to Thyristor Control Systems.

Available in a variety of packages and configuration including plug-in, panel mount or P.C. boards. Also available packaged in combination with Sensors and Power Thyristor Systems.



SOLID STATE RELAYS & HYBRID RELAYS

Triac Electronic Systems specializes in the design and manufacture of Solid State Relays & Hybrid Relays. The genuine thyristor is the heart of all such devices.

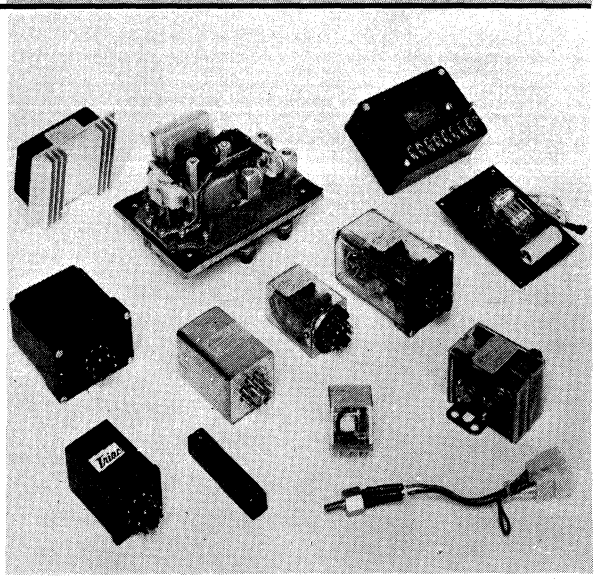
Solid State Relays are indicated in applications where long life cycling or high inrush currents, or great speeds or sophisticated design such as zero voltage, phase control or soft start is required.

It is essential when choosing a solid state relay to work closely with a knowledgeable supplier. Solid state relay design is an area of expertise unto itself.

Triac truly majors in this field, providing the most advanced state of the art and OEM design at low cost. A solid state relay should be designed for your exact application to avoid unnecessary "extras." Perhaps a hybrid would better suit your requirements?—A relay with electro-mechanical input, such as a reed relay to gate the triac? Or should the output be shunted with mechanical switching closure? Or perhaps both? These are some of the questions to be answered.

Triac is prepared to assist you in these design questions, makes available to you their diversification and field experience and welcomes your inquiry.

You can choose from a broad line of designs, sizes, mountings, configuration, speed, termination and specialized applications. Solid State Relays are available for phase control, soft start and zero voltage switching.



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TIMERS: ELECTRONIC

Triac Electronic Systems timing relays provide the most advanced state of the art industrial timers at low price levels.

Through improved genuine thyristor circuitry, many problems often encountered with conventional R-C timers have been eliminated. Timers are available all solid state or in combination with electro-mechanical components.

Triac diversification and volume in thyristor system design enables it to set new standards for OEM design at low cost. For example, the newly developed TTB simple timer for P.C. board application is as low as $4.00 in 1,000 qty. At slightly higher cost is a two stage timer switch designed for the automation industry, where a fixed output pulse is required regardless of duration of input pulse. These modules are compact, reliable and truly economical. In addition, a most comprehensive line of conventional and special timers are available as follows: SIMPLE DELAY . . . OFF/ON DELAY . . . SEQUENCE and MULTI-STAGE SYNCHRONOUS . . . PRECISION . . . SINGLE SHOT CONTROLLED PULSE . . . REPEAT & RECYCLE . . . ZERO VOLTAGE . . . PHASE ANGLE . . . SPECIAL INDUSTRIAL . . . SPOT WELDER SEQUENTIAL . . . CASCADING and MANY OTHERS.

We can satisfy the most versatile design requirements such as: timing range, operating voltage, current switching capability, accuracy, mounting, packaging, environmental condition, protection from line transient and noise, etc. We can probably fulfill your exact requirement without imposing unnecessary "extras" thus providing substantial savings to you.

Triac manufactures a series of automatic multi-function programmers combining thyristor technology with electro-mechanical devices. These programmers provide automatic sequence control for automation and industrial process. Stepping action is based upon time interval or any other physical parameter such as speed, acceleration, temperature, pressure, level control, etc. Interlocks, safetys and other controls may be programmed.

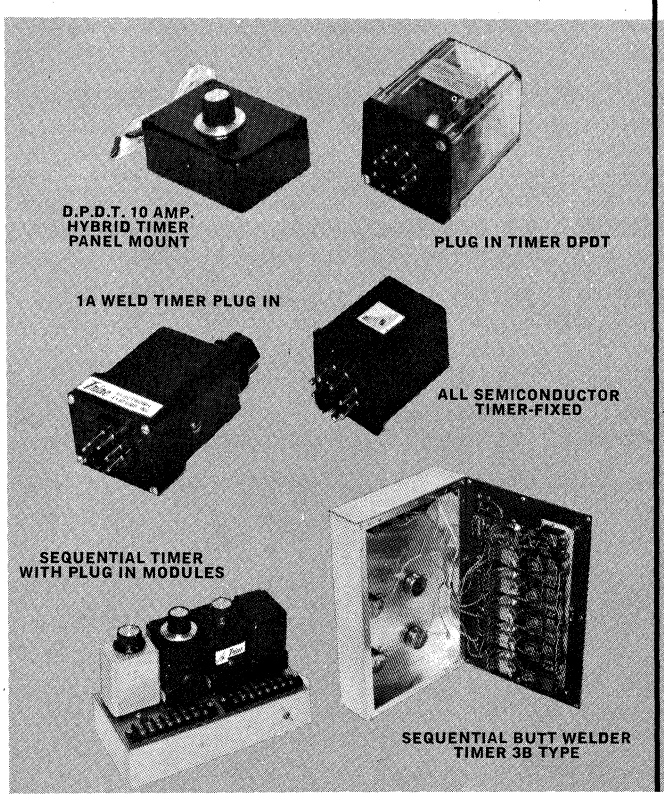
Triac offers its complete design facilities to you to help solve your particular application and welcomes your inquiry without obligation.

PRECISION DIGITAL TIMER COUNTER, PROGRAMMER with READOUT and RADIO TRANSMITTER

A crystal controlled clock pulses a digital counter providing unusual precision and repeatability over wide time ranges and ambient conditions. Shortcomings normally inherent in ordinary timers, such as "first cycle" effect abortive intervals, transient failure, etc. have been eliminated. Capability includes: present timing, programming, adjustable clock, adjustable dwell, repeat cycling, multiprogrammed cycles, memory and numerous other features. The digital display is bright, clear and legible—either tube or LED.

BCD output and radio transmission enable this DIGITAL TIMER COUNTER, to control remote stations readily, to receive remote or manual signals, to interface with computers or other equipment. A versatile instrument meeting the most exacting demands of contemporary sophisticated timing systems.

Available in 3, 4, 5 or 6 digital models and up to 16 stations. Operates from 120 VAC or battery pack.



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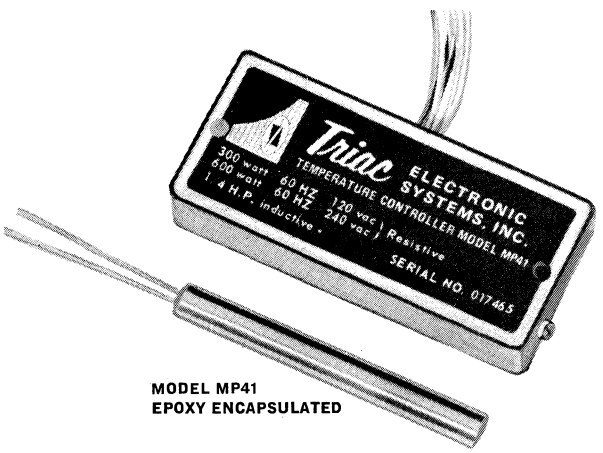
Triac TEMPERATURE CONTROLLER

PROPORTIONAL OR ON/OFF CONTROL • THERMISTOR SENSOR • RESISTIVE OR INDUCTIVE LOAD
SELF-CONTAINED POTENTIOMETER

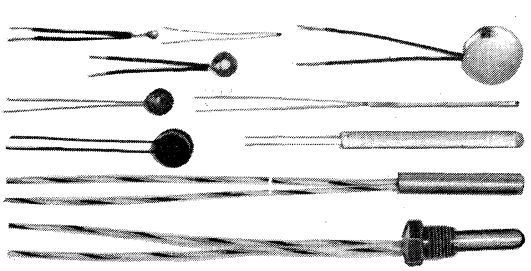
- **All solid state** reliability. Integrated circuit threshold detector and trigger for controlling a triac.
- **Proportional control** insures smooth continuous power supply.
- **On-Off Control** versatility
- **Thermistor sensor,** temperature range—10 to 180°F supplied with each unit. 3' Teflon leads.
- **Wide temperature ranges** available from —60 to 600°F at additional cost.
- **Compatible** with sensors for other physical parameters such as pressure and position.
- **Potentiometer control,** included and integral with each unit.
- **External potentiometer** control connections available.
- **True A.C. power switching.** Inductive load any power factor. Up to ¼ H.P.
- **High capacity resistive load.** 300 watts, 120 vac, 600 watts, 240 vac (external resistor required for 240 vac).



MODEL MP41
EPOXY ENCAPSULATED

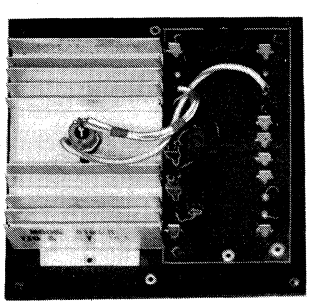
The *Triac* MP41: Features the latest development in monolithic integrated circuit technology, combined with all solid state switching: Functions as a threshold detector plus a trigger circuit for controlling a bidirectional triode thyristor, power semiconductor device. Full wave A.C. switching is provided thus accommodating inductive loads of any power factor, as well as resistive loads. This exclusive design is well suited for a large range of industrial and commercial applications. The input consists of a differential amplifier stage capable of detecting minute changes in sensor resistance as a function of bridge imbalance. The greater the magnitude of bridge imbalance the faster the trigger rate for firing the power semiconductor and the more power supplied in smooth stepless increments. Proportional control bandwidth is factory set at ±5—10% but may be modified for any bandwidth from zero to 100% temperature range with the use of external components. For motor control, inductive loads and other applications ON-OFF control is provided for by a simple change of connections. Hysteresis differential is factory set at ±5—10% but may be modified upward to any percent with the use of external components.** Inductive loads of any power factor may be accommodated in the ON-OFF mode only .

THERMISTORS SENSORS & PROBES



Triac Electronic Systems can supply thermistors in a wide variety of temperature ranges, probe sizes and configurations. Most units are available with standard, linear or interchangeable characteristics with negative or positive temp. coefficients.

PH21 TEMP. CONTROLLER



- Proportional and On-Off
- Sizes from 15 — 200 amps
- Single and 3 Phase
- Zero Voltage Crossing
- Resistive and Inductive Loads
- Temp. Range—50 to 600°F
- Control Point Repeatability ±.4%
- Compatible with Sensors for other physical parameters.

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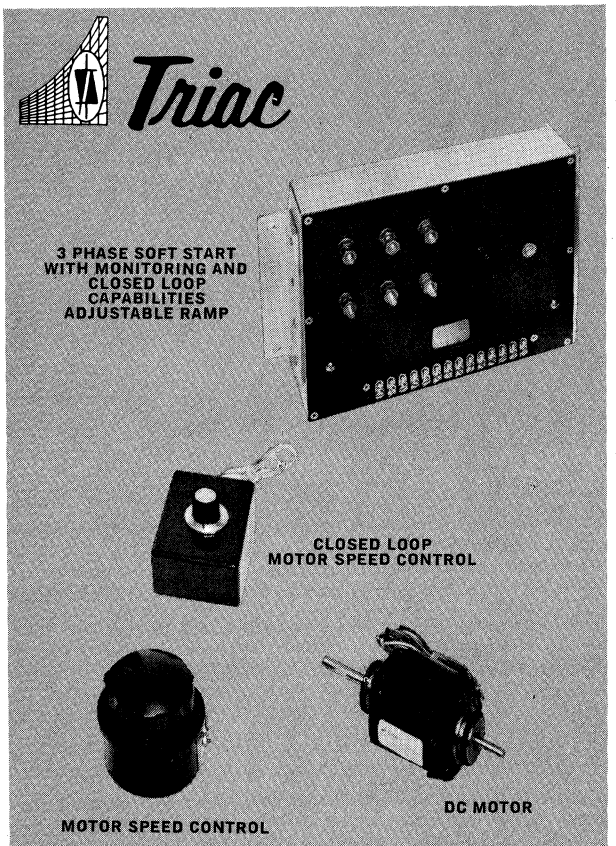


MOTOR CONTROL...SOFT START... PHASE CONTROL & VARIABLE TRANSFORMER... POWER LINE BOOSTER

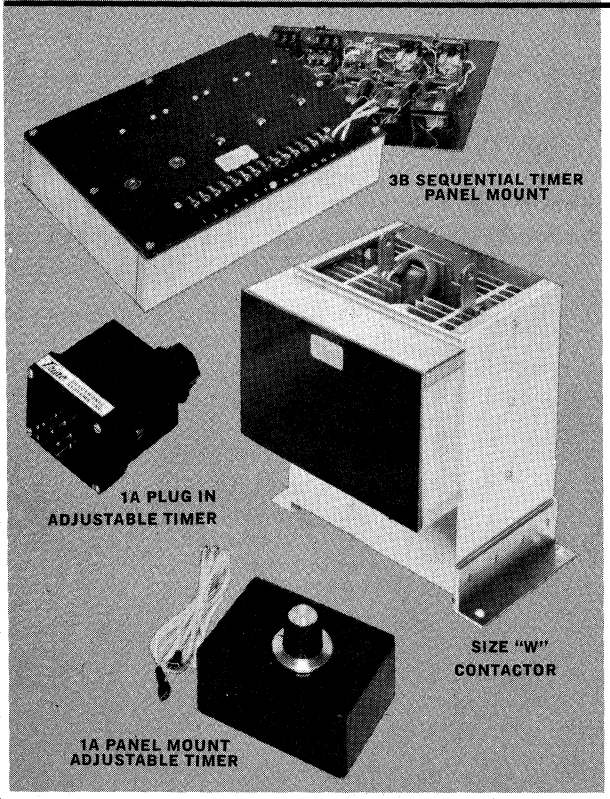
LOW COST, LOW POWER MOTOR CONTROLS for fractional horsepower applications. Triac Electronic Systems volume and diversification of genuine thyristor systems design and manufacturing makes available practical low cost motor speed control open/closed loop, constant speed and/or torque. The technology is available today to provide sophisticated functions not available yesterday because of cost or state of the art.

HIGH POWER MOTOR CONTROLS are available to 400 H.P. one, two or three phase. Engineered closed loop constant speed systems featuring advanced state of the art. Genuine thyristor technology is the heart of all modern electronic motor speed design. Systems contain surge inhibitors, transient suppressors and power factor correctors, providing accurate, economical control in the most difficult applications.

SOFT START. The gradual, automatic application of line voltage to mechanical or electrical "inertia" application in such a manner as to limit inrush and provide gradual starting. Triac provides a variety of soft starts utilizing genuine thyristors for motor control, transformer switching, incandescent networks, etc. Also available are economical up and down "ramps" for lighting aesthetics and psychodelics.

PHASE CONTROL & VARIABLE TRANSFORMER. Equivalent to auto-transformer application except that size, weight, cost and versatility are superior. Manual and automatic systems featuring genuine thyristors are available from ¼ to 1,000 amps at all voltages.

POWER LINE BOOSTER. Transformer and genuine thyristors provide automatic line voltage corrections in case of "brown outs". Particularly suited for sensitive power equipment such as computers, air conditioners, medical electronics, machine tools, etc. Voltage deficits automatically or manually brought to full level thus insuring continued operation regardless of "cut back" by the utility. These line boosters are manufactured in a variety of sizes for single or three phase. They are extremely reliable and relatively inexpensive.



WELDING POWER CONTROLS... SYNCHRONOUS & NON SYNCHRONOUS

Resistance welding control combinations with built in heat control, automatic power factor correction. Modular industrially proven design. Genuine thyristor contactors. Soft start techniques. Triac Electronic Systems' extensive involvement in the science and volume production of high current AC switching systems enables it to offer sophisticated electronics to the welding industry at a dramatically lower cost than specialized suppliers. In many instances prices are no higher than obsolete mechanical contactors and lower than ignitrons. Thyristor contactors are available from 8 to 300 KVA at all voltages. Three phase conversion systems are also available.

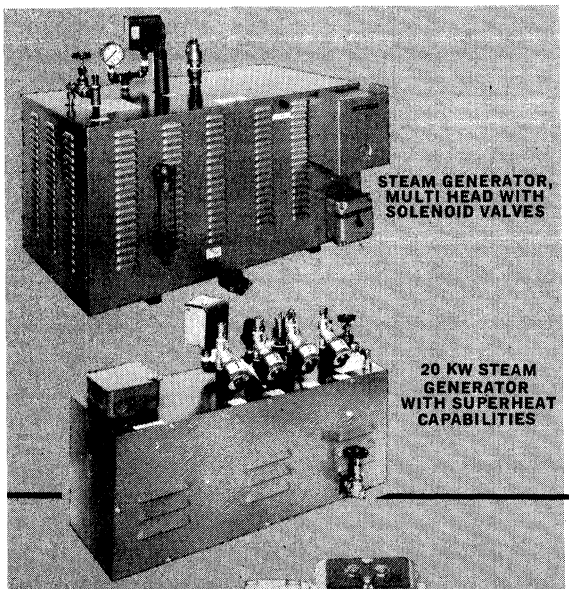
These contactors are essentially equivalent to the broad line of Triac HIGH POWER THYRISTOR SYSTEMS.

WELDING CONTROL TIMERS. Triac Electronic Systems manufactures a comprehensive line of specialized timers for the resistance welding industry. Sophisticated technology plus volume applications to all industries enables Triac to offer a vastly superior timer at low cost. Every timer is protected from inductive "kicks" caused by transformer transients and is reliable and accurate. Timers are all solid state or in combination with mechanical relays. Types include, 1A, 2A, 2B, 3A, 3B, Butt, 5 Pot, etc. These timers are available as modular plug in, panel or combination packages. In addition, custom designs are readily produced. Also available are synchronous and precision types.

Triac Electronic Systems provides substantially more per dollar compared to specialized manufacturers who supply the resistance welding industry exclusively. The rapid pace of development and obsolescence, the immensity of the electronics industry and the high cost of development make diversification and volume imperative for value and reliability. Triac Electronic covers the full spectrum of thyristor electronics and passes the benefit to you.

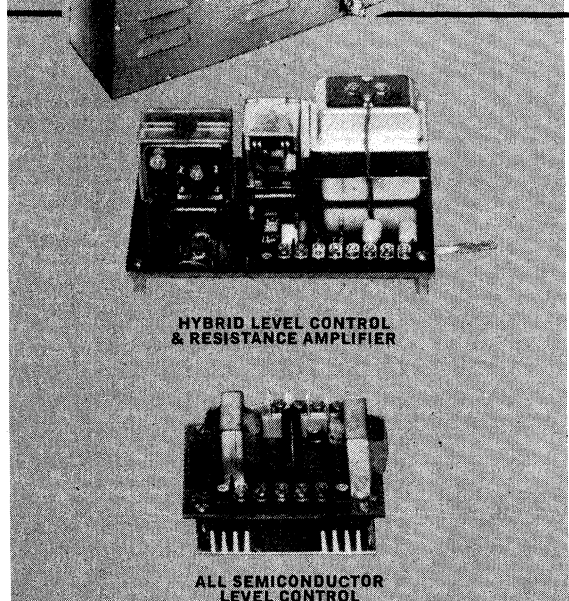
TRIAC ELECTRONIC SYSTEMS
INCORPORATED

PAN-AM BUILDING, SUITE 303 EAST • 200-B PARK AVE.
NEW YORK, N. Y. 10017 • TEL.: 212—687-0620



BOILERS — STEAM GENERATORS

Triac Electronic Systems manufactures several electronically controlled small boilers with a variety of steam pressure and temperature capabilities. The use of thyristors to control boiler water level, on/off switching and proportional steam control from electric power represents advanced state of the art resulting in economy of operation, versatility and high safety margins. In addition, an important advantage of the sophisticated low cost electronic system is the ability to control superheated steam and the precision flow of steam where steam itself is used as an energy or control source. The fluid and high energy nature of steam properly controlled and implemented is in natural simbiosis with thyristor electronics. Many frontier applications are available to this combination which neither energy system could fulfill alone. Triac is involved with many of these systems and invites you to explore their possibilities.

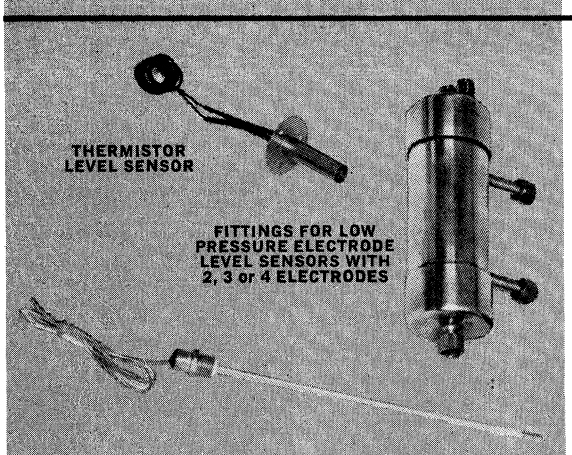


BOILER LEVEL — RESISTANCE LIQUID LEVEL CONTROL — RESISTANCE SENSING AMPLIFIER

Genuine thyristors make ideal components for boiler water level control, liquid level control and resistance sensing amplification. High reliability, low cost, amplification factor and direct "in line" capability make these devices the almost perfect component to control liquid level. The absence of water or other liquid resistance denotes low level and can trigger the thyristor to turn on pump or solenoid directly, sound alarm or give visual display. Triac can provide a number of low cost level systems, complete with stainless steel or platinized titanium sensors for almost any fluid. For non-electrically conducting liquids or for gasses, Triac can supply thermistor controlled level systems. Operation is based upon a calibrated energy supply to the immersed thermistor sensor and the ability of the specific heat of the media level to influence the equillibrium of the thermistor. Ordinarily involved circuitry is required, but with genuine thyristors this becomes simple and inexpensive. Level systems can be provided with offset or time interval differential. Interface with other sub-systems such as flame or smoke control is easy. Alarm, safety or manual reset are standard. Reliability and low cost are well indicated.

In addition, these controls make inexpensive resistance sensing amplifiers. When the external circuit resistance exceeds the set point a signal triggers the thyristor on or off and control is achieved. Sensors may be photoelectric, thermistor, magnistor, etc. Resistance ranges in Ohms, are: 10, 100, 1000, 100,000, and 1,000,000.

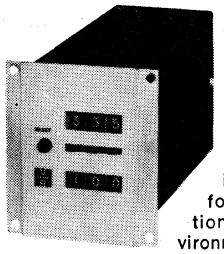
Triac welcomes your inquiry and is ready to assist you.



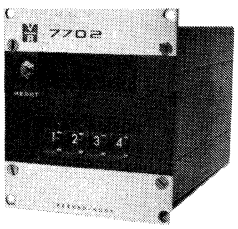
LIQUID LEVEL ELECTRODE SENSORS PROBE ASSEMBLIES — FITTINGS

Triac manufactures a wide line of liquid level sensors and probe electrode assemblies to accommodate corrosive and non-corrosive liquids for a variety of temperatures and pressures. Electrodes are available with pressure tight assemblies for vertical suspension from top positions or with pressure tight fittings for side mountings. Such fittings can contain one to four electrodes of specified length. Housing is made from cast iron, aluminum or stainless steel. Bottom blowdown and gauge glass fittings are also supplied. Electrodes are metallic rods of non magnetic stainless steel, platinized titanium, or platinum wire. These rods are fitted with double layers of Teflon (Du Pont registered T.M.) sleeving for maximum reliability and performance. For information on low cost, quality liquid level sensors, etc. contact Triac.

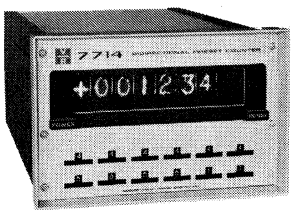
When it comes to counting, recording or controlling, come to Veeder-Root



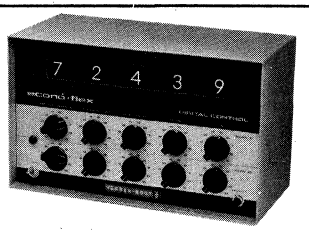
The 7102 Digi-Flex* Predetermining Counter: Electrically driven. Off-the-shelf. Both versatile and economical. Ideally suited for control applications in industrial environments.



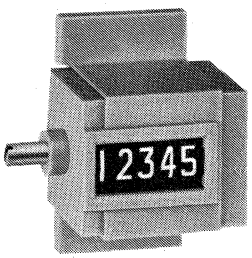
The 7702
Predetermining and Control Counter
Only about 4 x 4 x 7 inches small, but does a big job. Contains predetermining counter which compares input signal with preset number. When coincidence is reached, output circuit is activated to perform control functions. Can replace mechanical, electromechanical devices in machine tool, weaving, knitting, paper, chemical, pharmaceutical applications.



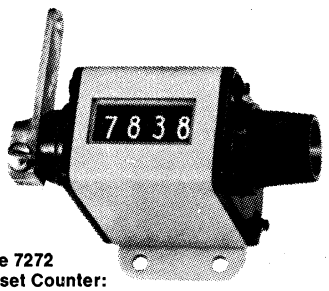
The 7714
Bidirectional Preset Counter:
Predetermining digital counter for bidirectional control applications. Wide flexibility for custom requirements through selection of multiple control levels. Offers a variety of input and output options. Rugged.



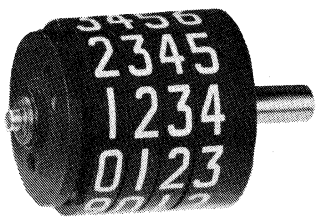
The 7122 Econo-Flex Predetermining Counter: High speed—up to 10,000 CPS—counting and controlling instrument. Has reliability of integrated circuitry. Low cost. Accepts input signals from photo heads, contact closures, switching devices. Ideal for all types of high speed cut-to-length weighing and blending applications.



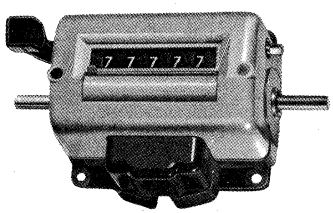
The 7458-59-60-61
Small Square Case Counter:
Compact with high visibility figures. Accurate, dependable. Low torque. Long life. Tamper-proof, virtually dustproof. Choice of drives and mounts. For vending machines, check writers, business & office equipment.



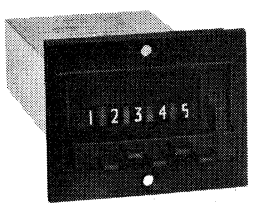
The 7272
Reset Counter:
For indoor and outdoor use where small size, accuracy, and legible figures are essential. Features acetal resin components and a corrosion-resistant case.



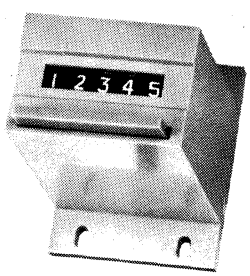
The 7179
Precision Internal Pinion Counter:
Miniature size. Low torque over wide temperature range. High speed. Great impact resistance. Long life. Highly reliable; no wheel-to-wheel contact. Ideal for limited space application—altimeters, engine instrumentation, common decimal counting, etc.



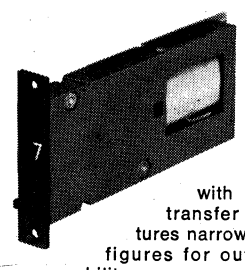
The 7283
Predetermining Counter:
Rapid reset counter with positive electrical knock-off. Features a positive interlock and base or panel mount. Recommended for industrial precision control.



The 7441 High Performance Predetermining Counter:
Designed for lowest cost, high reliability. Compact. New programmed reset design ensures reset reliability. Unique interlock prevents accidental changes to preset number. For automatic test equipment, packaging machinery, process control.



The 7438 Reset Electric Counter:
Offers the convenience of push-bar reset with the economy of rotary reset. Simple, one piece frame construction assures reliability. Ideal for test equipment, control equipment and office machines. Available with 5 figures and a variety of mountings. AC or DC.



The 1969 Veeder Decade* Totalizer:
Single wheel, electric counter with electric readout, transfer and reset. Features narrow width with large figures for outstanding readability.

*Trademark of Veeder-Root

Veeder-Root always comes through with the finest equipment you can buy.

In fact, our line of counters is so complete, it'll solve any application problems you may have.

For further information on our full line of mechanical, electrical and electronic totalizers and controls, write to: Veeder-Root, Hartford, Connecticut 06102.

VEEDER-ROOT

Digital Systems Division

A VEEDER INDUSTRIES COMPANY

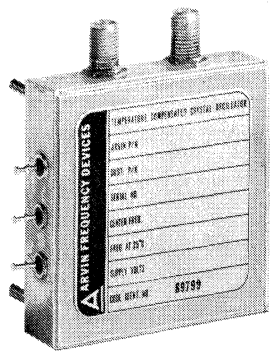
Veeder-Root World-Wide: Argentina: Buenos Aires • Australia: Melbourne • Brazil: Sao Paulo
England: Croydon, Surrey • Scotland: Dundee • West Germany: Neuhausen/Filder • Canada: Toronto

ARVIN FREQUENCY DEVICES

complete frequency management capability

ARVIN TCXO

Arvin temperature compensated crystal oscillators provide precise frequency management without the use of ovens, permitting small size, light weight, instant warm-up, and low power drain. Sine, pulse and square wave outputs are available. Both TTL and COSMOS are available. Units generating more than one frequency can be provided. All circuit values are computer optimized. Following are typical specifications. Let us know your exact requirements.



TCXO

Some units available off-the-shelf.

Example: 1 MHz $\pm 5 \times 10^{-7}$ $-40°$C to $+75°$C @ $150 in single quantities.

Example: 2 to 10 MHz $\pm 5 \times 10^{-6}$ $-55°$C to $+85°$C @ $75 in single quantities.

Ultra Stable TCXO's

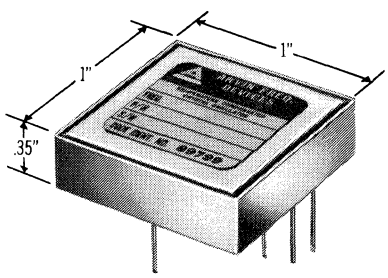
Frequency Range . . . 1 Hz to 200 MHz

Frequency Stability . . . . . 5×10^{-5} to 1×10^{-7} over temperature range as wide as $-55°$ to $+85°$C.

Dimensions as small as 2″ × 2″ × .500.

ARVIN TC/VCXO

Arvin TC/VCXO's have all the advantages of Arvin TCXO's combined with a unique voltage control capability. This gives Arvin TC/VCXO's even greater flexibility without the need for external compensating circuitry or added power. Units generating one or more frequencies can be provided with sine, pulse and square wave outputs. Both TTL and COSMOS are available. Following are typical specifications for Arvin TC/VCXO's. Send us your exact requirements.



Frequency Range . . . . . to 200 MHz

Frequency Deviation . . to ± 2000 PPM

Deviation Rate . . . . . DC −15 KHz

Linearity . . . . . to ± 1% of best straight line

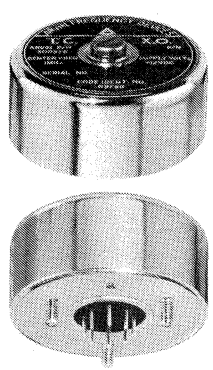
Input Voltage . . . . . ± 5 to ± 50 VDC

Packaging . . . . . MIL, NASA, or commercial

Frequency Stability . . . . . to ± 1 PPM depending on frequency and temperature

OSCILLATOR R&D

Arvin Frequency Devices is equipped to design, develop, and manufacture in quantity a variety of oscillators and frequency control equipment. Our specialty is high reliability TCXO, VCXO, TC/VCXO devices and low frequency crystal oscillators for miniaturized communications applications. Matched TC/VCXO units are available for phase-locked loop circuits. We have built TCXO's for satellite, missile, airborne, and portable ground equipment applications. Arvin Frequency Devices provide precise frequency management in the smallest possible package, with low power drain, and stabilities as high as 1×10^{-7} in a range to 200 MHz. Let us help solve your frequency management problems. We welcome research and development contracts. Call us early in the design stage.



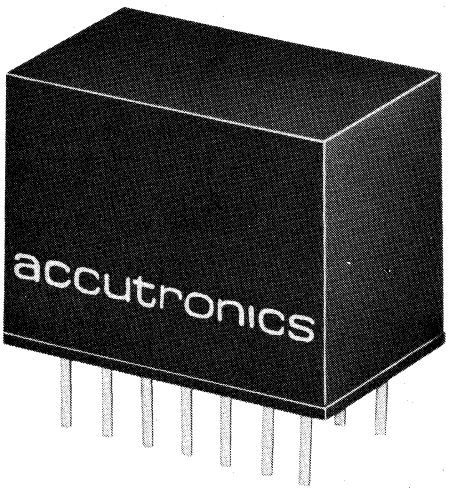
FOR ADDITIONAL INFORMATION PHONE OR WRITE:

ARVIN FREQUENCY DEVICES
ELECTRONIC SYSTEMS DIV., ARVIN INDUSTRIES, INC.

15th STREET PLANT • COLUMBUS, INDIANA 47201 • PHONE: (812) 379-3842 • TWX: (810) 352-1272

DUAL IN-LINE
Series 80

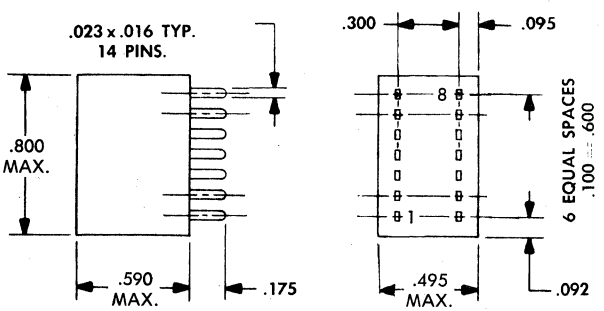
375KHz to 30MHz



MODEL PK02-29J

- **375KHz to 30MHz**
- **DIP PACKAGE**
- **TTL LOGIC**
- **SMALL SIZE**

Series 80 Crystal Oscillator is designed for applications where limited space is available. The unit is packaged in a .800 x .590 x .495 plastic case which contains the oscillator circuit, buffer amplifier, and hermetically sealed crystal. The dual-in-line mounting configuration is standard .100 x .300 grid pattern. Typical applications are system clocks, time reference, data transmission, and marker generators.



Pin Functions
Pin #1 & 7 — Common
#8 — Output
#14 — +5vdc Supply
Remainder N/C

TYPICAL SPECIFICATIONS FOR SERIES 80 CRYSTAL OSCILLATOR

SUPPLY VOLTAGE: 5 ± VDC ±5%

FREQUENCY AND POWER REQUIREMENT:

375KHz to 750KHz	300MW
750KHz to 1.5KHz	250MW
1.5KHz to 6MHz	150MW
6MHz to 30MHz	100MW

OUTPUT:

Waveform: Square
Symmetry Ratio:
50/50 ±1% to 6MHz
50/50 ±20% 6MHz to 30MHz
Logic: "0" Level = .4V Max.
"1" Level = 2.4V Min.
Load Current: I_{Source} = 400 μa Max.
Sink Current: I_{Sink} = 16 ma Max.
Rise Time: < 50Nsec.
Fanout: 10 SN7400 TTL Loads

STABILITY:

Temperature vs. Drift: ±20 PPM 0°C to 50°C
Other temperature ranges available

accutronics
A HAMMOND CORPORATION COMPANY
628 North St. Geneva, Illinois
Area Code 312 232-2600
TWX: 910-237-1680 CBL: AKUTRONX

MINIATURE OSCILLATOR
Series 110

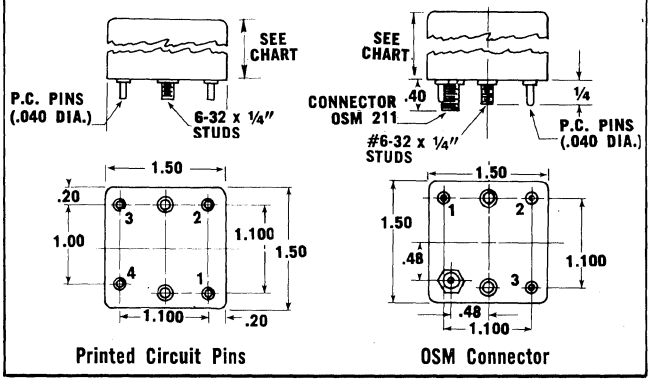
1MHz to 250MHz

FREQUENCY STABILITY

PARAMETER	ORDERING GUIDE			
	CJ	JL	KM	
Temperature Range	−55°C to +75°C	0°C to +60°C	+15°C to +35°C	
Frequency Stability	±0.005%	±0.001%	±0.0005%	

BASE DIMENSIONS

ORDERING GUIDE
1



FREQUENCY, WAVEFORM & HEIGHT

PARAMETER	ORDERING GUIDE			
	2	4	7	
Frequency	1MHz to 60MHz	60MHz to 150MHz	10MHz to 250MHz	
Waveform	Square	Compatible with Hi-Speed Logic	Sine	
Case Height	0.50" PC pins	0.75" PC pins	1.50" OSM Connector	

OUTPUT SPECIFICATIONS

PARAMETER	ORDERING GUIDE		
	28	69	11
Frequency Range	1MHz to 60MHz	60MHz to 150MHz	10MHz to 250MHz
*Supply Voltage	+5VDC ±5%	+5VDC ±5%	+12VDC ±5%
Waveform	Square	Output compatible with Hi-Speed logic. Please specify when ordering.	Sine
Rise Time	<25 NS		———
Fall Time	<15 NS		———
Distortion	———		<10%
Source Voltage	5V peak ±5% from 680Ω 5V peak ±5% from 330Ω >10MHz		———
Sink Voltage	0.0V ±0.3V @ 5MA		———
Output Voltage	———		+10 dbm ±3 db
Load Resistance	TTL or DTL	ECL, MECL or TTL	50Ω resistive
Output Stage	NPN Common Emitter	———	———

TERMINATION

ORDERING GUIDE	
P	L
PRINTED CIRCUIT PINS	OSM CONNECTOR
Pin #1 Plus Supply	Pin #1 Plus Supply
#2 Common	#2 Common
#3 Common	#3 Common
#4 Output	OSM Output

GENERAL SPECIFICATIONS

PARAMETER	FREQUENCY RANGE			
	1MHz to 10MHz	10MHz to 20MHz	20MHz to 60MHz	60MHz to 250MHz
Current Drain	< 50MA	< 30MA	< 30MA	< 60MA
Symmetry	50/50 ±1%	50/50 ±20%	50/50 ±20%	———

* These are standard operating supply voltages and output voltages. Other voltages are available upon request.

FILL IN BLANKS BELOW TO CONSTRUCT YOUR PART NO. Typical No. is CJ 1 2 28 P

When ordering, please specify Series No., Model No. and frequency.

	1			
Frequency Stability CJ, JL or KM	Base Dimensions 1	Frequency Waveform Height 2, 4, or 7	Output Specifications 28, 69 or 11	Terminations P or L

accutronics
A HAMMOND CORPORATION COMPANY
628 North St. Geneva, Illinois
Area Code 312 232-2600
TWX: 910-237-1680 CBL: AKUTRONX

LOW CURRENT DRAIN
Series 162

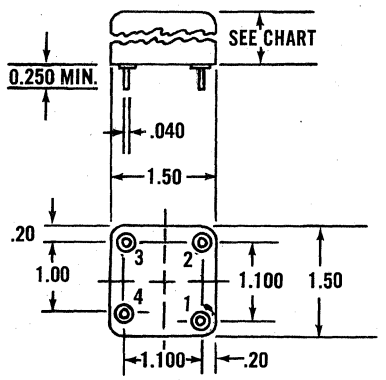
1Hz to 1MHz

FREQUENCY STABILITY

PARAMETER	ORDERING GUIDE			
	CJ	JL	KM	
Temperature Range	−55°C to +75°C	0°C to +60°C	+15°C to +35°C	
Frequency Stability	±0.005%	±0.001%	±0.0005%	

BASE DIMENSIONS

ORDERING GUIDE
1



FREQUENCY, WAVEFORM & HEIGHT

PARAMETER	ORDERING GUIDE			
	3	5	6	
Frequency	1 Hz to 1 MHz	1 Hz to 1 MHz	60 Hz to 1 MHz	
Waveform	Square Output Option 26	Square Output Option 28	Sine Output Option 12	
Case Height	0.625″	1.000″	1.370″	

OUTPUT SPECIFICATIONS

PARAMETER	ORDERING GUIDE		
	26	28	12
Frequency Range	1Hz to 1MHz	1Hz to 1MHz	60Hz to 1MHz
*Supply Voltage	+20VDC ±5%	+5VDC ±5%	+12VDC ±5%
Waveform	Square	Square	Sine
Rise Time	<250NS 25 pfd load	<50NS 10 pfd load	———
Fall Time	<200NS 25 pfd load	<25NS 10 pfd load	———
Distortion	———	———	<5%
Source Voltage	+15V min @ 10 MOS loads	5V peak ±5% from 680Ω	———
Sink Voltage	+0.1V max @ 10 MOS loads	0.0V ±0.3V @ 10MA	———
Output Voltage	———	———	1V RMS ±30%
Load Resistance	MOS Logic	TTL Logic	10KΩ resistive
Symmetry	50/50 ±1%	50/50 ±1%	———
Current Drain	<5MA @ 1Hz	<15MA @ 1Hz	<15MA @ 60Hz

* These are standard operating supply voltages and output voltages. Other voltages are available upon request.

TERMINATION

ORDERING GUIDE
P

PRINTED CIRCUIT PINS

Pin #1 — Plus Supply
#2 — Common
#3 — Common
#4 — Output

GENERAL APPLICATION DATA

- Very Low Current Drain
- Compatible with MOS or TTL Logic
- PC Board Mounting or Chassis
- Excellent Stabilities
- Replaces Tuning Forks Oscillators
- Sine Wave Output
- Crystal Controlled
- Small Size

FILL IN BLANKS BELOW TO CONSTRUCT YOUR PART NO. Typical No. is CJ 1 3 26 P

When ordering, please specify Series No., Model No. and frequency.

Frequency Stability CJ, JL or KM	1 Base Dimensions 1	Frequency Waveform Height 3, 5 or 6	Output Specifications 26, 28 or 12	P Terminations P

accutronics
A HAMMOND CORPORATION COMPANY
628 North St. Geneva, Illinois
Area Code 312 232-2600
TWX: 910-237-1680 CBL: AKUTRONX

HIGH STABILITY OSCILLATOR
Series 165

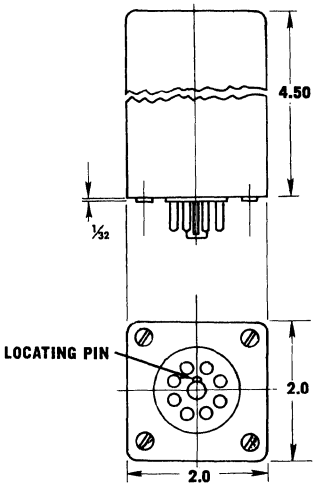
1MHz to 150MHz

FEATURES

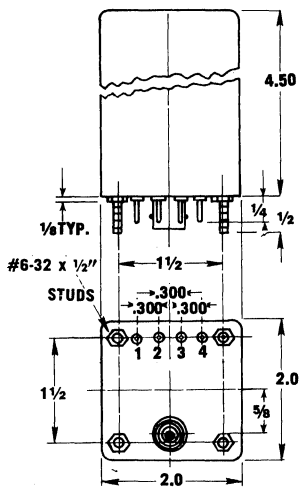
- All Units Operate On Frequency Without Multiplication
- Low Spurious Content
- Excellent Short Term Stability
- Low Harmonic Content
- Logic Compatibility

APPLICATIONS

- Frequency Source For Multiplier Chain
- Telemetry Main Carrier Source
- Integrated Circuit Clock
- Digital Scanning Clock
- Computer Time Base
- Reference Oscillator



Pin #1 — Common OSC
#2 —Plus Supply OSC
#5 — Oven Plus
#6 — Oven Common
#8 — Output



Pin #1 — Plus Supply OSC
#2 — Common OSC
#3 — Common Oven
#4 — Plus Supply Oven
BNC — Output

SPECIFICATIONS

PARAMETER	MODEL			
	JU2013	JT2013	JN2011	JT2011
Frequency Range	1MHz to 20MHz	20MHz to 60MHz	60MHz to 100MHz	100MHz to 150MHz
Frequency Adjust	±5 PPM Min.			
Temperature Range	0°C to +60°C			
*Supply Voltage (OSC)	+12VDC ±2%			
*Supply Voltage (Oven)	+24VDC ±5% or 28VDC ±5% (Specify)			
Waveform	Sine			
Load	50 Ohms Resistive			
Oven Power	15 Watts at turn-on: 6 Watts at 25°C Following 1 Hr. Warmup			
Power Output	0DBM ±1.5DBM	0DBM ±1.5DBM	0DBM ±1.5DBM	0DBM ±1.5DBM
Harmonic Content	−30DB	−30DB	−20DB	−20DB
Spurious Response	−70DB	−60DB	−60DB	−60DB
Current (OSC)	35 Ma	50 Ma	50 Ma	50 Ma
Short Term Stability	$<5x10^{-10}$ Per Sec.	$<1x10^{-9}$ Per Sec.	$<1x10^{-9}$ Per Sec.	$<1x10^{-9}$ Per Sec.
Tolerance	$\pm5x10^{-8}$	$\pm1x10^{-7}$	$\pm5x10^{-7}$	$\pm5x10^{-7}$
Unit Shipped at	$\pm5x10^{-8}$ Per 24 Hrs.	$\pm5x10^{-7}$ Per 24 Hrs.	$\pm1x10^{-7}$ Per 24 Hrs.	$\pm1x10^{-7}$ Per 24 Hrs.
Drift after 200 Hrs. (Typical)	$\pm2x10^{-8}$ Per 24 Hrs.	$\pm5x10^{-8}$ Per 24 Hrs.	$\pm1x10^{-7}$ Per 24 Hrs.	$\pm1x10^{-7}$ Per 24 Hrs.
Stabilization to $\pm5x10^{-7}$ of nom. freq.	35 Min.	45 Min.	45 Min.	45 Min.
Size	2" x 2" x 4½"			
Header add Y	Octal Plug	Octal Plug	N/A	N/A
Header add M	BNC & Solder Pins			

PARAMETER	MODEL	
	JU2028	JT2028
Frequency Range	1MHz to 20MHz	20MHz to 60MHz
Frequency Adjust	±5 PPM Min.	
Temperature Range	0°C to +60°C	
Supply Voltage (OSC)	+12VDC ±2%	
Supply Voltage (Oven)	+24VDC ±5% or 28VDC ±5% (Specify)	
Waveform	Square	
Output Voltage	Compatible TTL Logic Fanout of 10	
Oven Power	15 Watts at turn-on: 6 Watts at 25°C Following 1 Hr. Warmup	
Short Term Stability	$<\pm5x10^{-10}$/Sec.	$<\pm1x10^{-9}$/Sec.
Tolerance	$\pm5x10^{-8}$	$\pm1x10^{-7}$
Unit Shipped at	$\pm5x10^{-8}$/24 Hrs.	$\pm5x10^{-7}$/24 Hrs.
Drift after 200 Hrs. (Typical)	$\pm2x10^{-8}$/24 Hrs.	$\pm5x10^{-8}$/24 Hrs.
Stabilization to $\pm5x10^{-7}$ of nom. freq.	35 Min.	45 Min.
Rise Time	<20 NS	<10 NS
Fall Time	<20 NS	<10 NS
Size	2" x 2" x 4½"	
Header add Y	Octal Plug	
Header add M	BNC & Solder Pins	

* These are standard operating supply voltages and output voltages. Other voltages are available upon request.

ORDERING INFORMATION:

To Order, Specify Model No. (Example JU2028) Header (Y or M) and Frequency.

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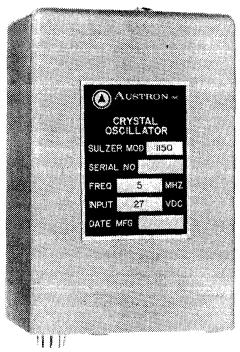
SERIES 1100 CRYSTAL OSCILLATORS
HIGH STABILITY OVEN-CONTROLLED

MODEL 1150

The Model 1150 is a very rugged, high precision, crystal oscillator specifically designed for use in satellite navigation systems or other applications which demand a precise time base frequency reference.

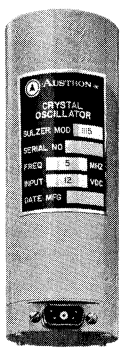
Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	5 X 10^{-11}/day ultimate aging
Input Voltage:	27 VDC ±10%
Input Power:	2.5 watts operating
Size:	2⅜" X 3-3/16" X 5"
Weight:	2 lbs max



MODEL 1115

The Model 1115 is specifically designed for use in undersea equipment or other applications where high stability and minimal power consumption are of prime importance.

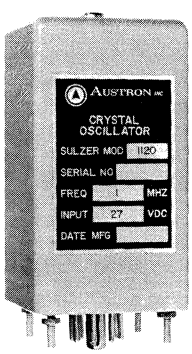
Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12 to 15 VDC ±5%
Input Power:	150 mw @ 25°C (typical)
Size:	2" diameter X 5½" length
Weight:	12 ounces



MODEL 1120

The Model 1120 is a compact, rugged crystal oscillator specifically designed for use in counters, synthesizers and communications equipment.

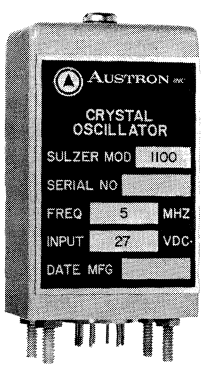
Frequency:	1 MHz, 5 MHz or 10 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12v to 27v DC
Power Consumption:	3 watts operating (typical)
Size:	2¼" X 2⅛" X 4"
Weight:	9 ounces



MODEL 1100

The Model 1100 is high stability crystal oscillator combining precision performance specifications with small size for applications where available space is at a premium.

Frequency:	5 MHz
Output:	1 vrms sine wave
Aging:	1 X 10^{-9}/day ultimate aging
Input Voltage:	12 VDC to 27 VDC
Input Power:	2 watts operating (typical)
Size:	1¼" X 1¾" X 3¼"
Weight:	7 ounces



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If you buy quality

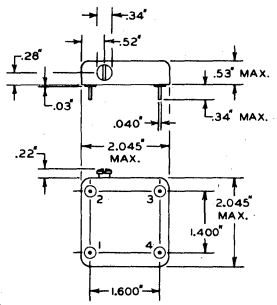
TEMPERATURE COMPENSATED (TCXO) CRYSTAL OSCILLATORS

BLILEY TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS are designed to integrate the characteristics of high quality crystals with temperature compensated circuitry to achieve improved frequency stability without temperature control. Bliley crystals, specially processed for low aging, are used with temperature compensation networks that have been individually adjusted to match the unique crystal characteristics. The complete solid state package operates with minimum current drain and features exceptional reliability.

TCCO-26

STOCK MODELS — FAST DELIVERY			
MODELS	TCCO-26M-5	TCCO-26MA	TCCO-26LA
Frequency	1 MHz	1 MHz	5 MHz
Stability 0°-60°C	±1 PPM	±1 PPM	±1 PPM
Input Voltage	+12 Vdc; 22 Ma	+5 Vdc; 30 Ma	+5 Vdc; 20 Ma
Output Drive	12 Volt TTL'S	5 Volt TTL'S	5 Volt TTL'S

All stock models have output: Logic "one" +2.4V and Logic "Zero" .4V with sinking current 16 ma. Rated Frequency stability is based on a regulated supply within 5% on 12 Volt models and 1% on 5 Volt models.



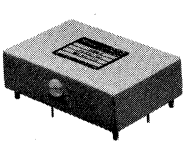
CUSTOM MODELS			
SINE WAVE OUTPUT RANGE 1 MHz - 100 MHz	FREQUENCY STABILITY WITH TEMPERATURE DEVIATION		LOGIC OUTPUT RANGE 200 kHz - 50 MHz
MODELS	STABILITY	TEMP RANGE	MODELS
TCCO-26	$\pm 1 \times 10^{-6}$	0 - 60°C	TCCO-26A
TCCO-26-1	$\pm 5 \times 10^{-7}$	0 - 60°C	TCCO-26A-1
TCCO-26-2	$\pm 2 \times 10^{-6}$	−20 to +70°C	TCCO-26A-2
TCCO-26-3	$\pm 5 \times 10^{-7}$	−20 to +70°C	TCCO-26A-3
TCCO-26-4	$\pm 1 \times 10^{-6}$	−40 to +70°C	TCCO-26A-4
TCCO-26-5	$\pm 3 \times 10^{-6}$	−55 to +70°C	TCCO-26A-5
TCCO-26-6	$\pm 1 \times 10^{-7}$	+20 to +40°C	TCCO-26A-6

All Bliley temperature compensated crystal oscillators listed on this page contain coldweld sealed Bliley crystals to minimize long term aging. Except for the mechanical trim adjustment access screw, the entire oscillator package is hermetically sealed to assure long term reliability. Standard options include choice of operation on either 12 Vdc (±5% regulation) or 5 Vdc (±1% regulation) supply voltage. All standard units are designed for mounting on PC boards. Custom options include special case sizes, mounting brackets and output terminal configurations.

VOLTAGE CONTROLLED (VCXO) CRYSTAL OSCILLATORS

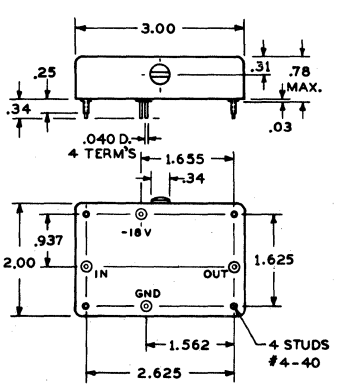
Bliley voltage controlled crystal oscillators combine inherent crystal stability and voltage controlled frequency deviation in a single solid state device. Performance characteristics are realized through careful selection of crystal parameters together with the associated oscillator and reactive components. Center frequencies may be specified in the range 1-50 MHz with performance characteristics as listed in the following table:

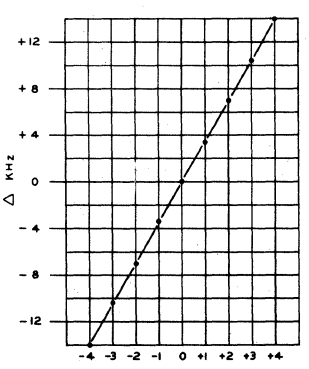
DESIGN PARAMETERS FOR BLILEY VCCO SERIES OSCILLATORS



VCCO-9

FREQUENCY DEVIATION	FREQUENCY STABILITY	TEMPERATURE RANGE
±.01%	±.001% ±.002%	0 to 50°C −20 to +70°C
±.05%	±.002% ±.005%	0 to 50°C −20 to +70°C
±.1%	±.004% ±.008%	0 to 50°C −20 to +70°C
±.2%	±.005% ±.01%	0 to 50°C −20 to +70°C





Typical VCCO oscillator linearity with ±14 kHz deviations at 45 MHz center frequency.

- **Standard design parameters are based on operation with −24 Vdc; 30 ma supply. Other voltages may be specified as a custom option.**
- **Voltage control on standard models is designed for increasing frequency with increasing voltage.**
- **Standard output is sine wave, typical 1.5V rms into 1000 ohms or .5V rms into 50 ohms.**
- **Mechanical trim is provided for center frequency adjustment ±50 ppm minimum at zero voltage.**
- **Typical modulation voltage is ±5V with a modulating input impedance of 50K ohms and modulation rate from DC to 20 kHz.**

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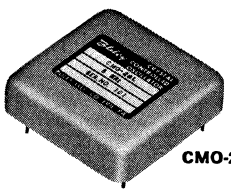
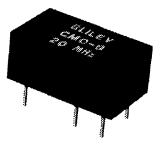
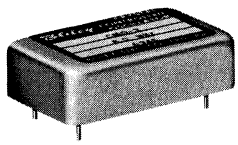
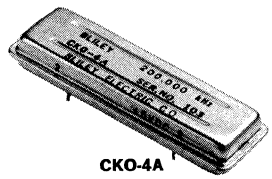
CRYSTAL CLOCK OSCILLATORS

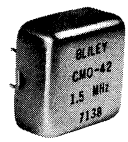
Bliley offers a complete line of crystal clock oscillators backed up by top technology in the field of crystal controlled devices. A wide choice of models is available with either sine wave or logic output to drive TTL circuitry. Selection of the clock oscillator that is best for your application is dictated by the size and performance parameters as well as economic considerations. All models have been designed with primary emphasis on quality.


CMO-26


CMO-8


CMO-3


CKO-4A


CMO-42

SPECIFICATION GUIDELINES

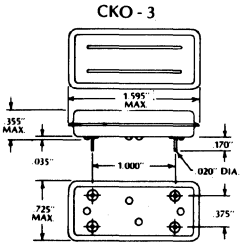
- Model CMO-8 is smallest size and model CMO-32C has lowest price.
- Models CMO-8, CMO-32C and CMO-42 mount in standard 14 pin DIP sockets, or directly on PC boards.
- All standard models designed for operation on +5 Vdc.
- All models are rated for overall frequency tolerance; external trimmer not needed.
- Models CKO-3 and CKO-4 are coldweld sealed. Electrical trim available as custom option.
- Model CMO-26 is hermetically sealed. Electrical or mechanical trim are available as custom option.

MODEL	FREQUENCY RANGE	TEMPERATURE RANGE			OUTPUT
		0° to 50°C	0° to 70°C	–20° to 50°C	
CKO-3	3 MHz – 20 MHz	±.001%		±.002%	Sine Wave
CKO-4A	200 kHz – 20 MHz	±.001%		±.002%	Logic
CMO-32C	2 MHz – 10 MHz	±.005%	±.01%		Logic
CMO-42	200 kHz – 30 MHz	±.005%	±.01%		Logic
CMO-8	1 MHz – 25 MHz	±.005%	±.01%		Logic

MODELS CMO-3 and CMO-31	LOGIC OUTPUT		SINE WAVE OUTPUT
TEMPERATURE RANGE	OVERALL TOLERANCE		OVERALL TOL.
	20 kHz to 50 kHz	50 kHz to 30 MHz	3 MHz to 100 MHz
0° to 50°C	±.003%	±.001%	±.001%
0° to 70°C	±.005%	±.0012%	±.0012%
–20° to 50°C	±.007%	±.0015%	±.0015%
–40° to 70°C	±.012%	±.002%	±.002%

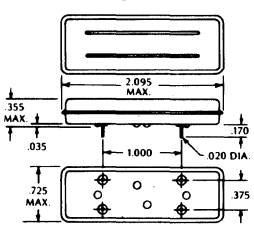
CMO-26 SERIES	LOGIC OUTPUT			SINE WAVE OUTPUT
TEMPERATURE RANGE	OVERALL TOLERANCE			OVERALL TOL.
	50 Hz to 4 kHz	1 kHz to 50 kHz	50 kHz to 25 MHz	800 kHz to 100 MHz
15° to 35°C	±.002%	±.0015%	±.0008%	±.0008%
0° to 50°C	±.004%	±.003%	±.001%	±.001%
0° to 70°C	±.006%	±.005%	±.0012%	±.0012%
–20° to 50°C	±.007%	±.006%	±.0015%	±.0015%
–40° to 70°C	±.01%	±.007%	±.002%	±.002%

CKO - 3



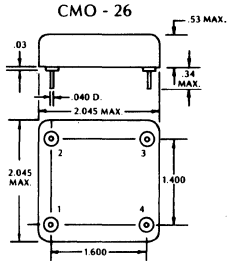
1 - NEG. OSC.
2 - VOLTAGE CONTROL 0 TO +5V
3 - +5V DC
4 - OUTPUT

CKO-4



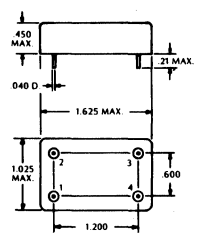
1 - NEG. OSC.
2 - VOLTAGE CONTROL 0 TO +5V
3 - +5V DC
4 - OUTPUT

CMO - 26



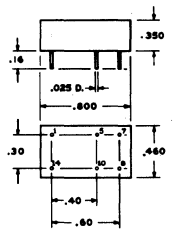
1 - NEG. OSC. & RF GND
2 - VOLTAGE CONTROL OR NC
3 - +5V DC
4 - OUTPUT

CMO - 3



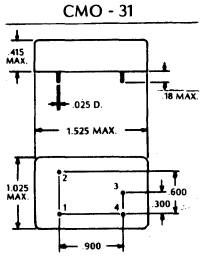
1 - NEG. OSC. & RF GND
2 - N.C.
3 - +5V DC
4 - OUTPUT

CMO - 8



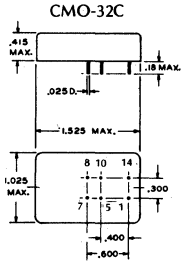
1, 5, 10 - N.C.
7 - GROUND
8 - OUTPUT
14 - +5V DC

CMO - 31



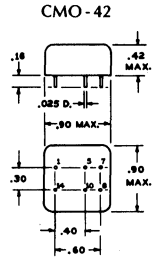
1 - +5V DC
2 - COMMON
3 - COMP. OUTPUT (IF SPECIFIED)
4 - OUTPUT

CMO-32C



1, 5, 10 - N.C.
7 - COMMON
8 - OUTPUT
14 - +5V DC

CMO - 42



1, 5, 10 - N.C.
7 - GROUND
8 - OUTPUT
14 - +5V DC

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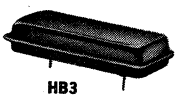
CRYSTALS

Coldweld Sealed Crystal Holders for High Reliability

This group of crystal holders is hermetically sealed by a coldweld process, without heat or flux, to minimize contamination. Crystal units supplied in these enclosures have improved aging and reliability. All units are custom built to your specifications. Data sheets for each type are available on request.

HB2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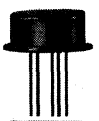
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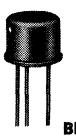

BK3

BK2

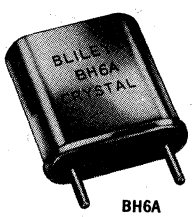
BA6

COLDWELD SERIES

BLILEY HOLDER	HB2	HB3	BK2	BK3	BK5	BA2	BA4	BA6	BA9
FREQUENCY RANGE	0.2-100 MHz	2.5-250 kHz	1-15 MHz	8-150 MHz	2-30 MHz	3-150 MHz	2-150 MHz	0.2-100 MHz	2-250 kHz
DIMENSIONAL DRAWING	8	9	10	11	12	13	14	15	16

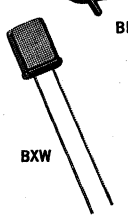
General Communication and Mil-Type Crystal Holders

Bliley offers a complete selection of crystal units in Mil-type holders and commercial variations such as wire leads, mounting brackets and ruggedized models. For quotation, choose the basic holder style required, indicate any special variations and advise performance characteristics for complete crystal unit.



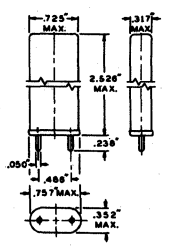
BH6A

BH9A


BXW

GENERAL COMMUNICATIONS AND MIL-TYPE CRYSTAL HOLDERS

BLILEY HOLDER	MIL HOLDER	FREQUENCY RANGE	DIMENSIONAL DRAWING
BH9T	—	1-2 kHz	1
BH9A	HC-13/U	2-250 kHz	2
BH91A	—	2-250 kHz	2
BH9W	HC-34/U	2-250 kHz	2
BH120	—	100-250 kHz	3
BH120W	—	100-250 kHz	3
BH6A	HC-6/U	0.2-150 MHz	4
BH61A	HC-17/U	0.2-150 MHz	4
BH6W	HC-33/U	0.2-150 MHz	4
BH4	HC-32/U	2-150 MHz	5
BH4W	—	2-150 MHz	5
BK2W	HC-40/U	1-15 MHz	10
BK3	HC-35/U	8-150 MHz	11
BK5W	HC-37/U	2-30 MHz	12
BXW	HC-18/U	3-150 MHz	6
BXP	HC-25/U	3-150 MHz	6
B27	HC-27/U	1-30 MHz	7
HB2	HC-39/U	0.2-100 MHz	8
HB3	HC-41/U	2.5-250 kHz	9
BA2	HC-42/U	3-150 MHz	13
BA6	HC-36/U	0.2-100 MHz	15

1


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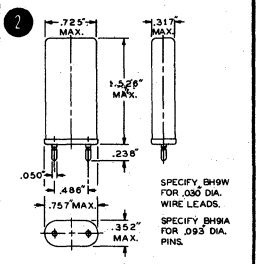

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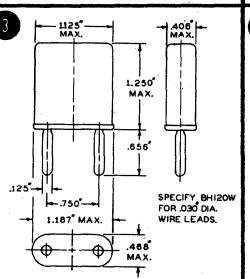

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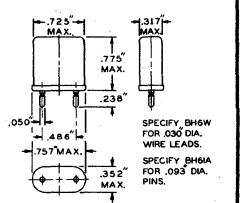

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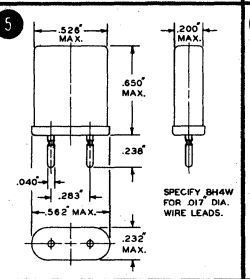

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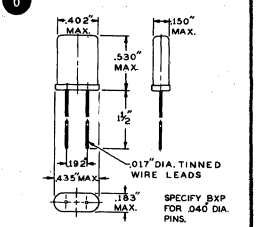

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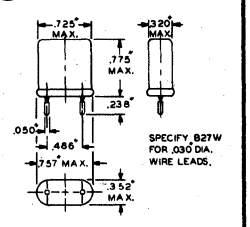

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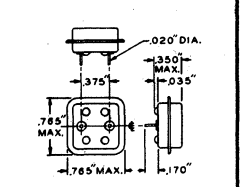

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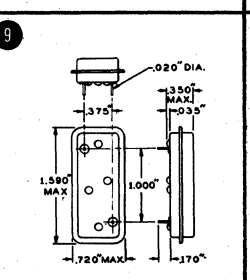

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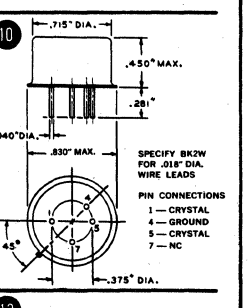

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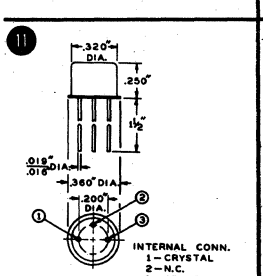

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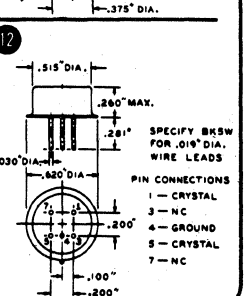

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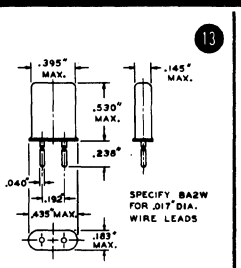
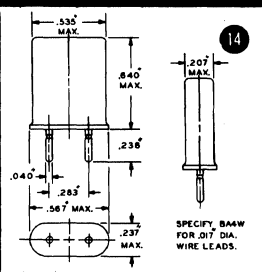
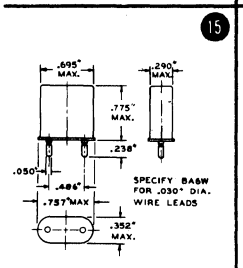
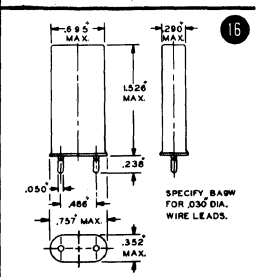
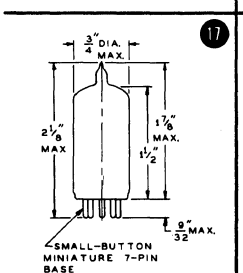
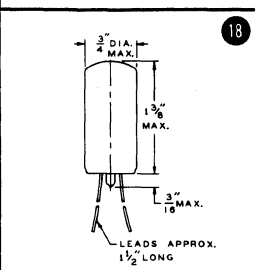


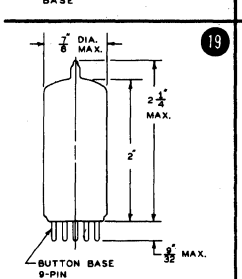


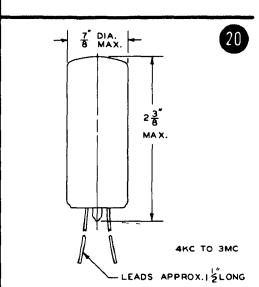


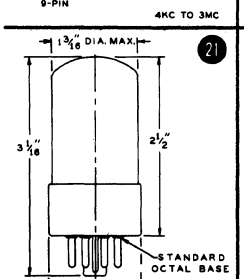


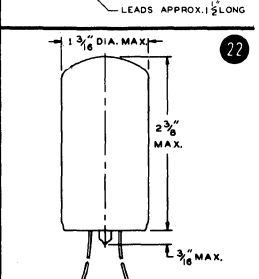


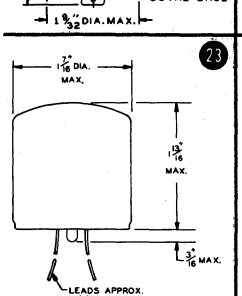


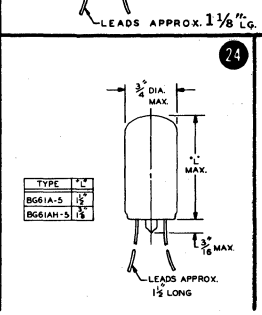


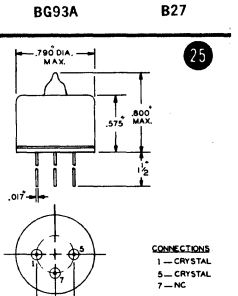




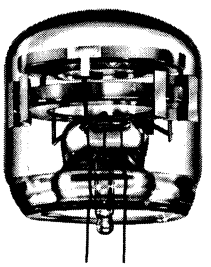


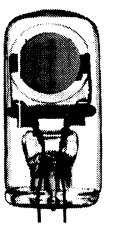






Ultra High Stability Glass Units


BG11AH-5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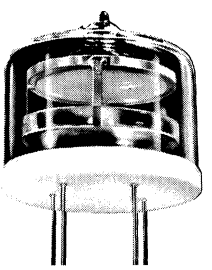
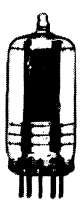

BG61AH-5S

This is an outstanding group of crystal units incorporating the advanced technology and craftsmanship that has made Bliley famous for quality without compromise. Exceptionally low aging and high Q characteristics provide precision reference for synthesizers and systems clocks. Complete data available in special bulletins supplied on request.

ULTRA HIGH STABILITY GLASS SEALED CRYSTAL UNITS

BLILEY TYPE	FREQUENCY RANGE	MODE	Q	AGING	DIMENSIONAL DRAWING
BG61A-5	5 MHz	Fifth	2.5×10^6	2×10^{-9}/wk.	24
BG61AH-5	5 MHz	Fifth	2.5×10^6	2×10^{-9}/wk.	24
BG61AH-5S	5 MHz	Fifth	2.5×10^6	7×10^{-10}/wk.	25
BG11AH-5	2.5 MHz	Fifth	4.5×10^6	5×10^{-10}/wk.	23
BG61AH-3S	4-5 MHz	Third	2×10^6	2×10^{-9}/wk.	25
B27	5 MHz	Third	1.8×10^6	2×10^{-8}/wk.	7
B27	10 MHz	Third	1.5×10^6	2×10^{-8}/wk.	7
BG93A	1 MHz	Fund.	1.5×10^6	1×10^{-8}/wk.	22

Glass Sealed Crystal Holders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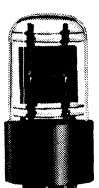
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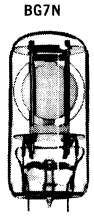
BG93A

B27

Vacuum sealed crystals in this group of holders exhibit superior aging characteristics and long term reliability. Ideal for use in high stability crystal and oven combinations. Data sheets supplied on request.

GLASS SEALED CRYSTAL HOLDERS

BLILEY HOLDER	FREQUENCY RANGE	DIMENSIONAL DRAWING
B27	2-30 MHz	7
BG6A	3-100 MHz	17
BG61A	3-100 MHz	18
BG7	4-3000 kHz	19
BG72A	4-3000 kHz	20
BG9D	90-160 kHz	21
BG9A	1-5 MHz	21
BG93D	90-160 kHz	22
BG93A	1-5 MHz	22

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CRYSTAL FILTERS

BLILEY CRYSTAL FILTERS are custom engineered devices that may be supplied with a wide variety of characteristics over the frequency range in which quartz crystal resonators can be produced. With over forty years of experience in the design and manufacture of quartz crystal resonators, Bliley offers a unique combination of crystal technology and filter design capability for your custom applications.

A general guide for determination of bandwidth limits is presented in Table 1. The chart on Page 9 of Bulletin 529K provides greater detail for various segments of the frequency range. Selectivity (the ratio of 60 db bandwidth to 6 db bandwidth) is generally a compromise between desired performance and economics. Typical selectivity is 2, with requirements of 1.5 not uncommon. Passband ripple, for narrow band filters, is normally 0.3 db with 1 db maximum over the temperature range −55° to +90°C. Wide band filters typically exhibit 0.5 db ripple and very wide passbands may exhibit 2 db ripple at temperature extremes.

TABLE 1 Range kHz	Bandwidth % at 6 db Min.	Max.
100-250	.05	6
200-400	.04	5
300-600	.035	5
1000-5000	.01	2
5000-20000	.02	2
20000-30000	.03	1

The following listing presents a sample of typical Bliley filters showing performance characteristics that have been established. Our design range covers Butterworth, Gaussian (linear phase), Chebyshev, band reject, and comb sets including contiguous comb sets.

TABLE 2 Type No.	Center Frequency	Bandwidth (6 db)	Bandwidth (60 db)	Maximum Insertion Loss	Nominal Impedance (ohms)	Case Size L x W x H (in.)
BFN-0018B21	18.75 kHz	20 Hz	250 Hz	3 db	27 k	3½ x 1 17/32 x 1 5/16
BFN-0060B21	60 kHz	15 Hz	200 Hz	6 db	1 k	2 x 2 x 3 1/16
BFN-0100B31	100 kHz	500 Hz	1.5 kHz	6 db	27 k	4 x 1 3/8 x 2 21/32
BFN-0100B23	100 kHz	3 kHz	7 kHz	3 db	680	4 x 1 3/8 x 2 21/32
BFN-0112B21	112 kHz	5.5 kHz	12 kHz	3 db	10 k	4 x 1 3/8 x 2 21/32
BFN-0200B32	200 kHz	100 Hz	400 Hz	3 db	8.2 k	2 27/64 x 1 47/64 x 1 1/16
BFN-0330B33	330 kHz	250 Hz	1 kHz	3 db	6 k	1 1/16 x 1 25/64 x 1 1/4
BFN-0500B41	500 kHz	300 Hz	1.2 kHz	3 db	4 k	2 3/8 x 1 x 1 1/4
BFN-2000B21	2000 kHz	100 Hz	1000 Hz	3 db	1.5 k	2 3/8 x 1 x 1 1/4
BFN-2000B22	2000 kHz	4 kHz	16 kHz	3 db	50	2 3/8 x 1 x 1 1/4
BFN-2215B28	2215 kHz	250 Hz (3 db)	1 kHz	3 db	4 k	2 5/16 x 1 5/16 x 1 47/64
BFN-2215B27	2215 kHz	2.5 kHz (3 db)	10 kHz	3 db	4 k	2 5/16 x 1 5/16 x 1 47/64
BFN-2400B42	2400 kHz	4.4 kHz (3 db)	18 kHz	3 db	2 k	2 3/8 x 1 x 1 1/4
BFN-2500B36	2500 kHz	5 kHz (3 db)	20 kHz	3 db	2 k	2 5/16 x 1 5/16 x 1 5/16
BFN-3000B14	3000 kHz	3 kHz	12 kHz	3 db	4.7 k	2 3/8 x 1 x 1 1/4
BFN-3000B47	3000 kHz	3 kHz (3 db)	6 kHz	6 db	2 k	2 5/16 x 1 5/16 x 1 1/8
BFN-4000B21	4000 kHz	5 kHz (3 db)	20 kHz	3 db	50	2 3/8 x 1 x 1 1/4
BFN-5000B50	5000 kHz	500 Hz	2500 Hz (40 db)	3 db	1.6 k	2 27/64 x 1 47/64 x 1 1/16
BFN-5000B16	5000 kHz	3.5 kHz	12 kHz	3 db	1.6 k	2 3/8 x 1 x 1 1/4
BFN-5000B23	5000 kHz	5 kHz (3 db)	20 kHz	4 db	50	2 3/8 x 1 x 1 1/4
BFN-5000B22	5000 kHz	10 kHz	40 kHz	3 db	1.6 k	2 5/16 x 1 5/16 x 1 47/64
BFN-5000B53	5 MHz	80 kHz	175 kHz	10 db	100	2 3/8 x 1 x 1 1/32
BFN-7000B22	7000 kHz	8 kHz	50 kHz	6 db	500	2 3/8 x 1 x 1 1/4
BFN-9000B22	9000 kHz	1 kHz	10 kHz	3 db	1 k	2 3/8 x 1 x 1
BFN-9000B13	9000 kHz	3 kHz	12 kHz	3 db	600	2 3/8 x 1 x 1
BFN-11B53	10.00 MHz	1 kHz	2 kHz	3 db	220	2 3/8 x 1 x 1
BFN-11B36	10.01 MHz	8 kHz	20 kHz	3 db	50	2 3/8 x 1 x 1
BFN-11B8	10.7 MHz	4.2 kHz	10 kHz	3 db	400	2 3/8 x 1 x 1
BFN-11B23	10.7 MHz	13 kHz	30 kHz (80 db)	3 db	1 k	2 3/8 x 1 x 1 1/32
BFN-11B21	10.7 MHz	15 kHz	32 kHz	3 db	1 k	2 3/8 x 1 x 1 1/32
BFN-11B22	10.7 MHz	30 kHz	60 kHz	3 db	2 k	2 3/8 x 1 x 1 1/32
BFN-11B41	10.7 MHz	40 kHz	80 kHz	5 db	1 k	2 3/8 x 1 x 1
BFN-11B60	10.7 MHz	90 kHz	220 kHz	3 db	3.3 k	2 5/16 x 1 5/16 x 1
BFN-11B61	10.7 MHz	210 kHz	450 kHz	10 db	50	2 3/8 x 1 x 1 1/32
BFN-11B51	11.00 MHz	3 kHz	10 kHz	3 db	180	2 3/8 x 1 x 1
BFN-11B34	11.5 MHz	37.5 kHz	85 kHz	3 db	50	2 3/8 x 1 x 1
BFN-11B35	11.5 MHz	37.5 kHz	200 kHz (402db)	3 db	50	2 3/8 x 1 x 1
BFN-12B21	12.00 MHz	41 kHz	82 kHz	3 db	1.8 k	2 3/8 x 1 x 1
BFN-13B1	13 MHz	15 kHz	30 kHz	3 db	680	2 3/8 x 1 x 1
BFN-13B2	13 MHz	30 kHz	60 kHz	3 db	1.5 k	2 3/8 x 1 x 1
BFN-15B21	15.00 MHz	1.1 kHz	10 kHz	3 db	50	2 3/8 x 1 x 1
BFN-18B21	18.00 MHz	20 kHz	50 kHz	3 db	50	2 3/8 x 1 x 1
BFN-20B21	20 MHz	60 kHz	200 kHz	3 db	1 k	2 3/8 x 1 x 1 1/32
BFN-20B23	20 MHz	210 kHz	500 kHz	4 db	3 k	2 5/16 x 1 5/16 x 1
BFN-21B24	21.4 MHz	30 kHz	75 kHz	3 db	1.3 k	2 3/8 x 1 x 1
BFN-30B21	30 MHz	45 kHz	85 kHz	3 db	1 k	2 3/8 x 1 x 1

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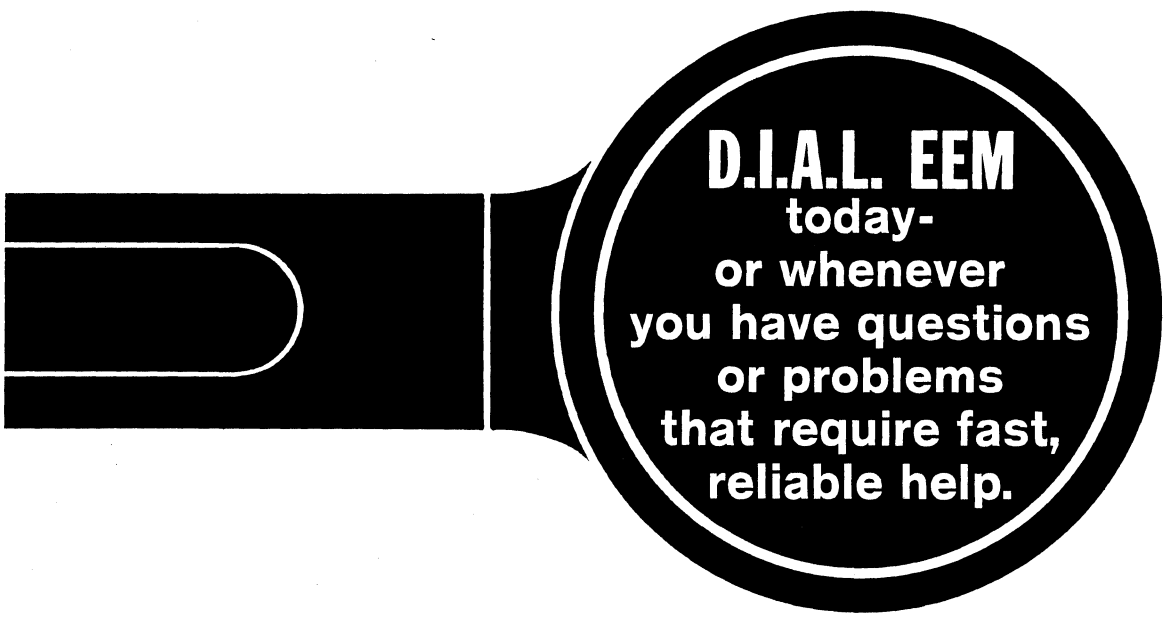

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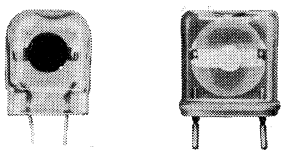
BULOVA® QUARTZ CRYSTALS

- AT • CT • DT • +5° (E and H Elements) GT
- MT • NT • PT (XY¹ Flex.) • JT • SL
- Military Types • General Communications • Precision SSB
- Coldweld • Glass Sealed • Glass Bulb • Metal Holders
- Military crystals meet latest MIL-C-3098 specifications
- Special shock and vibration mounts available



HIGH PRECISION GLASS-ENCAPSULATED CRYSTALS

Covering a frequency range of 5,000 Hz thru 180 MHz, Bulova has available in glass holders the Mil types HC-26/U and HC-27/U, as well as the standard vacuum tube types. A 3rd overtone 5 MHz crystal is available in the HC-27/U holder with Q's in excess of 1 million and stability of 1 pp 10^{10} for 24 hours.

FILTER AND OSCILLATOR CRYSTAL

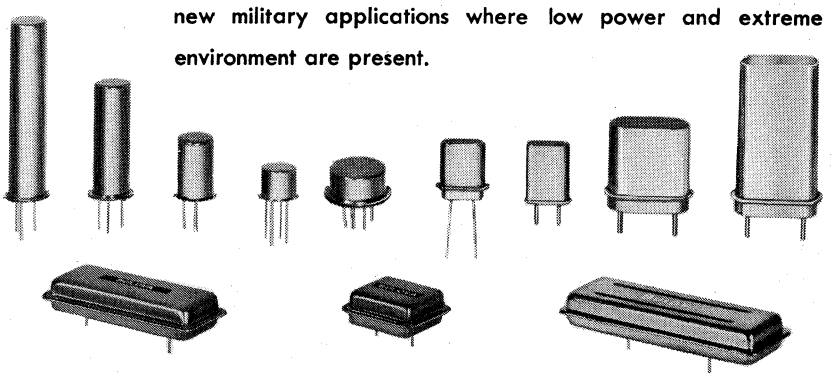
Bulova has designed a line of quartz crystals for filter, clock oscillator and TCXO applications, with fundamental frequencies from 2,000 Hz to 33 MHz as well as overtones up to 180 MHz.

- Spurious attenuation as low as 60 db.
- Motional parameters of L and C can be held to within ±3%.

A COMPLETE LINE FOR ALL APPLICATIONS IN A FREQUENCY RANGE OF 2,000 Hz THRU 180 MHz

Commercial: Crystals for Aviation, Marine and Data communications equipment. Manufactured to the highest quality in standard type holders or modified to suit special designs.

Military: Bulova produces all the standard military "CR" types and is Q.P.L. on most of the current "CR" types. Designs crystals for new military applications where low power and extreme environment are present.



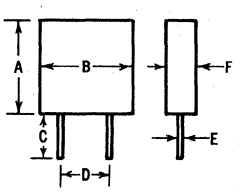
Coldweld Sealed Crystals—

Bulova has extended the developmental perimeter of coldweld types to provide a more miniaturized package with a broader frequency output. A support facility has been built capable of handling volume production. Series 100 coldweld holders consists of twelve (12) configurations which include the seven (7) main military types. The military crystals fit within the dimensional requirements of the military drawing.

Features:

- High Quality-High Reliability
- Tolerances as close as 3 ppm of nominal can be held on initial adjustment.
- Aging rates up to 3 pp 10^8 per week.
- Small package/broad frequency capability.

CRYSTAL HOLDERS



MIL TYPE	BULOVA TYPE	DIMENSIONS IN INCHES					
		A (Max)	B (Max)	C	D	E	F (Max)
HC-6/U	70	.775	.757	.238	.486	.050	.352
HC-13/U	73	1.526	.757	.238	.486	.050	.352
HC-18/U	80	.530	.435	1.500	.192	.017	.183
HC-25/U	83	.530	.435	.238	.192	.040	.183
HC-27/U	77	.775	.757	.238	.486	.050	.352
HC-26/U	76	.530	.435	1.500	.192	.017	.185

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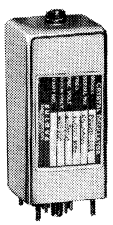
BULOVA® CRYSTAL OSCILLATORS

Bulova offers a full line of both Military and Industrial crystal oscillators—provides a total capability from custom engineering to volume production, using the latest automatic test equipment. Bulova's full line of crystal oscillators includes • high stability crystal oscillators • temperature compensated crystal oscillators (TCXO) • computer clock oscillators • voltage-controlled crystal oscillators (VCXO)

HIGH STABILITY CRYSTAL OSCILLATORS

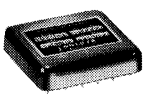


PCOXO

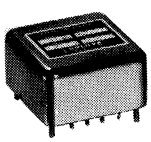
The high frequency stability of these oscillators results from housing a high precision crystal and an oscillator circuit with AGC to maintain low constant crystal drive in a stable DC proportional control oven.

	MILITARY		INDUSTRIAL	
MODEL	PCOXO-101	PCOXO-106	PCOXO-3	PCOXO-5
Frequency Range	1.0 to 10MHz	30 to 100 MHz	1.0 to 10MHz	1.0, 3.0 or 5.0MHz
Temp. Range	−55°C to +70°C	-55°C to+70°	0°C to +60°C	0°C to +60°C
Stability				
Temp. Range	$\pm 1PP10^3$	$\pm 5PP10^7$	$4PP10^{10}$/°C	$2PP10^{10}$/°C
Aging per day	$1PP10^9$	$5PP10^8$	$5PP10^9$	$5PP10^{10}$
Line Voltage ±10%	$\pm 5PP10^9$	$\pm 5PP10^7$	$\pm 5PP10^9$	$\pm 5PP10^9$
Load ±10%	$\pm 1PP10^9$	$\pm 5PP10^7$	$\pm 1PP10^9$	$\pm 1PP10^8$
Warm-up at +25°C after 1 hr.	$\pm 1PP10^8$	$\pm 1PP10^7$	$\pm 3PP10^8$	$\pm 1PP10^8$
Output	.5VRMS (min)	1 MW (Min)	1VRMS (min)	1VRMS
Load	50 ohms	50 ohms	1K ohms	1K ohms
Input Voltage	+28VDC	+28VDC	+28VDC	+28VDC
Turn on Power	18W	18W	12W	12W
Power at 25°C	4.5W (Typ)	4.5W (Typ)	4.5W (Typ)	4.2W (Typ)
Size	2″ x 2″ x 4″	2″ x 2″ x 4″	2″ x 2″ x 4″	2″ x 2″ x 4″

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS



TCXO-1
TCXO-100



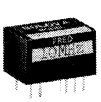
TCXO-2
TCXO-50

Bulova temperature compensated crystal oscillators employ a computer selected and optimized variable capacitance diode and thermistor compensation network to maintain frequency stability over wide temperature ranges, without the use of an oven.

MODEL	TCXO-1	TCXO-2	TCXO-50	TCXO-100
Frequency Range	3MHz to 12MHz	3, 4 or 5MHz	1MHz to 12MHz	1MHz to 20MHz
Frequency Adjustment Range	±3PPM	±0.3PPM	±3PPM	±3PPM
Frequency Stability	±1PPM over Temp. Range of −40°C to +70°C	±0.2PPM over Temp. Range of −40°C to +75°C	±0.5PPM over Temp. Range of 0°C to +60°C	±2.5PPM over Temp. Range of 0°C to 60°C
Aging Rate per wk.	$\pm 1PP10^8$	$\pm 1PP10^8$	$\pm 1PP10^8$	$\pm 1PP10^8$
Power Input	12VDC ±2% at 150mw	12VDC ±5% at 50mw	12 and 5 VDC	12 and 5 VDC
Output	1VP-P into 1K ohm	125 mv RMS into 50 ohms	T^2L	T^2L
Size	2″ x 2″ x 0.5″	2″ x 2″ x 1″	2″ x 2″ x 1″	2″ x 2″ x 0.5″
Weight	3 oz.	5 oz.	5 oz.	3 oz.

COMPUTER CLOCK OSCILLATORS

XO-140
XO-14



XO-304
XO-302

These computer clock oscillators feature crystal stability, printed circuit board mounting and outputs directly compatible with DTL or TTL loads.

MODEL	XO-140	XO-304*	XO-14	XO-302*
Frequency Range	8KHz to 1MHz	4MHz to 25MHz	8KHz to 1MHz	4MHz to 25MHz
Temp. Range	−40°C to +70°C	−55°C to +85°C	0°C to +60°C	0°C to +60°C
Frequency Stability over Ambient	±120PPM	±50PPM	±65PPM	±25PPM
Input Voltage	+5VDC	+5VDC	+5VDC	+5VDC
Output	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V	Logic Zero: 0 to .4V Logic One: 2.6 to 5V
Size	1″ x 2″ x .5″	.8″ x .5″ x .4″	1″ x 2″ x .5″	.8″ x .5″ x .4″

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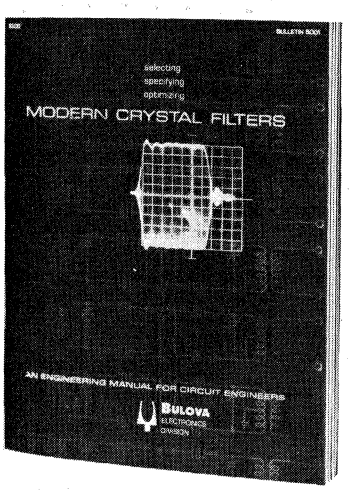
BULOVA® CRYSTAL FILTERS



COMPUTER OPTIMIZED FILTER DESIGNS

To provide optimized designs for individual system requirements, Bulova has a co-related library of computer programs. From pre-packaging tolerance analysis of individual components to the finished product spec'd to the customer's parameters, we can determine design "trade-off" quickly and economically.

The prime parameters have been programmed to make available the following crystal filter types

1. **Butterworth Designs**
2. **Butterworth-Thompson Designs**
3. **Chebyshev Designs**
4. **Bessel Designs**
5. **Elyptic Designs**
6. **Lerner Designs**
7. **Gaussian (Transitional)**
8. **Image Parameter**

FULL PRODUCTION CAPABILITY

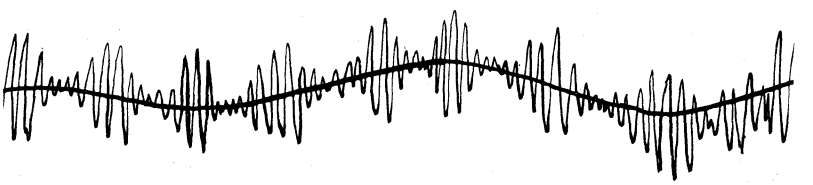
From crystal configuration to finished product, each segment of manufacture utilizes the most advanced and controlled production techniques. Geared to large volume requirements, Bulova's modern automated test facilities allows for a mass production output with no loss in quality—fully equipped environmental laboratory available for most testing. Short runs and engineering prototypes are handled in our pre-production shop.

Computer Designed for Reliable Performance Accurate — 4KHz to 150MHz

The business of Crystal Filter design and production has been Bulova's business since 1955. It is another reason for our leadership in the broad area of frequency control and related precision products.

We are a design/production center to fulfill the most exacting system specifications. Combining many years of experience, an engineering team of many design disciplines and advanced computer techniques, we can produce 'state-of-the-art' filters in cost-controlled packages to military and commercial specifications.

TYPICAL FILTER APPLICATIONS FROM



4KHz ← * → 150 MHz

Band Pass	**Notch**
Band Elimination	**Time Delay**
Single Side Band	**Equalizer**
Narrow Band	**Lerner**
Wide Band	**Time Domain**
Linear Phase	
RF & IF	**Discriminators**

*For areas not specified above, consult our application engineering department.

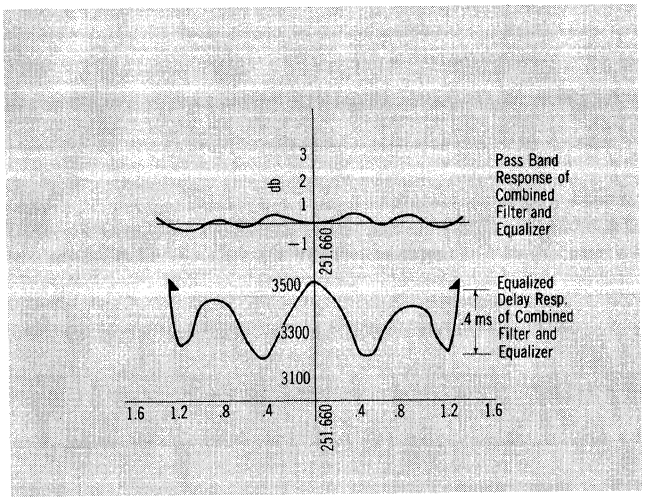
CUSTOM DESIGNED TO THESE POSSIBLE PARAMETERS:

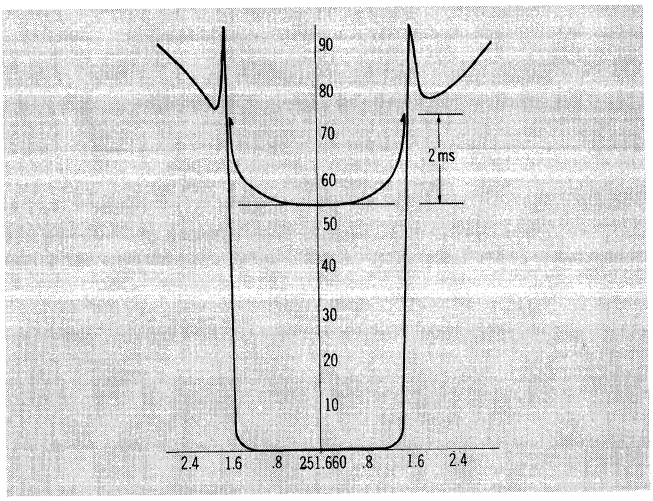
Band Widths	from .001% to 8% of Center frequency
Shape Factor:	1.08 Ratio for 60 db BW to 3 db BW
Ripple Factor	<0.5 db
Phase Linearity	<5%
Carrier Rejection	>70 db
Ringing	>40 db
Insertion Loss	<3 db
Attenuation	>100 db
Phase Matching	closer than 3° (Filter to Filter) over environmental requ.
Temperature Tolerances	<0.005% (depending upon frequency)
Max. Operating Temperature Range	−55°C to +125°C
Shock & Vibration	All applicable MIL specifications

BULOVA CRYSTAL FILTERS

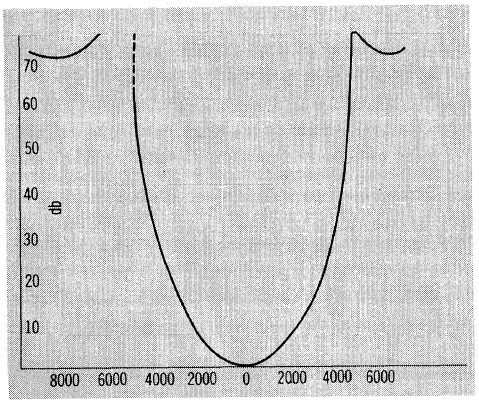
New State-of-the-Art Series

Sharp Sideband Filter and Equalizer

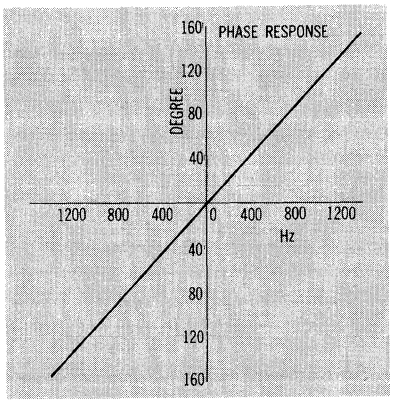




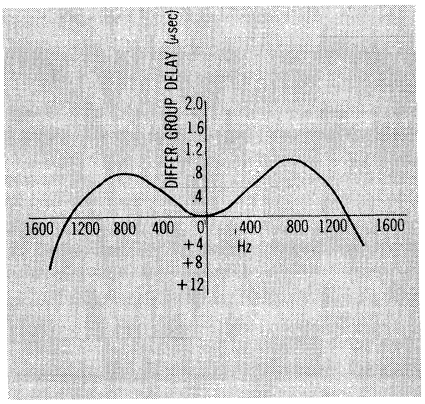
Linear Phase Filter



Attenuation



Phase Response



Group Delay Response

The attenuation response is basically that of a Gaussian filter. The attenuation peaks improve the shape factor without degrading the transient response.

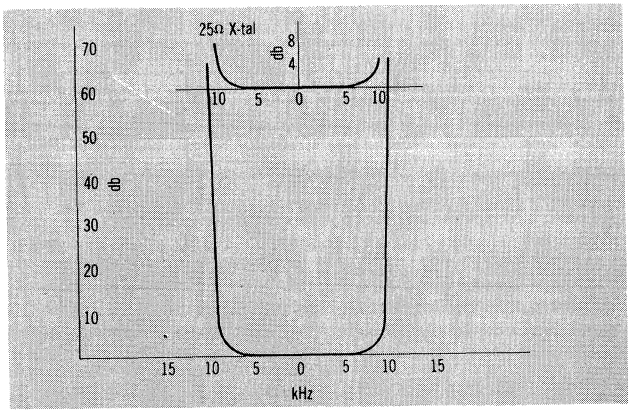
Filter with Excellent Shape Factor

1.16 to 1.0; 60 db to 3.0 db

For a slightly wider bandwidth the shape factor could be better than 1.1 to 1.0; 60 db to 3.0 db.

L3 db	U3	L60	U60	X-tal Resist.
8,750 Hz	8,700 Hz	10.150 kHz	10.100 kHz	25 Ω
8,870 Hz	8,820 Hz			15 Ω

Return DIP	80 db Bandwidth
65 db	fo ±14.5 kHz



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ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

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BULOVA® OSCILLATORS/RESONATORS

Whatever your requirements for tuning forks and oscillators, Bulova has either the product available or the inherent capability to meet your need. Reliability, accuracy and size criteria can be quickly met, with appreciable savings in engineering time and production costs. Each product is founded on the same design experience that has made the ACCUTRON a by-word of precision and accuracy.

from 1 Hz to 100K Hz
TIME PERIOD GENERATORS
From seconds to centuries
FREQUENCY DEVIATION COUNTERS
Accurate to 1 ppm down to 1 Hz

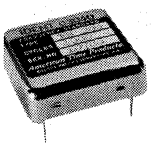
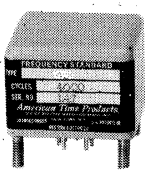
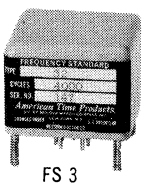
PRECISION OSCILLATORS

From 1 to 100k Hz
Accuracy to ±.002%

Multiple Frequency Models
Hermetically Sealed
Also Available in 5, 10, 20, and up to 1000 VA Packages

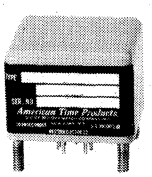
RESONATORS

The forks used in the precision oscillator packages also are available as discrete components without driver circuits. Accuracy is comparable to that given in the table.

	MICROPOWER	P.C. BOARD	CYLINDRICAL	SIMULTANEOUS MULTIPLE OUTPUTS	WIDE RANGE MODULAR
					
Model	FS 200	FS 11 FS 11-1 FS 11-F	FS 27	FS 300 or FS 400	FS 3 FS 32-1 FS 32 F
Frequency, Hz	360 to 1000 Hz	400 Hz to 50 kHz	360 to 1300 Hz	60,120,240,480 50,100,200,400	240 Hz to 100 kHz
Frequency Accuracy	up to ±.01%	up to ±.02%	up to ±.002%	up to ±.002%	up to ±.002%
Temperature Range	FOR SOME ACCURACIES AS MUCH AS −65°C to + 125°C				
Input	1.5 V DC at 6 to 20 microamps	STANDARD 28 V DC (AVAILABLE 3 to 40 V DC)			
Output	0.1 volt	sine, square wave or compatible with logic			
Load	500 K ohms	10 K OHMS TO 500 K OHMS OR LOGIC CIRCUITRY			
Size	1-5/16" x 1-5/16" x 3/8"	1-1/2" x 1-1/2" x 3/8"	23/32" x 3"	1-1/2" x 1-1/2" x 1-3/16"	1-1/2" x 1-1/2" x 1-3/16"
Weight	1 ounce	1½ ounces	2 ounces	2-1/2 ounces	2-1/2 ounces

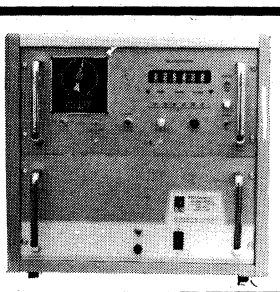
TIME PERIOD GENERATORS

Extremely accurate master clocks with single or multiple outlets and any combination of pre-set closures or timing functions



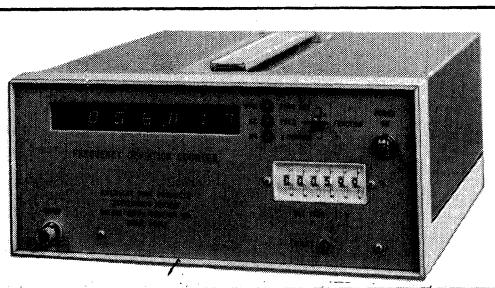
Pre-coded clock, accuracy to ±.002%

Masterclock for radio, TV or similar networks; accurate to ± 1 x 10^{-9}/day



FREQUENCY DEVIATION COUNTER

Incorporates 3 functions in one unit: Measures frequency deviation to ±.0001%, measures frequency in Hz and measures time intervals from 1 to 999,999 in micro-seconds



From Bulova Electronics Division: Frequency Control Components • Crystal Oscillators • Crystal Filters • LC Filters • Fork Oscillators • Coils • Servo D.C. Amplifiers • Optical Devices • Time Period Generators • Time of Day Systems • Inverters • Frequency Changers • Frequency Deviation Counters

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CTS KNIGHTS, INC.

SPECIALISTS IN FREQUENCY MANAGEMENT

CRYSTALS

OSCILLATORS

FILTERS

OVENS

CRYSTALS

LET US SOLVE YOUR CRYSTAL PROBLEMS...

CTS Knights, Inc. offers a complete line of crystals in the frequency range of 1.000 MHz to 200 MHz. Precision crystals with stabilities of 1 x 10^{-10} per day — high frequency crystals of all types including a new line of low cost coldweld units.

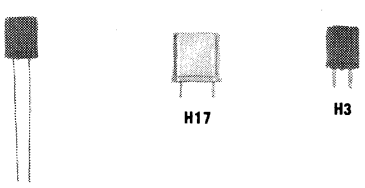
CTS has the combination of high volume production capability and sophisticated engineering to economically meet any crystal requirement.

PRECISION CRYSTALS

K5W K3 K17

TYPE	FREQUENCY RANGE	MODE	STABILITY VS. TIME	HOLDER
K17	2-20 MHz	Fund.	5 x 10^{-9}/day	Coldweld
	4-10 MHz	O.T.	1 x 10^{-9}/day	Coldweld
K5W	3-6 MHz	Fund.	1 x 10^{-8}/Day	Coldweld
K3	6-20 MHz	Fund.	1 x 10^{-8}/day	Coldweld
	20-200 MHz	O.T.	1 x 10^{-8}/day	Coldweld

HIGH FREQUENCY CRYSTALS



H3W H17 H3

FREQUENCY RANGE	CUT/MODE	R_S (Ohms)	STABILITY VS. TEMP.	TEMPERATURE RANGE	HOLDER
1-5 MHz	AT-Fund.	500	±.005%	−55 to +105°C	H17, K17
4-20 MHz	AT-Fund.	150	±.004%	−55 to +105°C	H3, K3
20-60 MHz	AT-3rd	50	±.004%	−55 to +105°C	H3, K3
60-100 MHz	AT-5th	60	±.004%	−55 to +105°C	H3, K3
100-140 MHz	AT-7th	80	±.004%	−55 to +105°C	H3, K3
140-180 MHz	AT-9th	120	±.004%	−55 to +105°C	H3, K3

Whatever your crystal needs may be, they can be furnished by CTS Knights, Inc. The illustrations and descriptions above portray a limited picture of the more popular types — let us quote on these and on more specialized requirements.

ORDERING INFORMATION: Place orders using the following address:

CTS Knights, Inc., 222 Reimann Avenue, Sandwich, Illinois 60548 • Telephone (815) 786-8411 • TWX 910-642-0860

CTS KNIGHTS, INC.

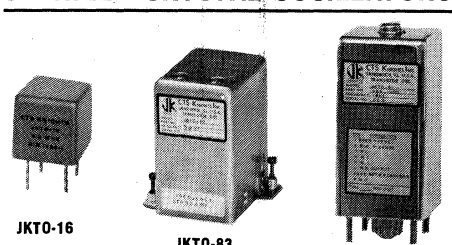
SPECIALISTS IN FREQUENCY MANAGEMENT

OSCILLATORS

LET US SOLVE YOUR OSCILLATOR PROBLEMS...

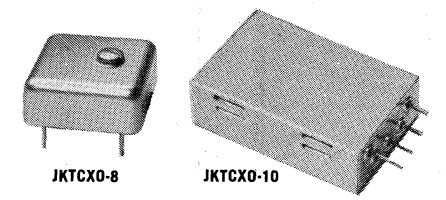
CTS Knights, Inc. has the breadth of product line and the engineering depth to custom design an oscillator to your requirements. The best solution to your problem might be an uncompensated oscillator, an ovenized oscillator, a temperature compensated oscillator, a voltage controlled oscillator, a temperature compensated crystal, or some combination of these units — CTS Knights offers them all. CTS specializes in using in-depth engineering knowledge to custom design a unit specifically for your requirements.

OVENIZED CRYSTAL OSCILLATORS



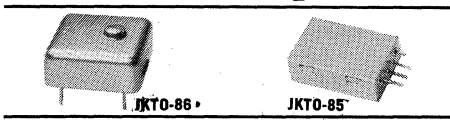
Type	Frequency Range	Stability vs Time	Stability vs Temperature	Oscillator Input	Oven Input	Size	Special Features
JKTO-16	5-20 MHz	$1x10^{-6}$/yr.	$5x10^{-8}$(0°C to +50°C)	5 VDC	28 V	1x1x1	
JKTO-30	1-10 MHz	$5x10^{-8}$/day	$5x10^{-8}$(−10°C to +55°C)	12 VDC	28 V, 115 V	2x2x4	Low Cost
JKTO-41	1-100 MHz	$5x10^{-8}$/day	$3x10^{-8}$(−40°C to +70°C)	28 VDC	28 V	2x2x4	
JKTO-56	4-6 MHz	$1x10^{-9}$/day	$1x10^{-8}$(−10°C to +60°C)	12 VDC	28 V	2x2x4	Low Power 2.5 watts
JKTO-83	1-6 MHz	$1x10^{-9}$/day	$1x10^{-8}$(−55°C to +70°C)	30 VDC	30 VDC	2½x2½x3	Fast Warmup

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS



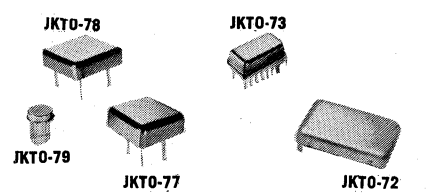
Type	Frequency Range	Stability vs Time	Stability vs Temperature	Oscillator Input	Size	Special Features
JKTCXO-2	3-5 MHZ	$1x10^{-8}$/wk	$5x10^{-7}$(−40°C to +70°C)	12-28 VDC	2x2x⅝	
JKTCXO-5	20-120 MHz	$1.2x10^{-5}$/yr	$1x10^{-6}$(0°C to +70°C)	12 VDC	2x2x1	
JKTCXO-7	3-10 MHz	$1x10^{-6}$/yr	$1x10^{-6}$(0°C to +70°C)	12 VDC	1½x1½x¾	
JKTCXO-8	25 KHz-20 MHz	$1x10^{-6}$/yr	$2x10^{-6}$(−55°C to +85°C)	12 VDC	2x2x⅝	
JKTCXO-10	3-5 MHz	$1x10^{-6}$/yr	$2x10^{-6}$(−40°C to +70°C)	8 VDC	1x1½x½	Low Power (12 mw)

VOLTAGE CONTROLLED CRYSTAL OSCILLATORS



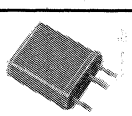
Type	Frequency Range	Modulation Input	Deviation	Oscillator Input	Size	Special Features
JKTO-85	17.5 to 22.5 MHz	±2VPP DC to 20 KHz	±20 KHz	8 VDC	1x1½x½	20mw power
JKTO-86	5 to 30 MHz	±2VPP DC to 20 KHz	±1000 ppm	12 VDC	2x2x¾	

CRYSTAL CLOCK OSCILLATORS



Type	Frequency Range	Stability vs Time	Stability vs Temperature	Oscillator Input	Size	Special Features
JKTO-72	2 KHz-20 MHz	$6x10^{-6}$/yr	50ppm(0°C to +70°)	5 VDC	1½x2⅜x$^{25}/_{64}$	Low Cost
JKTO-73	10 MHz	$3x10^{-6}$/yr	50ppm(0°C to +70°)	5 VDC	$^{61}/_{64}$x$^{17}/_{32}$x$^{23}/_{64}$ High	DIP
JKTO-77	5-20 MHz	$5x10^{-6}$/yr	100ppm(−55°C to +125°C) 50ppm(0°C to +70°C)	5 VDC	1x1x⅜	TTL Output
JKTO-78	1.8-50 MHz	$5x10^{-6}$/yr	100ppm(−55°C to +125°C) 50ppm(0°C to +70°C)	5 VDC	1½x1½x$^{27}/_{64}$	TTL Output
JKTO-79	156 KHz-25 MHz	$5x10^{-6}$/yr	100ppm(−55°C to +105°C)	5 VDC	TO-8 Can	TTL Output

TEMPERATURE COMPENSATED CRYSTALS



Type	Frequency Range	Stability vs Time	Stability vs Temperature	Oscillator Input	Size	Special Features
TCX	6-25 MHz	$3x10^{-6}$/yr	5ppm(−30°C to +60°C)	10 VDC	HC-6/U	3 Lead

The illustrations and descriptions above illustrate a limited number of our standard designs. Contact us for your oscillator requirements.

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CTS KNIGHTS, INC.

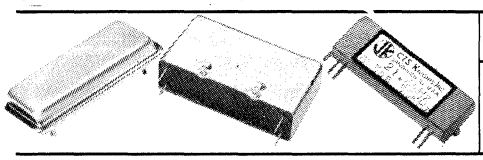
SPECIALISTS IN FREQUENCY MANAGEMENT

FILTERS

LET US SOLVE YOUR FILTER PROBLEMS...

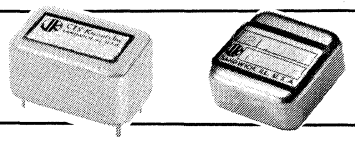
CTS has total capability in crystal filters. Symmetrical and asymmetrical bandpass, band reject and discriminators from 1 KHz to 100 MHz are available. Our experienced design engineers will use monolithic filter crystals in their computer-aided designs whenever desirable. Give us an opportunity to custom design a filter to your requirements.

CRYSTAL FILTERS



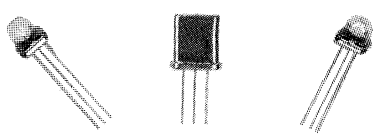
Part Number	Center Frequency	3 DB Bandwidth	Shape Factor	No. Poles	Insertion Loss	Max. Ripple	Nominal Impedance	Ultimate Attenuation	Package
961-0160	10.7 MHz	240 KHz Min.	5/1	4	5 db Max.	1.5 db	500 ohms	50 db	2.0″x1.0″x.6″
961-0253	21.4 MHz	30 KHz Min.	1.8/1	8	2 db Max.	1.0 db	2000 ohms	100 db	1.75″x.6″x.22″
961-0217	21.4 MHz	25 KHz Min.	1.8/1	8	2 db Max.	1.0 db	3000 ohms	80 db	1.6″x.73″x.35″

CRYSTAL DISCRIMINATORS



Part Number	Center Frequency	Band-width	Distor-tion	Voltage Slope	Crossover Stability	Video Freq. Response	Z in, Z out	Package
964-0015	21.4 MHz	100 KHz	2% Max.	35mv/KHz	±1 KHz Max.	DC-75 KHz	2K ohms 100K ohms	1.03″x1.03″x.4″
964-0014	17.0 MHz	65 KHz	2% Max.	200mv/KHz	±1 KHz Max.	DC-75 KHz	50 ohms 300K ohms	1.6″x.95″x.75″

MONOLITHIC FILTER CRYSTALS



CTS is a leader in the high volume production of monolithic dual coupled resonators. We have the capability to design and manufacture dual coupled resonators to fulfill your specific requirement. Our experienced engineering staff will assist you in tailoring dual coupled resonators that can be combined to form 4, 6, or 8 pole filters. This building block approach allows you to take advantage of the low cost and small size of the dual coupled resonator, and also gives the overall advantage of building your own filter in-house. For further information ask for our publication, "Application Notes on Monolithic Coupled Resonators" or contact us directly for help with your filter problems.

OVENS

LET US SOLVE YOUR OVEN PROBLEMS...

CTS Knights offers a complete line of thermostat controlled and proportional controlled ovens for commercial and/or military applications. If a standard oven does not fit your application, our experience with precise temperature control provides us with excellent capability to design custom ovens for your special application.

Series	Group	External Size (Seated Height)	Cavity Size	Calibration Temperature	Cycling @ 25°C	Voltage	Mounting
905	THERM	1 5/16″ x 1 3/4″	1 1/64″ ID x 1 3/16″	65° to 85°C ±2.5°C	±.1°C	6.3 to 26V AC/DC, 115V AC	Octal Plug-in
906	THERM	1 5/16″ x 2 5/16″	1 1/64″ ID x 1 5/8″	65° to 85°C ±2.5°C	±.1°C	6.3 to 26V AC/DC, 115V AC	Octal Plug-in
915	THERM	1 33/64″ x 1 19/64″	10 HC-18/U Crystals	65° to 85°C ±3°C	±.5°C	6.3 to 26V AC/DC, 115V AC	Two 2/56 Screws
916	THERM	1 5/8″ x 2 23/32″	1 23/64″ ID x 1 3/8″	65° to 85°C ±2.5°C	±.1°C	13, 26 AC/DC 115V AC	Octal Plug-in
918	THERM	2 1/4″ x 3 5/16″	1 11/16″ ID x 2 1/2″	65° to 85°C ±3°C	±.05°C	26V AC/DC 115V AC	Octal Plug-in
919	THERM	2 1/4″ x 4 5/16″	1 11/16″ ID x 3 1/2″	65° to 85°C ±3°C	±.05°C	26V AC/DC 115V AC	Octal Plug-in
923	P.C.	2″ x 2″ x 1″	1 29/64″ sq. x 29/64″	60°C to +100°C ±2°C		24 to 32V DC	Pins
927	P.C.	1 9/16″ x 1 7/8″ x 4 3/16″	1 1/32″ ID x 2 55/64″	65° to 85°C ±1°C		24 to 32V DC	Octal Plug-in
930	P.C.	2″ x 2″ x 4 1/8″	1 17/64″ Sq. x 2 23/32″	60°C to +100°C ±2°C		12 to 36V DC	Octal Plug-in
932	P.C.	1 7/16″ Sq. x 2 1/4″ to 4 3/4″	1 1/32″ ID x 1 17/64″ to 3 23/64″	+40°C to +100°C ±3°C		12 to 115V AC/DC	Octal Plug-in
947	THERM	3 5/16″ x 3 1/2″	2 13/32″ ID x 2 13/32″	65° to 85°C ±3°C	±.05°C	26V AC/DC 115V AC	Octal Plug-in
948	THERM	3 5/16″ x 4 7/8″	2 13/32″ ID x 3 27/32″	65° to 85°C ±3°C	±.05°C	26V AC/DC 115V AC	Octal Plug-in
952	P.C.	1 5/8″ x 2 5/16″ to 4 17/32″	1 1/32″ ID x 1 1/8″ to 3 21/64″	+35°C to +75°C ±1°C		28V DC	Octal Plug-in

Contact us for your crystal filter and component oven requirements.

Illustrations and descriptions above illustrate a limited number of our standard designs.

ORDERING INFORMATION: Place orders using the following address:

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CONNOR-WINFIELD CORPORATION
WEST CHICAGO, ILL. 60185 • PHONE (312) 231-5270

- Connor-Winfield's TTL compatible oscillators, CMOS and other type oscillators are designed primarily for use with IC systems.
- Each RC oscillator is custom compensated over the operating temperature range.
- Custom design service available on request. Delivery of most units stock to 3 weeks.

CMOS COMPATIBLE CRYSTAL OSCILLATOR — .03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

Output		Model	Supply Voltage	Supply Voltage	Frequency Tolerance	Fixed Frequencies Available	Frequency Adjust	Type	Package	Unit Price
Low Power CMOS Square	0.5Vpp to 10Vpp into 2KΩ load or 2.5Vpp to 12Vpp into 10KΩ load depending on supply voltage Amplitude stability ±5% with fixed supply voltage	C120MSA thru Y	Any fixed voltage 5 to 15VDC ±5%	< 0.1 MA to 20 MA	See Table A at top of next page	.00005 Hz to 60 MHz	Optional	Xtal	1.6" L x 1.2" W x 0.4" h	$78 to $108

SOS CMOS AVAILABLE AT HIGHER FREQUENCIES

DIP CRYSTAL AND SOLID STATE OSCILLATORS — PLUG INTO SINGLE IC SOCKET

Output		Type	Model	Frequency Tolerance	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current	Package	Unit Price
TTL Pulse	Negative pulse, risetime 0.4 μs nominal duration 60 μ or less Amplitude 2.4Vp nominal into a 2KΩ load	RC	L14A L13A*	±1.0% 0° to +50°C	30 Hz to 50 KHz	External ±2% Standard	±5% 5VDC	2 MA nominal	14 Pin DIP 0.78" L x 0.49" W x 0.17" h	$28
			L16A	±0.1% +20°C to +40°C ±0.25 0° to +50°C					16 Pin DIP 0.89" L x 0.49" W x 0.22" h	$53
TTL Square	Logic zero < 0.4V, I_{sink} 16ma Logic one > 2.4V into 200Ω to 2KΩ load Duty cycle 50%,† risetime < 50ns Amplitude stability ±5% with fixed supply voltage	RC	L14Q L13Q*	Same as L14A	15 Hz to 25 KHz	External		35 MA nominal	14 Pin DIP 0.78" L x 0.49" w x 0.44 "h	$48
			L14R L13R*	Same as L16A						$73
		Xtal	L14C L13C*	±.001% 0° to +50°C	.00005 Hz to 60 MHz	Optional ±30 ppm		5 MA 150 MA	14 Pin DIP 0.78" L x 0.49" W x h 0.35", 0.44" or 057" depending on frequency	$53 to $210
			L14D L13D*	±.0025% 0° to +65°C						
			L14E L13E*	±.005% −25°C to +75°C						
Sine	Amplitude $3V_{rms}$ nominal into a 10KΩ load (can drive 1KΩ) Harmonic distortion < 5% Amplitude stability ±5% with fixed supply voltage	RC	L14B L13B*	Same as L14A	60 Hz to 20 KHz	External ±2% Standard		35 MA nominal	14 Pin DIP 0.78" L x 0.49" W x 0.57" h	$68
			L14N L13N*	Same as L16A						$93
		Xtal	L14F L13F*	±.001% 0° to +50°C	20 KHz to 60 MHz	Optional ±30 ppm	Dual Supply +5VDC and +12VDC	35 MA to 150 MA	> 1 MHz, 14 Pin DIP 0.78" L x 0.49" W x 0.75" h	$93 to $250
			L14G L13G*	±.0025% 0° to +65°C						
			L14I L13I*	±.005% −25°C to +75°C					< 1 MHz, 14 Pin DIP 1.2" L x 0.8" W x 0.48" h	

* Use Model L14 for .023" x .011" pins; use Model L13 for .017" x .017" pins. † > 10 MHz, 60/40.

TCXO — .03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

Output		Model*	Frequency Tolerance	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current	Package	Unit Price
TTL Square	Logic zero < 0.4V, I_{sink} 16ma Logic one > 2.4V into 200Ω to 2KΩ load Duty cycle 50%, risetime < 50ns Amplitude stability ±5% with fixed supply voltage	C12A	±.00005% +25°C to +35°C	.0001 Hz to 30 MHz	±30 ppm	5VDC ±1%	10 MA to 75 MA	1.75" sq. x 0.4" h or 0.5" h depending on frequency	$148 to $298
		C12B	±.00015% 0° to +50°C						
Low Power CMOS Square or Sine	0.6V to 9.5V with a 10V supply into a 600Ω to 15KΩ load Amplitude stability ±5% with fixed supply voltage	C12C	±.00025% −25°C to +65°C			Any fixed voltage 8 to 15VDC ±1%	< 1 MA to 20 MA		

* NOTE: For TTL output, place prefix "I" in front of model number.

VCXO — .03" DIAMETER GOLD-PLATED SOLDER PINS (OTHER PIN DIMENSIONS BY REQUEST)

Output		Model*	Frequency Tolerance	Fixed Frequencies Available	Voltage Control	Supply Voltage	Supply Current	Package	Unit Price
TTL Square	Logic zero < 0.4V, I_{sink} 16ma Logic one > 2.4V into 200Ω to 2KΩ load Duty cycle 50%, risetime < 50ns Amplitude stability ±5% with fixed supply voltage	V12A	±.00005% +25°C to +35°C	1 KHz to 30 MHz	20ppm/V Control <1 KHz Linearity ±.2% ±4V* with 5V supply ±10V with 12V supply 0.3 MA	5VDC ±1%	10 MA to 75 MA	1.75" sq. x 0.4" h or 0.5" h depending on frequency	$178 to $328
		V12B	±.0005% 0° to +50°C						
Power Low CMOS Square or Sine	0.6V to 9.5V with a 10V supply into a 600Ω to 15KΩ load Amplitude stability ±5% with fixed supply voltage	V12C	±.001% −25°C to +65°C			Any fixed voltage 8 to 15VDC ±1%	< 1 MA to 20 MA		

* NOTE: For TTL output, place prefix "I" in front of model number.

CONNOR-WINFIELD CORPORATION
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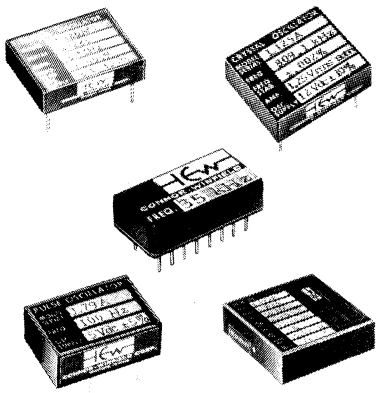

TABLE A (SEE CHARTS BELOW)

Model	Frequency Tolerance	Temp. Range Degrees C
C120MSK, IC5K1	±.0025%	+20 to +40
C120MSA, IC5A1	±.002%	+20 to +40
C120MSN, IC5N1	±.0025%	+10 to +40
C120MSR, IC5R1	±.0025%	0 to +50
C120MSS, IC5S1	±.003%	0 to +50
C120MST, IC5T1	±.003%	0 to +65
C120MSU, IC5U1	±.004%	0 to +65
C120MSX, IC5X1	±.004%	−25 to +50
C120MSB, IC5B1	±.005%	0 to +50
C120MSC, IC5C1	±.01%	0 to +65
C120MSY, IC5Y1	±.005%	−25 to +65
C120MSD, IC5D1	±.005%	0 to +65
C120MSE, IC5E1	±.01%	−25 to +75
C120MSF, IC5F1	±.02%	−25 to +75
C120MSG, IC5G1	±.02%	−55 to +75
C120MSH, IC5H1	±.05%	−55 to +75
C120MSJ, IC5J1	±.05%	−55 to +125

TABLE B (SEE CHARTS BELOW)

Model	Frequency Tolerance	Temp. Range Degrees C
IC5A2, L220A	±.002%	+20 to +40
IC5B2, L220B	±.005%	0 to +50
IC5C2, L220C	±.005%	0 to +65
IC5D2, L220D	±.01%	0 to +65
IC5E2, L220E	±.01%	−25 to +75
IC5F2, L220F	±.02%	−25 to +75
IC5G2, L220G	±.02%	−55 to +75
IC5H2, L220H	±.05%	−55 to +75
IC5J2, L220J	±.05%	−55 to +85

TABLE C (SEE CHARTS BELOW)

Frequency Tolerance	Temp. Range Degrees C
±0.05%	+15 to +35
±0.1%	0 to +50
±0.25%	0 to +65
±0.5%	−25 to +65

FLAT PACKAGE PC BOARD MOUNT CRYSTAL & SOLID STATE OSCILLATORS — .03" DIAMETER GOLD-PLATED SOLDER PINS*

Output		Type	Model	Frequency Tolerance	Fixed Frequencies Available	Frequency Adjust	Supply Voltage	Supply Current	Package	Unit Price
TTL Pulse	Negative pulse, duration 20 to 100 μs, risetime 1 μs nominal Amplitude 2Vp nominal into a 1KΩ load (4Vp in 10KΩ) Amplitude stability ±5% with fixed supply voltage	RC	L79A	Table C	1 Hz to 50 KHz	Screw Adjust ±2% Standard	5VDC ±5%	1 MA nominal	1.2" L x 0.8" W x 0.48" h	$48
Pulse	Negative pulse, duration 20 to 100μs, risetime 1 μs nominal Amplitude 10Vp nominal into a 10KΩ load Amplitude stability ±5% with fixed supply voltage		L80A				12VDC ±5%			$43
Square	Amplitude 10Vpp nominal into a 10KΩ load Duty cycle 50%, risetime 1 μs nominal Amplitude stability ±5% with fixed supply voltage		L118A		0.1 Hz to 20 KHz			10 MA nominal	1.6" L x 1.2" W x 0.4" h	$58
TTL Square	Logiz zero < 0.4V, I_{sink} 16ma Logic one > 2.4V into 200Ω to Duty cycle 50%, risetime < 50ns Amplitude stability ±5% with fixed supply voltage		L117A				5VDC ±5%	25 MA nominal		$63 to $83
		Xtal	IC5A1 thru J1	Table A	.00005 Hz to 400 KHz	Optional	5VDC ±10%	< 10 MA to 150 MA		$48 to $198
			IC5K1 thru Y1		40 KHz to 60 MHz		5VDC ±5%	5 MA to 35 MA		$48 to $83

ALSO SEE TCXO, VCXO AND COSMOS OSCILLATOR

Sine	Amplitude $3V_{rms}$ nominal into a 10KΩ load Harmonic distortion < 5% Amplitude stability ± 5% fixed supply voltage	Xtal	IC5A2 thru J2	Table B	20 Hz to 500 KHz	Optional	5VDC ±10%	15 MA to 100 MA	2" sq. x 0.6" h	$83 to $178
		RC	L199B	Table C	20 Hz to 20 KHz	Screw Adjust ±2% Standard	5VDC ±5%	25 MA nominal		$83
	Amplitude $5V_{rms}$ nominal into a 10KΩ load Harmonic distortion < 5% Amplitude stability ±5% with fixed supply voltage	Xtal	L220A thru J	Table B	20 Hz to 500 KHz	Optional	12VDC ±10%	15 MA to 100 MA		$93 to $188
		RC	L200B	Table C	20 Hz to 20 KHz	Screw Adjust ±2% Standard	12VDC ±5%	15 MA nominal		$78
	Amplitude $1.25V_{rms}$ nominal into 10KΩ load Harmonic distortion < 10% (5% typical) Amplitude stability ±5% with fixed supply voltage	Xtal	L125A	±.002% +20°C to +40°C	400 KHz to 60 MHz	Optional	12VDC ±10% or up to 40VDC	5 MA to 15 MA nominal	1.2" L x 1" W x 0.5" h	$58 to $68
			L125B	±.004% 0° to +50°C						
			L125C	±.005% −25°C to +65°C						

ALSO SEE TCXO AND VCXO

*** OTHER PIN DIMENSIONS BY REQUEST**

AC VOLTAGE REFERENCE

Available ±0.1% amplitude stability and sine wave distortion less than 1%. Square wave also available.

Model	Temp. Range	Amplitude Stability	Total Sinewave Distortion	Fixed Frequencies	Model	Temp. Range	Amplitude Stability	Total Sinewave Distortion	Fixed Frequencies Available	Package	Unit Price
L200BD L220BD	0°C to +50°C	±5%	< 1%	100Hz to 20KHz 100Hz to 600KHz						2" x 2" x 0.6" PC Board Mount Gold Solder Pins	$88 $98 to $198
L200BV L220BV		±0.25%	< 5%	100Hz to 10KHz	L204BV L224BV	+20°C to +40°C	±0.1%	< 5%	100 Hz to 10 KHz		$98 $108 to $208
L200BR L220BR			< 1%		L204BR L224BR			< 1%			$108 $118 to $218

CIRTECH CORPORATION

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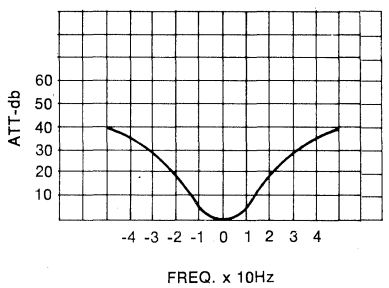
Our ability to produce active L.C. and crystal filters makes our position unique in supplying a customer with a complete package of filter requirements.

DCA and MIL-STD-188 crystal filters provide constant envelope delay at carrier frequencies of 100 KHz to 4.0 MHz.

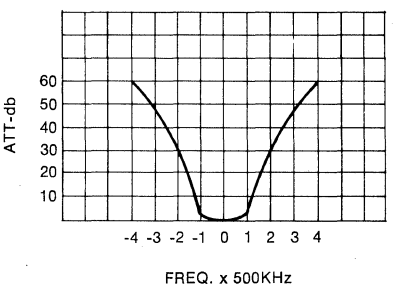
TYPICAL FILTERS

BAND PASS — I.L.S. FILTER
(L.C. FILTER)



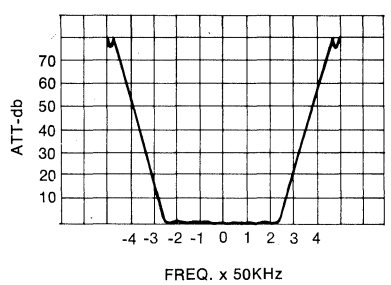
Fo 90Hz
BW 0.4db 10Hz
30/.4 5:1
I.L. 4db
Temp. −30°C to +60°C
Size 2″ x 1.5″ x 2″

BAND PASS
(L.C. FILTER)



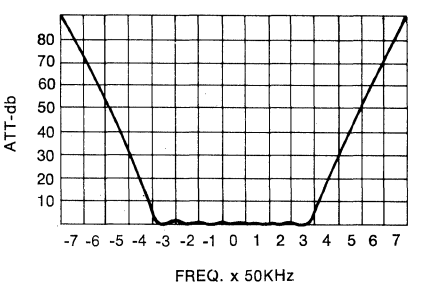
Fo 30MHz
BW 3db 1MHz
BW 60db 4MHz
I.L. 6db
Temp. −40°C to +80°C
Size 1″ x 2.37″ x .75″

BAND PASS — 10.7 WIDE BAND
(CRYSTAL FILTER)



Fo 10.7
BW 3db 210KHz
BW 70db 350KHz
I.L. 12db Max.
Temp. −40°C to +80°C
Size .6″ x .7″ x 2.3″

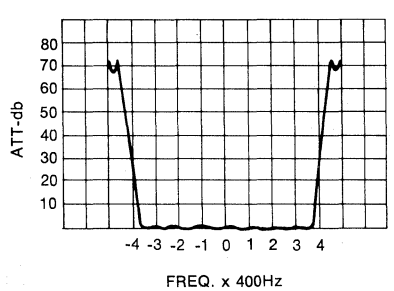
BAND PASS — 21.5MHz WIDE BAND
(CRYSTAL FILTER)



3db 250KHz
I.L. 8db Max.

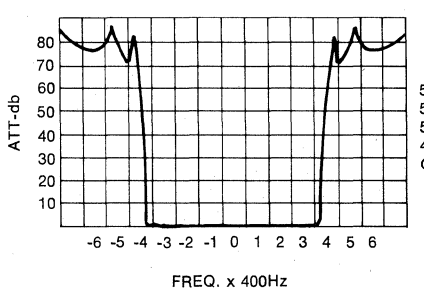
80db 560 KHz
Size .45″ x 1.5″ x 2.4″

1750KHz USB
(CRYSTAL FILTER)

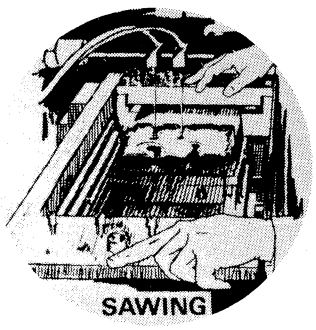


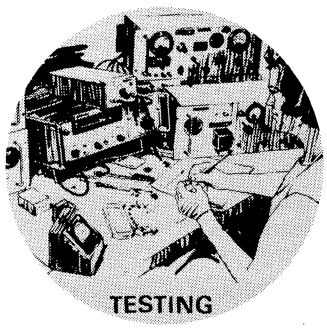
1750 30db Min.
1750.3 to 1753.5
2db Max.
1749.7 & 1754
60db Min.
I.L. 6db Max.
Size 1″ x 4.5″ x 2.5″

500KHz — USB — EQUALIZED CHANNEL
(CRYSTAL FILTER)

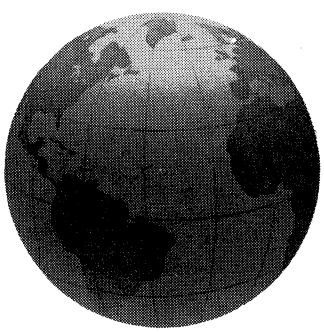


500.005KHz 40db
500.300KHz 1db
503.1KHz 1db
499.7 & 503.574 = 60db
GROUP DELAY 500.350 to
503020 500μsec Max.
I.L. 6db — Size 4″ x 2″ x 2″



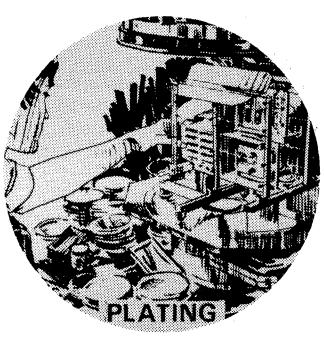


HIGH RELIABILITY AND SERVICE . . . are only two reasons why the name Croven is on buyer's lists and engineer's specifications across Canada, U.S. and around the world. Croven manufactures a standard line of Solder-Sealed Quartz Crystals, and specializes in Coldweld and Monolithic filters. Croven meets the exceptional reliability, frequency stability and low aging characteristics so vital to the electronic and aerospace industries of today. We will be pleased to assist your individual requirements. Just call us.



croven

QUARTZ CRYSTALS
MONOLITHIC FILTERS



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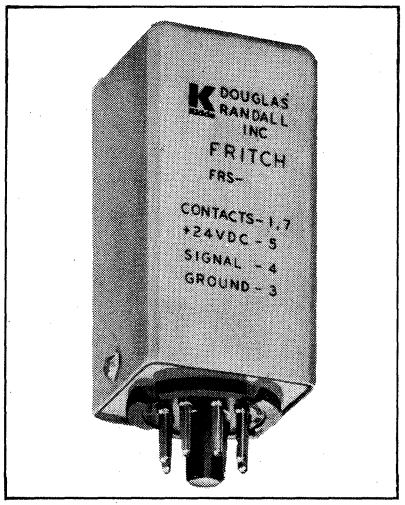
Douglas Randall TONE CONTROLS

DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

Kidde

FRITCH® — Frequency Responsive Switch



The FRITCH is a sensitive rapid tone decoder. Frequency detection is accomplished by active filters, and a reed relay provides the output on standard units. Custom units are available with solid state switching.

Two basic types are supplied — Type I for single tone use and Type II for use where several tones are present simultaneously.

FRITCHES are available in octal plug housings or for P.C. boards.

Specifications

FREQUENCY RANGE: 7 Hz to 100 KHz.

BANDWIDTH: Must Operate: ±2% fo. May Operate ±5% fo.

NORMAL CHANNEL SPACING: 11%.

INPUT SIGNAL LEVEL: 5 VRMS, 1 VRMS or 0.7 VRMS (odbm).

INPUT IMPEDANCE: 25,000 ohms typical.

RESPONSE TIME: To 75 pulses per second depending on frequency.

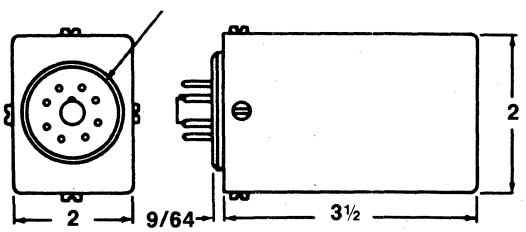
DC POWER INPUT: 12 V or 24 VDC ±10% (other voltages available).

OUTPUT CONTACTS: Form 1A, 2A, 1B, 2B, 1C or 1A1B.

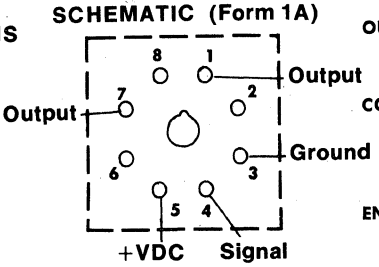
CONTACT RATING: Form A or B — 10 W, 0.5 A or 250 VDC Max. Form C — 3 W, 0.25 A or 28 VDC Max.

ENVIRONMENTAL LIMITS: Shock: 50 g; Vibration: 35 g; Temperature: −0°C to +50°C.

STANDARD OCTAL TUBE BASE DIMENSIONS

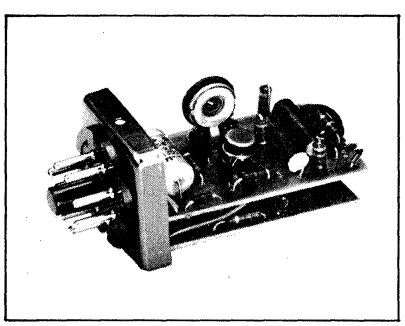


SCHEMATIC (Form 1A)



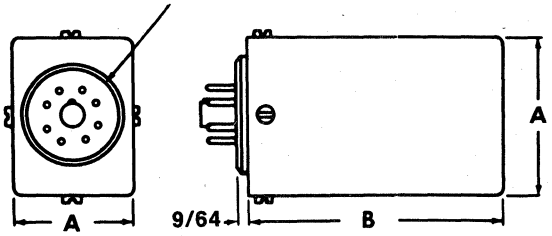
® Registered trademark of Douglas Randall Frequency Responsive switch. (Patent 3584275)

Oscillators



Douglas Randall Oscillators are solid state RC devices. The oscillator circuit operates continuously. The output stage is gated to a low impedance driver circuit, insuring extremely rapid signal response and freedom from frequency shift due to keying. Keying is accomplished by connecting the proper terminal to the power supply common (see schematic). The oscillators have reverse polarity protection incorporated in the unit to protect them if improperly connected. Single, double and triple tone versions are available in standard octal plug housings. They are also available for P.C. Mounting.

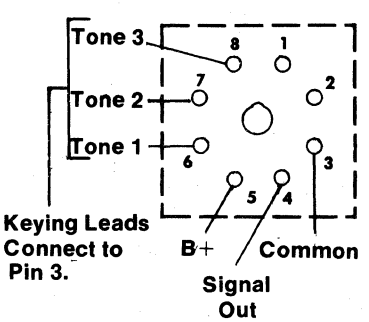
STANDARD OCTAL TUBE BASE



Dimension
Single Tone
A — 1½
B — 2¾

Double or Triple Tone
A — 2
B — 3½

SCHEMATIC



Specifications

DC POWER INPUT: 12 V or 24 VDC ±10% (other voltages available).

LOAD IMPEDANCE: 600 ohms.

OUTPUT SIGNAL: Standard, 1 V RMS.

DISTORTION: 1%.

RESPONSE TIME: 50 Microseconds.

DECAY TIME: 50 Microseconds.

FREQUENCY RANGE: ±1%: 0°C to 40°C. ±1.5%: −20° to +65°.

Soul Source

AND, in many instances*, "sole source", as well. Particularly, when **all** of the fine-print parameters must be met. Our customers will attest to the fact that we've been soul source because we understand their problems, requirements and specifications. We're completely responsive to their needs. When they've a problem in systems implementation, time, temperature, frequency, crystals, filters, oscillators, controlling or counting, people usually call us first. After all, solving problems in these areas . . . or telling people that we can't . . . is how we've built our reputation. Both customers and non-customers will tell you it's true. And, it's good to be true.
Matter of fact, we're seriously thinking of adopting a customer's suggestion for the slogan of our company: "People doing things that matter . . . imaginatively!"

OSCILLATORS, 1 Hz to 12 GHz • TCXO • VCXO • TC/VCXO • Precision Standards • Microwave Sources

EROS NO.	TYPE	FREQUENCY	STABILITY	TEMP. °C.	MISC.	SIZE
600 EC-23	TCXO	5 MHz	1 ppm	−55 to +85	aging 1 ppm/yr.	2.0x1.0x0.6
600 RA-35	TCXO	100 MHz	3 ppm	−55 to +95	aging 3 ppm/yr.	2.5x3.5x1.1
600 R46	TCXO	10.0 kHz	0.5%	0 to +50	aging 0.5%/yr.	1.5x1.5x.34
600 SG-S5	TCXO	3.0 MHz	0.5 ppm	−40 to +70	aging less than 1 ppm/yr.	2.0x2.0x.65
600 F-18	TCXO	5 channel 4.0 kHz to 12.0 kHz	0.1%	−55 to +125	simultaneous frequency outputs	3.480x2.4x.75
400 EC-20	VCXO	10.0 MHz	10 ppm	−55 to +80	dev. ±10 kHz linearity less than 2%	3.0x2.02x1.40
400 SL 47	VCXO	4.6 MHz	.002%	−35 to +85	dev. ±85 ppm sens. ±22 ppm/v	3.0x1.75x1.0
800 CM 26	STD.	1.0 MHz	$5x10^{-11}$/°C.	0 to +55	aging $5x10^{-10}$/day	2x2x4
800 DL 8	STD.	10.0 MHz	$5x10^{-9}$	0 to +50	aging $1x10^{-9}$/day	2x2x4
MO-RA 34	MICRO	1.369 GHz	±.05% w/o phase lock	−55 to +85	phase lock to crystal	2.5x5.0x1.2

***DIP hybrid oscillator: hermetically sealed,** our EROS-200 has a frequency range of 100kHz to 15MHz, ambient stability of ±.005%, ambient range of −55° C. to +105° C., **output voltage that is compatible with 10 T²L loads,** will withstand vibrations of 35G peak to 2kHz, shock of 500G 1 mSec. half-sine, acceleration to 10,000G, and is packaged in a 14 lead DIP that measures **.515″x.875″x.200″.** If that won't do it, we can supply radiation hardened units!

CRYSTALS, Coldweld • Metal Can • Complete frequency range from 2kHz to 200MHz with total QPL approval on nearly all military crystals to MIL-C-3098E. Precision coldweld crystals for applications needing superior long term aging, maximum reliability and crystal Q. Aging rates of 5×10^{-10}/day now being achieved on precision time base crystals. Improved process techniques provide for production of tight tolerance temperature crystals for use in Temperature Compensated Crystal Oscillators (TCXO's).

FILTERS: • **CRYSTAL:** 2 kHz to 100 MHz; Bandpass, Sideband, Rejection, Linear Phase, Monolithic, Discriminators • **L C:** DC to 150 MHz; Bandpass, Lowpass, Highpass, Rejection • **ACTIVE:** DC to 1 MHz; Bandpass, Lowpass, Highpass • **R F COAXIAL:** 100 MHz to 1 GHz, Bandpass, Lowpass, Highpass.

ER NO.	TYPE	FREQUENCY	BANDWITH	TEMP. °C.	SIZE
23600 BANDPASS	CRYSTAL	20.0 MHz	6 db 35 kHz 60 db 60 kHz	−55 to +100	0.625x1.312x0.5
11500 BANDPASS	CRYSTAL	75.0 MHz	6 db ±12 kHz 70 db 70 db ±400 kHz (70 ultimate)	−55 to +90	1.0x2.19x0.75
15700 BANDPASS	CRYSTAL	20.6 MHz	6 db 36 kHz 60 db 70 kHz 100 db 600 kHz (100 db ultimate)	−54 to +70	2.380x1.32x.80
10800 DISC.	CRYSTAL	8.8 MHz	±20 kHz p to p 6% linearity	−55 to +110	1.75x1.25x.5
AI-3 LOWPASS	RF COAXIAL	400.0 MHz	0.3 db 200 to 400 MHz 58 db 520 MHz to 900 MHz	−55 to +125	1.266x3.380x0.75
1079 BANDPASS	LC	500 kHz	6 db 90 kHz 60 db 150 kHz	−55 to +125	3.19x.82x.82
1217 BESSEL	LC	61.0 MHz	3 db 1.9 MHz time delay 325 nsec ins. loss 6 db	−40 to +80	4.5x2.25x1.10
AF-SA-6 TUNEABLE	ACTIVE	340 Hz	Lowpass 340 Hz Highpass 2-100 Hz	0 to +70	2.5x3.5x0.75

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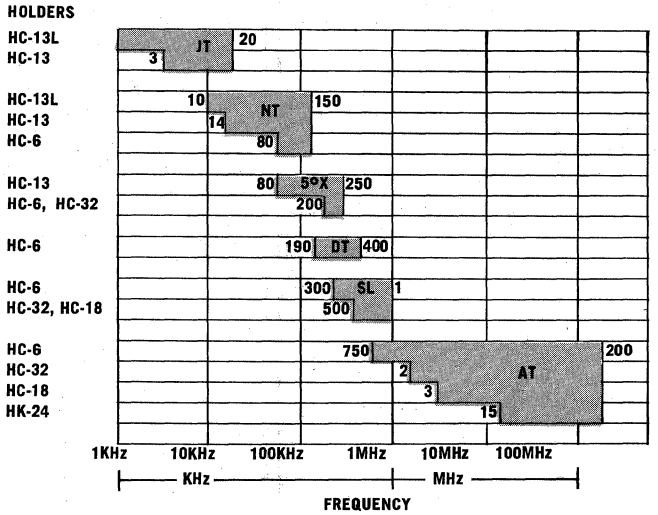
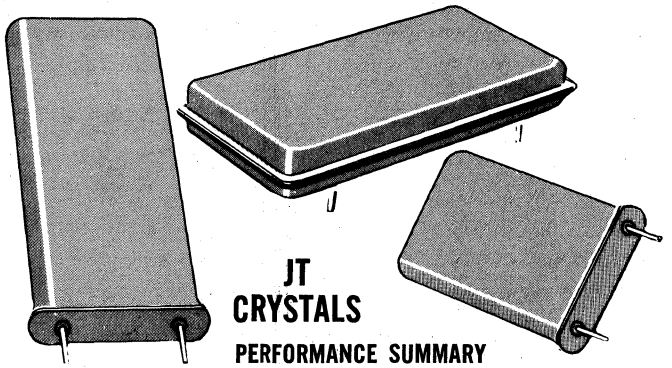
QUARTZ CRYSTALS

MAJOR CRYSTAL TYPES—FREQUENCY vs. HOLDERS



The JT Cut and the Reverse JT manufactured by Erie Frequency Control covers the frequency range from 400 Hz to 20 KHz providing low resonant frequencies and a small temperature coefficient making this product extremely important to the stability of audio frequency controls. Crystals are manufactured to full compliance with CR-88A/U specifications covering this frequency range.

Erie is proud that one of the predecessor firms to the Erie Frequency Control Division was Hill Electronics, Inc., with specialized capabilities in the manufacture of JT crystals, both for their own use in single and very narrow multiple frequency filters, stable regulation of sonar frequency oscillators and for use in military communication gear. Erie believes it is the leading producer of audio frequency crystals. Many thousands of these units have been made for military as well as tight commercial requirements. Erie has made over 100,000 units in the 4.000 KHz to 4.4057 KHz range alone and has unique capabilities in their application to filter design.



JT CRYSTALS

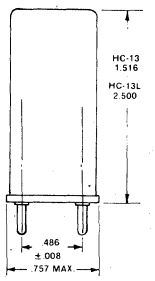
PERFORMANCE SUMMARY

General — A length thickness flexure type crystal, manufactured by Duplexing two 5° x cut crystals into one bar.

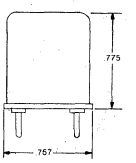
Frequency Range	400 Hz - 3 KHz	3 KHz - 20 KHz
Holder Type	HC 13 Long	HC 13/U
Height	2½"	1½"
Seal	Solder	Solder
Type Coldweld	Not Available	CW 13

Nominal Frequency Tolerance	±.015% −40°C to +70°C
Best Frequency Tolerance	±.010% −40°C to +70°C
Zero Temperature Coefficient	25°C
Resistance	See graph
Q Range	25000
Aging	≤ 1×10^{-6}/day initial and ≤ 2×10^{-7}/day after 3 months.

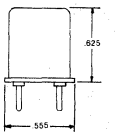
CRYSTAL HOLDERS



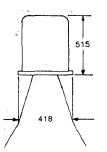
HC-13
1 KHz - 250 KHz
PIN DIA. .050
SPACING .486
THICKNESS .350



HC-6
80 KHz - 200 MHz
PIN DIA. .050
SPACING .486
THICKNESS .350

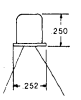


HC-32
200 KHz - 1 MHz
2 MHz - 200 MHz
PIN DIA. .040
THICKNESS .225
SPACING .275



HC-25/HC-18
500 KHz - 1 MHz
3 MHz - 200 MHz
LEAD DIA. .017
SPACING .192
THICKNESS .166

Variations in lead length, diameter, ground pins and mounting available in all holder sizes upon request.

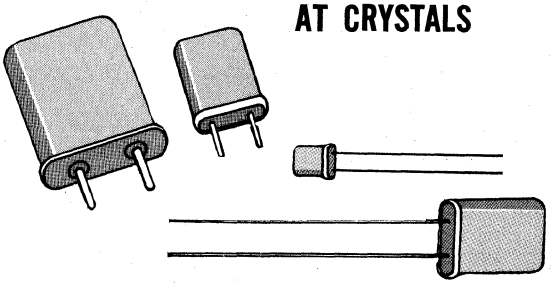


HK-24
15 MHz - 200 MHz
LEAD DIA. .015
SPACING .080
THICKNESS .124

PERFORMANCE SUMMARY

General — A Thickness — shear type crystal, manufactured by controlled lapping of miniature substrates to exact thickness dimensions.

AT CRYSTALS



Frequency Range	750 KHz 200 MHz	2 MHz 200 MHz	3 MHz 200 MHz	15 MHz 200 MHz
Holder Type			HC-18	
	HC-6	HC-32	HC-25	HK-24
Height	.775"	.625"	.515"	.250"
Seal	Solder	Solder	Solder	Solder
Type Coldweld			HC-25C.W.	
	HC-6C.W.	N/A	HC-18C.W.	N/A

Nominal Frequency Tolerance	±.005% from −55°C to +105°C
Best Frequency Tolerance	±.0025% from −55°C to +105°C ±.0005% from − 5°C to + 60°C
Zero Temperature Coefficient	Per customer spec between +25°C and +100°C
Q Range	50 K to 500 K (function of frequency range)
Aging	≤ 2×10^{-8}/day initial ≤ 5×10^{-9}/day after 3 months

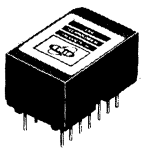
ERIE FREQUENCY CONTROL
Division of Erie Technological Products, Inc.
499 LINCOLN STREET / CARLISLE, PENNSYLVANIA 17013
TELEPHONE(717) 249-2232 / TELEX 084-2328

CRYSTAL OSCILLATORS

STANDARD AND CUSTOM DESIGNS

TTL DIP PACKAGE CRYSTAL OSCILLATORS

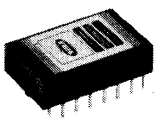
New low cost Oscillator for computers, data communications and timing circuitry.



20A01111

Frequency Range: 4 to 20 MHz
Size: .375″ H. x .78″ L. x .49″ W.
Stability: ±0.01
Input Voltage: +5 Vdc
Power: 15 ma
Output: TTL Comp.
Temp. Range: 0°C to 60°C
Source Max. Impedance: 10 ± j 10Ω

TTL DIP PACKAGE CRYSTAL OSCILLATORS WITH HERMETICALLY SEALED CRYSTAL

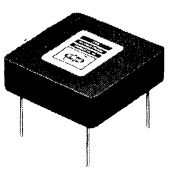


20A01046

Size: .20″ H. x .78″ L. x .49″ W.
Frequency: 15 MHz to 25 MHz
Input Voltage: +5 Vdc ±5%
Wave Form: Square
RT & FT ≤ 7.5 NS
0 State .4 ma max. @ 20 ma Sink
1 State 2.4 V min. @ −500 μa Source
Stability: ±25 PPM over Temperature Range
Setting Accuracy: ±100 PPM @ 25°C ±3°C
Temperature Range: 0°C to 70°C

CMOS COMPATIBLE CRYSTAL OSCILLATORS

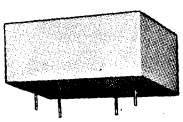
For time reference, computer clock, marker generator and transceivers.



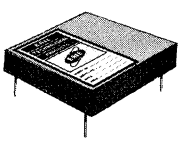
20A01089

Size: .312″ H. x 1.0″ L. x 1.0″ W.
Frequency: .01 Hz to 5 MHz
Input Voltage: 3 to 15 Vdc
Input Cur.: @ 6 Vdc & freq. @ 3 MHz—1 ma max.
Output: CMOS Compatible
Stability vs. Temperature:
±25 ppm — 0°C to +70°C
±5 ppm — −55°C to +125°C
±5 ppm — 0°C to +50°C
Setting Accuracy: ±100 ppm @ 25°C
For frequencies below 3.00 MHz, the package increases 1.5″ sq. x .40″ H.

LOW COST TTL CRYSTAL OSCILLATORS



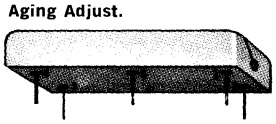
20A0183



20A01084

Frequency Range: 3 MHz to 15 MHz
Input Voltage: +5 Vdc ±5%
Input Current: 20 ma max.
Setting Tolerance: ±20 PPM
Frequency vs. Temp.: ±50 PPM over 0°C to 70°C
Frequency vs. VCC: ≤ ±1 PPM / ±5%
Frequency vs. RL: ≤ ±1 PPM / ±10%
Aging:
±10 PPM first 30 days / ±5 PPM/yr. thereafter
Wave Form: TTL compatible logic "1" 2.4 V min. "0" .4 V max.
Symmetry: 50/50 ±10%
Rise & Fall Time: 20 Nanosec. max.
Fanout: 10 7400/5400 Series
Material: Diallyl phthalate glass filled

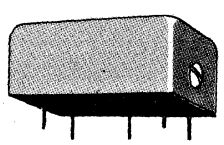
- **True F-M**
- **Supply Regulation**
- **Oscillator Buffering**
- **Linearization**
- **Small Size**
- **Low Cost**
- **Aging Adjust.**



20V01021 VCXO

Frequency: 40 GHz to 80 MHz
Power: +12 Vdc @ 20 ma max.
Output: 1 mw or logic
Stability:
±0.005% 0°C to +50°C
Deviation: ±0.05%
FM Linearity: 3% max.
Response: ±3 db DC to 20 KHz 0 db ref. @ 1 KHz

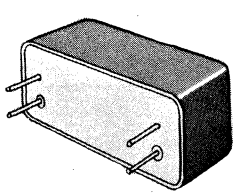
- **Low Power**
- **High Stability**
- **Small Size**
- **Low Cost**
- **Voltage Control Option**
- **Machined Aluminum Cavity**



20B01020

Frequency: 1 MHz to 10 MHz
Stability:
±5 x 10^{-9}/24 hours
±1 x 10^{-8} 0 to 70°C
Power: +12 Vdc @ 3 Watts max. @ 0°C
Size: 1.5″ x 1.5″ x 3″ Long

CRYSTAL FILTERS



Erie offers a complete line of crystal Bandpass and Reject Filters. Modern computerized designs are available to synthesize any of the following types: Butterworth, Chebyshev Elliptic Function, Bessel Function and Gaussian. 1-10 pole designs are standard with higher order types available. Comb set, multiple channel or BW and matched sets are also readily available. Units are rugged, compact and most can be designed to meet the environmental requirements of Mil-F-18327.

Center Frequency:
1 KHz to 50 MHz
Bandwidth:
.005% to 10%
Shape Factor:
As steep as 1/1.4 (6 db/60 db)
Ripple:
Generally less than 0.5 db
Insertion Loss:
Usually less than 3.0 db
Ultimate Attenuation:
100 db Max.
Max. Operating Temperature:
−55°C to +125°C

Erie manufactures a long line of high stability, high reliability frequency sources utilized in military and space work and other high technology areas. As these units are custom, we welcome your inquiries and specifications.

FOR OSCILLATORS AND FILTERS, CHECK ERIE'S CAPABILITIES, PRICES, DELIVERIES

HOW TO USE eem

electronic engineers master

1973-74

Need directory information?

EEM contains four complete directories which provide the most up-to-date information available. These directories are listed and described at the right. They appear in all three volumes, with the exception of the Trade Mark Directory which appears only in Volume 1. Directory references to Volume 4 indicate the 1973 edition, which you received in January. That copy of Volume 4 should be retained to complete the 4-volume set.

Add Volume 4/1973 to your copies of Volumes 1, 2 and 3 to make a complete set of **EEM** for 1973-74.

UNITED TECHNICAL PUBLICATIONS

Included in this volume are:

The Product Index and Directory

The Product Index and Directory (green section, page 9) lists more than 6,000 types of electronic products alphabetically, by product. Under each product heading is a complete, alphabetical listing of manufacturers who make that product. **Bold face** listings indicate which manufacturers have provided catalog data on that product in the white pages.

The Manufacturers and Sales Office Directory

The Manufacturers and Sales Office Directory (starts yellow section of each volume) lists more than 3,000 manufacturers of electronic components, materials, instruments, assemblies, systems, and key services. Provided are complete addresses, phone numbers, sales managers' names, names of application engineers, TWX numbers where applicable, selected distributors. **Bold face** listings indicate that manufacturers have provided catalog data in the white pages and that sales offices are listed.

The Distributor Directory

The Distributor Directory (yellow section, page 1594, with black edge marking) lists more than 1,000 electronic distributors and branch locations, alphabetically by distributor's name, geographically by state and city.

Need catalog information?

For complete catalog information on any product, refer to the Product Index and Directory (green section, page 9, all volumes) which provides a complete listing of all the manufacturers who supply a particular product. Those manufacturers listed in bold face with page and volume number references have provided catalog data on this product in the catalog section (white pages) where you can find the information you need. References to Volume 4 indicate the Volume 4 you received in January and which should be retained to complete your 4-volume set of EEM.

Need additional information in a hurry?

Two special telephone services are being maintained for EEM users to provide extra information you need. If you need to determine a local source of supply, just **D.I.A.L. EEM.** This toll-free service (**D**istributor **I**nformation **A**nd **L**istings), provides you with the name of a sales office or distributor in your area who can provide a needed product.
For up-to-the-minute listings of manufacturers who provide certain IC functions, **call the IC UPDATE HOTLINE.** Listings of IC functions are updated daily by manufacturers throughout the country. For information in a hurry, **just D.I.A.L. EEM** — call toll-free 800-645-9200 (in N. Y. State call collect (516) 294-0990). Or **call The IC UPDATE HOTLINE,** Dial toll-free 800-645-9201.

Need additional assistance?

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W H FERWALT, INC.

LAPWAI, IDAHO 83540
PHONE: (208) 843-2281

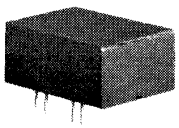
PRECISION OSCILLATORS

.0005 Hz TO 75 MHz

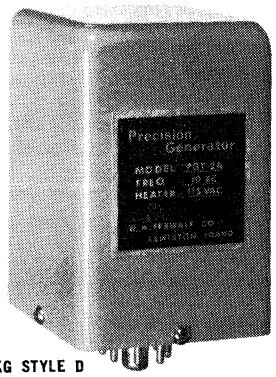
OVEN & NON-OVEN • VOLTAGE CONTROLLED
CRYSTAL CONTROLLED • LC & RC • PHASE LOCK
TEMPERATURE COMPENSATED • DRIVES INTEGRATED CKTS
CMOS TTL DTL RTL ECL & OTHERS

GENERAL CHARACTERISTICS AVAILABLE —

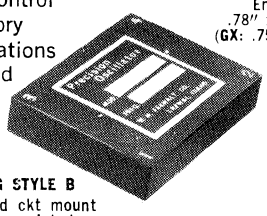
- Square-wave or Sine-wave output
- Manual trim or preset to ±.001% or better
- Supply voltages to suit customer requirements
- Internal dividing and gate control
- Special logic gating or memory
- Shock and vibration specifications
- Mil approved parts when req'd



PKG STYLE G
I.C. plug-in
Encapsulated
.78″ x 1.125″ x .5″
(GX: .75″ x 1.5″ x .5″)

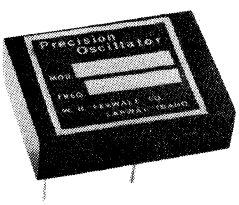


PKG STYLE D
Octal plug-in
Removable cover
2.0″ x 2¼″ x 3⅝″

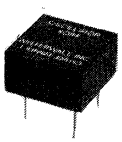


PKG STYLE B
Printed ckt mount
Encapsulated
1.9″ x 2.5″ x .5″
(BY: 1.9″ x 2.5″ x 1.0″)

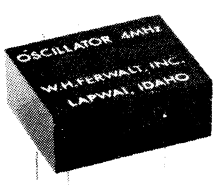
PKG STYLE J
Printed ckt mount
Encapsulated
1.25″ x 1.25″ x .5″
(JX: 1.25″ x 1.25″ x .32″)



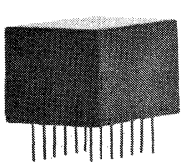
PKG STYLE A
Printed ckt mount
Encapsulated
1.5″ x 2.0″ x .56″
(AX: Without mtg. hole)
(AC: 7 pin plug-in; stud mt.)



PKG STYLE H
Printed ckt mount
Encapsulated
.875″ x .875″ x .5″



PKG STYLE F
Printed ckt mount
Encapsulated
1.0″ x 1.25″ x .5″



PKG STYLE K
I.C. 14 pin D.I.P.
.485″ x .78″ x .45″

Model Series	Frequency Range	Stability	Temperature Range	PK-to-PK Output	Load	Supply Voltage	Pkg. Style	1-9 Price Range[4]
CRYSTAL OSCILLATORS — NO OVEN REQUIRED								
X032	12.5KHz to 5.99MHz	±.003 to ±.01%[4]	0°C to +75°C[2]	3V Square[3]	25 DTL	+5V	A	$72 to $106
X032C	6MHz to 30MHz	±.003%	0°C to +75°C[2]	3V Square[3]	9 TTL	+5V	A	$82 to $92
X033	.001Hz to 30MHz	±.003%	0°C to +75°C[2]	3V Square[3]	9 DTL/TTL	+5V	B	$74 to $190
X045	1MHz to 5MHz	±.001%	+10°C to +50°C	.63V Sine	50 ohms	+15V	AC	$109.20
X071	200KHz to 20MHz	±.003%	0°C to +75°C[2]	3V Square	9 DTL/TTL	+5V	G	$70 to $88
X081	12.5KHz to 199KHz	±.003%	0°C to +75°C[2]	3V Square	9 DTL/TTL	+5V	GX	$98 to $116
X082	190KHz to 30MHz	±.003%	0°C to +75°C[2]	3V Square	9 DTL/TTL	+5V	F	$58 to $78
X094	190KHz to 16MHz	±.003%	0°C to +75°C[2]	3V Square	9 DTL/TTL	+5V	H	$65 to $84
X096	10MHz to 16MHz	±.005%	0°C to +70°C	1V Square	3 ECL	−5V	JX	$62.07
X0100	.005Hz to 3MHz	±.007%	−40°C to +85°C[2]	12V Square[5]	50 CMOS[5]	+12V	A	$75 to $150
X0110	4MHz to 10MHz	±.01%	0°C to +70°C	3V Square	10 TTL	+5V	F	$34 to $44
X0111	250KHz to 3.99MHz	±.01%	0°C to +70°C	3V Square	10 TTL	+5V	J	$36 to $50
X0112	63Hz to 249KHz	±.01%	0°C to +70°C	3V Square	10 TTL	+5V	AX	$43 to $70
X0120	500KHz to 20MHz	±.01%	0°C to +70°C	3V Square	9 TTL	+5V	K	$62 to $99
X0123	7.5KHz to 60KHz	±.01%	0°C to +50°C	1.5V Sine	10K ohms	+5V	A	$120.79
X0181	12Hz to 12.49KHz	±.003%	0°C to +75°C[2]	3V Square	1 TTL	+5V	GX	$126 to $149
TCX034	.0005Hz to 30MHz	±.0001%[1]	0°C to +50°C	3V Square[3]	9 DTL/TTL	+5V	B	$158 to $348
TCX056	100KHz to 30MHz	±.0001%[1]	0°C to +50°C	3V Square[3]	9 DTL/TTL	+5V	A	$158 to $177
TCX0101	.005Hz to 10MHz	±.0001%[1]	0°C to +50°C	12V Square[5]	50 CMOS[5]	+12V	B	$160 to $235
TCX0101A	.005Hz to 10MHz	±.0005%[1]	−55°C to +75°C	12V Square[5]	50 CMOS[5]	+12V	B	$203 to $315
ULF55	7.5Hz to 30KHz	±.01%	0°C to +50°C	3V Sine	10K ohms	+12V	D	$147 to $182
CRYSTAL OSCILLATORS — OVEN VOLTAGES: 115VAC, 28VDC, 6.3VAC, or OTHERS								
PGX50	65KHz to 17MHz	±.1PPM	0°C to +50°C	3V Sine	1K ohms	+28V	D	$189 to $245
PGX63	1Hz to 30MHz	±.1PPM	0°C to +50°C	3V Square[3]	1.5K ohms	+12V	D	$208 to $330
PGX99	1MHz to 5MHz	±.5PPM	−55°C to +80°C	8V Sine	470K ohms	+27V	—	$170
LC AND RC OSCILLATORS								
LC035	70KHz to 5MHz	±.5%	0°C to +85°C	2V Sine	10K ohms	+12V	A	$34.90
LC01028	733KHz to 5MHz	±1%	−50°C to +100°C	2V Sine	1K ohm	+12V	J	$51.21
PS057	10Hz to 40KHz	±1%/±2%[4]	0°C to +50°C	6V Sine	10K ohms	+12V	A	$39 to $46
RC036A	1Hz to 1MHz	±2%	−20°C to +85°C	3V Square[3]	8 DTL/TTL	+5V	A	$34 to $59
RC036B	1Hz to 1MHz	±1%	0°C to +75°C	3V Square[3]	8 DTL/TTL	+5V	A	$32 to $52
UJ039A	.1Hz to 100Hz	±2%	0°C to +50°C	3V Square	1.5K ohms	+12V	A	$25.50
RC0109	1Hz to 1MHz	±1%	0°C to +50°C	2.5V Sine	600 ohms	+15V	B	$62 to $83

VOLTAGE CONTROLLED OSCILLATORS (3V SQUARE WAVE OUTPUT EXCEPT VC0114 IS 3V SINE

Model Series	Center Frequency Range	Dev.	Input	Stability	Temperature Range	Load	Supply Voltage	Pkg. Style	1-9 Price Range[4]
VC047	1Hz to 75MHz	±10%	0V to −7V	±3%	0°C to +75°C	9 TTL	+5V	B	$82 to $159
VC068	5Hz to 15KHz	±10%	0V to −7V	±.5%	0°C to +75°C	9 TTL	+15V	B	$73 to $94
VCX0103	1Hz to 20MHz	±.01% to ±10%	±3V or 0V to +6V	±.0001% to ±1%	0°C to +50°C	5 TTL	+5V	BY	$257 to $380
VCX0255	1Hz to 30MHz	±.005%	0V to +6V	±.003%	0°C to +75°C	9 TTL	+5V	B	$99 to $176
VC0114	300Hz to 10KHz	±60%	+1.5V to +9V	±5%	+10°C to +44°C	125 ohms	+6V	B	$178.70
VC0115	60Hz to 50KHz[6]	0 to 100%	0V to +10V	±.1% F.S.	+15°C to +55°C	10 TTL	±15V	B	$120 to $124

[1] ±2 in 10^8 per day at constant ambient.
[2] For ±.01% over −55°C to +125°C add "A" to Model No. (Price increases).
[3] Sine wave filter options available: 1mw/50 ohm to 3VRMS/10K depening on frequency.
[4] Depending on frequency.
[5] TTL option available.
[6] Full scale frequency.

W. H. FERWALT, INC.

HWY. 95 & WEBB ROAD LAPWAI, IDAHO 83540 PHONE (208) 843-2281

OSCILLATORS

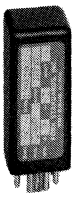
From FORK STANDARDS

Thousands of Frequencies — In Dozens of Packages

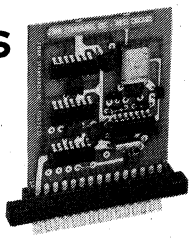
Precise Frequency Sources For Your Every Application

PLUG-IN TYPES

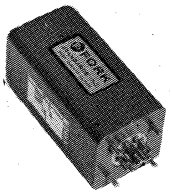
MODEL G, GQ
1½" sq.



MODEL T
1/64" sq.



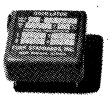
MODEL CQ
2½" W x 3¼" H



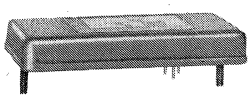
MODEL DQ
2" sq.

MODEL	FREQUENCY RANGE (WAVEFORM)
G, GQ — General Purpose:	.00001 Hz to 20 MHz (square wave); 1 Hz to 40 MHz (sine wave)
T — Economy:	400 Hz to 15 kHz (square wave)
CQ — Card:	50 Hz to 15 MHz (square wave)
DQ — Oven Stabilized:	.00001 Hz to 20 MHz (square wave); 1 Hz to 40 MHz (sine wave)

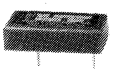
BOARD MOUNTING TYPES



MODEL FO, UQ
1½ sq.



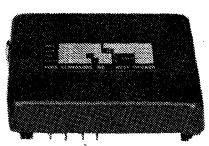
MODEL P, PQ
1½" x 3½"



MODEL LO, LQ
1½" x ¾"

MODEL EQ1
1⅛" sq.
MODEL EQ2
.5" x .785" x .45" H

MODEL AQ
1⅛" x 1⅝"



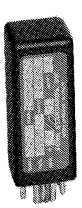
MODEL R, RQ
3⅛" sq.

NEW!
MODEL BQ
2" sq.

MODEL	FREQUENCY RANGE (WAVEFORM)
AQ — Economy High Frequency:	180 kHz to 20 MHz (square wave)
BQ — Compact: especially for low frequency sine wave:	.00001 Hz to 20 MHz (square wave); 1 Hz to 40 MHz (sine wave)
EQ1, EQ2 — DIP Packaged:	.01 Hz to 20 MHz (square wave)
FO — Compact Low Frequency:	.001 Hz to 15 kHz (square wave); 1000 Hz to 15 kHz (sine wave)
LO, LQ — Miniature:	.01 Hz to 20 MHz (square wave)
P, PQ — Stud Mount: extended range:	.00001 Hz to 20 MHz (square wave); 1 Hz to 40 MHz (sine wave)
R, RQ — Largest Case: versatile:	.00001 Hz to 20 MHz (square wave); 1 Hz to 40 MHz (sine wave)
UQ — Compact Crystal:	.0001 Hz to 20 MHz (square wave); 1000 Hz to 40 MHz (sine wave)

ECONOMY TYPES

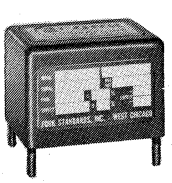
MODEL AQ
1⅛" x 1⅝"



MODEL T
1/64" sq.

MODEL	FREQUENCY RANGE (WAVEFORM)
AQ — Board Mount High Frequency:	180 kHz to 20 MHz (square wave)
CQ — Card Mounted:	50 Hz to 15 MHz (square wave)
T — Plug-In:	400 Hz to 15 kHz (square wave)

MIL-SPEC TYPES



MODEL S
2¼" x 1 1/16"

MODEL FO
1½" sq.

MODEL G, GQ
1½" sq.

Fork Standards oscillators such as the Model S have been designed and built to meet applicable military specifications MIL-E-5400 and MIL-E-16400 and satisfy the requirements of other high-reliability programs. Most other Fork standards oscillators can be supplied to meet the same or similar specifications; our inspection system is approved to MIL-I-45208A.

Consult Fork Standards regarding all of your specific military and aerospace requirements.

Fork Standards also makes Precise Frequency Power Inverters, Clock Motor Drivers, Frequency Divider Modules, DC Power Supply Modules, Tuning Fork Resonators.

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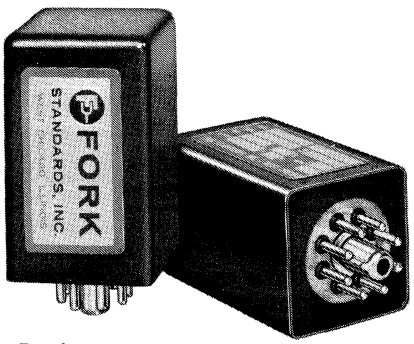
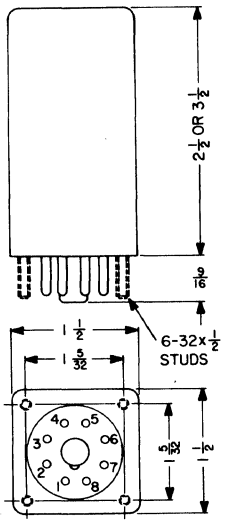
OSCILLATORS

PLUG-IN MODELS G, GQ





Terminals:
1—Common (output and supply negative)
2—NC (spare)
3—Output
4—Power supply positive
5-7—Spare (if provided)
8—Case ground

OUTPUT/FREQUENCY RANGE

OUTPUT / MODEL	SINE WAVE TYPE AA: 1 Hz up AT, DT: 200-20000 Hz	SQUARE WAVE TYPES B, BL, BN, BB
G (Tuning Fork)	1 - 15000 Hz	.00001 - 15000 Hz
GQ (Crystal)	1 Hz - 40 MHz	.00001 Hz - 20 MHz

SPECIFICATIONS

Weight: 4-7 oz. (120-210 gm)

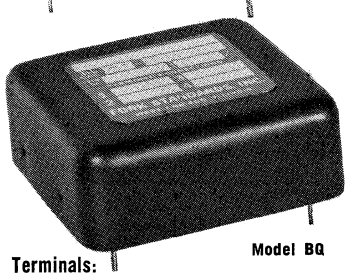
Supply: 5 or 12 VDC

Accuracy:
Tuning Fork (Model G): to .01% (Classes 2 - 5)
Crystal (Model GQ): to .001% (Classes 6, 7)

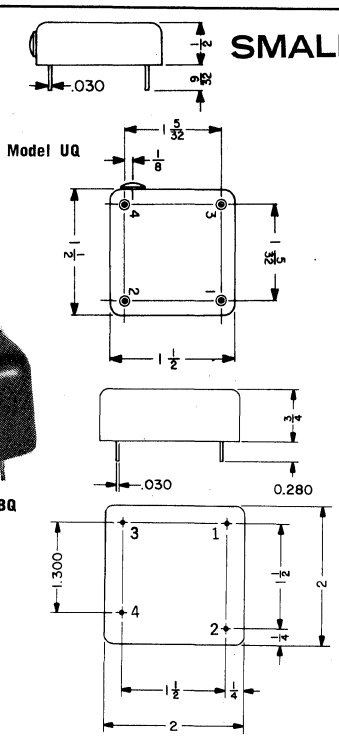
Price: $65-285 (1-9). Example: G-2C-1000-BN-12 (1000 Hz square wave, .1% accuracy, 0 - 65°C, 12 VDC) — $65

OEM and quantity discounts apply.

SMALL BOARD-MOUNT MODELS UQ, BQ



Model BQ



Terminals:
1—Common (output and supply negative)
2—NC (may be case ground or special)
3—Output
4—Power supply positive

OUTPUT/FREQUENCY RANGE

OUTPUT / MODEL	SINE WAVE TYPE AA: 25 Hz up AT, DT: 200-20000 Hz	SQUARE WAVE Types: B, BL, BN
UQ*	1000 Hz - 40 MHz, .6″ h.	.0001 Hz - 20 MHz, .5″h.
BQ	1 Hz - 40 MHz	.00001 Hz - 20 MHz

* Type AA sine wave only; square wave .6″ h. below 1 MHz.

SPECIFICATIONS

Weight: Model UQ, 1.75 oz. (49 gm); **Model BQ,** 3 oz. (90 gm) max.

Supply: 5 VDC preferred; to 15 VDC available

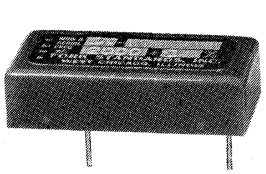
Accuracy: to .001% (Classes 5, 6, 7)

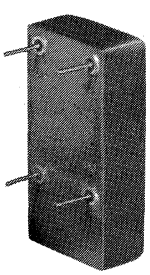
Price (Model UQ): $59-299 (1-9). Example UQ-7A-1M-BL-5 (1 MHz square wave, .001% accuracy, 15-35°C, 5 VDC) — $79

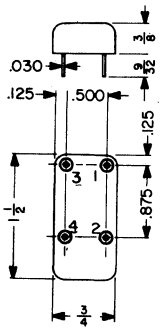
Price (Model BQ): $64 -299 (1-9): BQ-5C-400-AA-12 (400 Hz sine wave. 0.1% accuracy, 0-65°C, 12 VDC) — $141

OEM and quantity discounts apply.

MINIATURE BOARD-MOUNT MODELS LO, LQ







Terminals:
1—Common (output and supply negative)
2—NC (may be case ground or internal connection)
3—Output
4—Power supply positive

SPECIFICATIONS

Weight: .66 oz. (17.5 gm)

Supply: 5 or 12 VDC

Frequency Range: .01 Hz to 20 MHz

Accuracy:
Tuning Fork (Model LO): to .01% (Class 4)
Crystal (Model LQ): to .001% (Class 5 - 7)

Output: Square wave, type B, BN or BL

Price: $63-127 (1-9). Example: LQ-5A-200-BL-5 (200 Hz square wave, .005% accuracy, +15 to +35°C, 5 VDC) — $116

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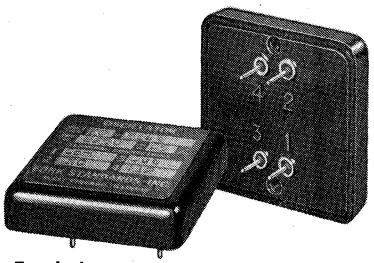
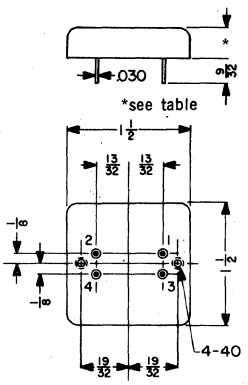
OSCILLATORS

FO SMALL BOARD MOUNT MODEL



Terminals:
1—Common (output and supply negative)
2—NC (internal connection)
3—Output
4—Power supply positive



OUTPUT/FREQUENCY RANGE

OUTPUT / MODEL	SINE WAVE TYPE AA only	SQUARE WAVE Types: B, BL, BN
FO	1000 - 15000 Hz, .5″ h.	.001 - 250 Hz, .6″ h. 250 - 15000 Hz, ⅜″ or .4″ h.

SPECIFICATIONS

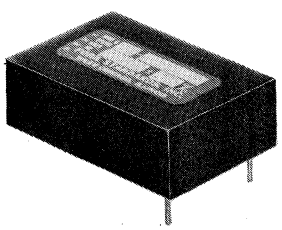
Weight: 1.5 oz. (42 gm) typical

Supply: 5 or 12 VDC

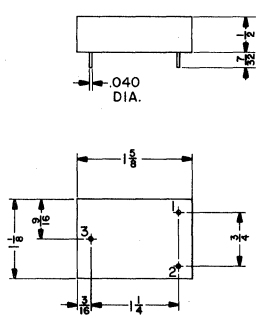
Accuracy: to .01% (Class 5)

Price: $72-326 (1-9). Example: FO-2C-2000-BL-5 (2000 Hz square wave, .1% accuracy, 0 - 65°C, 5 VDC) — $72
OEM and quantity discounts apply.

AQ ECONOMY CRYSTAL MODEL



Terminals:
1—Common (output and supply negative)
2—+5 VDC
3—Output



SPECIFICATIONS

Weight: 1 oz. (30 gm) max.

Supply: 5 VDC

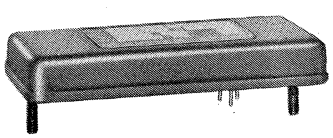
Frequency Range: 180 kHz - 20 MHz

Accuracy: (−55° to +85°C)
1 - 20 MHz = .005%
.18 - 1 MHz = .01%

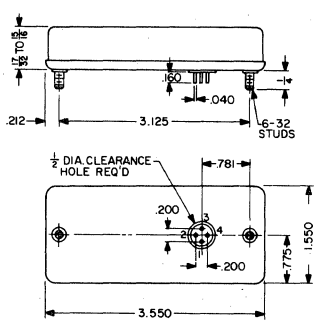
Output: Square wave (Type BL) only

Price: $22.50-32.50 (100 quant.) Example: AQ-200K (200 kHz square wave) — $25.75 (100 quant.)

P, PQ LARGE BOARD MOUNT MODELS



Terminals:
1—Common (output and supply negative)
2—NC (may be case ground or special)
3—Output
4—Power supply positive



OUTPUT/FREQUENCY RANGE

OUTPUT / MODEL	SINE WAVE TYPE AA: 1 Hz up AT, DT: 120-20000 Hz	SQUARE WAVE Types: B, BL, BN
P (Tuning Fork)	1 - 15000 Hz	.00001 Hz - 15 kHz
PQ (Crystal)	1 Hz - 40 MHz	.00001 Hz - 20 MHz

SPECIFICATIONS

Weight: 3½ oz. (100 gm.) max.

Supply: 5 or 12 VDC

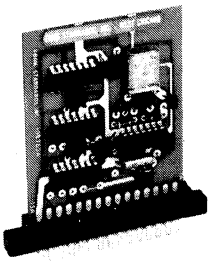
Accuracy:
Tuning Fork (Model P): to .01% (Classes 2 - 5)
Crystal (Model PQ): to .001% (Classes 5 - 7)

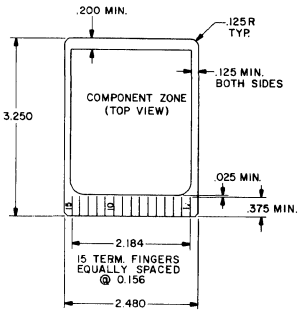
Price: $72-259 (1-9). Example: P-4A-2850-BL-15 (2850 Hz square wave, .01% accuracy, +15 to +35°C, 15 VDC) — $110
OEM and quantity discounts apply.

Note: Large case Fork Standards' oscillators such as the Models P and PQ can be supplied with a wide range of special features such as multiple outputs, gated outputs, amplitude regulated outputs, and very low distortion outputs. Consult Fork Standards' Applications Engineering Department to discuss your specific requirements.

OSCILLATORS

PLUG-IN-CARD MODEL CQ





Terminals:
1—Common
3—Output
15—Power supply positive

SPECIFICATIONS

Weight: 1 oz. (30 gm)

Supply: 5 VDC

Accuracy: to .001% (Class 5 - 7)

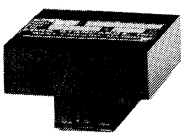
Frequency Range: 50 Hz to 15 MHz

Output: Square wave (Type BL)

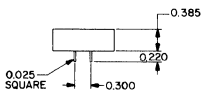
Price: $50 up (1-9). Example: CQ-6A-5M (5 MHz square wave, .0025% accuracy, 15 - 35°C) — $34 (100 quant.)

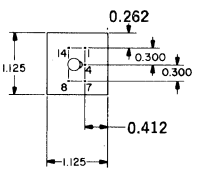
DIP PACKAGED MODELS EQ1, EQ2

Model EQ2



Model EQ1





Model EQ2: .5" x .785" x .45" h.

Terminals:
1—Output
7—Common (output and supply negative
14—Power supply positive

SPECIFICATIONS

Weight: .5 oz. (15 gm)

Supply: 5 VDC

Accuracy: .001% (Class 5 - 7)

Frequency Range: .01 Hz to 20 MHz

Output: Square wave (Type BL)

Price: $51.50-141.00 (1-9). Example: EQ-6C-10M (10 MHz square wave, .005% accuracy, 0-65°C) — $69

OEM and quantity discounts apply.

OTHER OSCILLATORS — RELATED PRODUCTS

The following oscillators are less frequently specified than those already described. Detailed Specification sheets are available upon request, or contact Fork Standards' applications engineers to discuss your specific needs.

MODEL DQ: Model GQ in oven, providing Class 9 (.0001%) or better accuracy over wide temperature range. Snap-action thermostat and proportional-control ovens available.

MODEL R, RQ: Largest case board mount unit, often used when unusual requirements must be met.

MODEL S: Specifically designed for military and aerospace, ruggedized, can be supplied to meet almost any output needs.

MIL SPEC: Most Fork Standards' oscillators can be made and tested to satisfy the requirements of MIL-I-45208A and other MIL Specs. Contact Fork Standards regarding your specific needs.

PRECISE FREQUENCY POWER INVERTERS, CLOCK MOTOR DRIVERS: Outputs from 10-75 VA, 50-1000 Hz (determined by plug-in oscillator). Standard and custom designed.

DIVIDER MODULES: Divide inputs to 5 MHz by 2, 3, 4, 5, 6, 8, 10, 16 or combinations.

SPECIFYING AN OSCILLATOR

Fork Standards' specification numbers completely define the oscillator to which they apply.

For example:

G - 3C - 4K - BL - 5
- G = Model G Case
- 3C = .05% Accuracy, 0 - 65°C
- 4K = 4 kHz Output Frequency
- BL = Square Wave Output for Micrologic Drive
- 5 = VDC Power Supply

OUTPUT OPTIONS

SQUARE WAVE:

B: ⅔ supply voltage, 10 k ohm load

BN: like B with fast rise time and equal symmetry

BB: like BN with two outputs

BL: Micrologic drive

BBL: like BL with complementary outputs

BP: Pulse to drive micrologic

ACCURACY/TEMPERATURE RANGE

Accuracy (%)	+15° to +35°C	0° to +65°C	−25° to +65°C	−40° to +65°C	−55° to +85°C
.2	2A	2C	2F	2N	2J
.1	2A	2C	3F	3N	4J
.05	2A	3C	4F	4N	5J
.01	4A	5C	6F	6N	7J
.005	5A	6C	6F	7N	7J
.0025	6A	7C	7F	8N	*
.001	7A	7C	8F	8N	*
.0005	8A	8C	8F	8N	*
.0001	9A	9C	9F	9N	*

- ☐ Tuning fork, Classes 2 - 5
- ▩ Crystal without oven, Classes 6 - 7
- ▨ Special crystal without oven. Accuracy .0005% from +10° to +60°C. Specify Class 7R.
- ▩ Crystal with oven, Classes 8 - 9. Specify Model DQ.

* Special oven unit. Consult factory.

SINE WAVE

AA: ¼ supply voltage rms, 10 k ohm load

AC: like AA except capacitor isolated

AT: like AA except transformer isolated

DT: 1 mW into 600 ohms, transformer isolated

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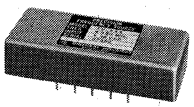
VOLTAGE CONTROLLED OSCILLATORS

We will happily "custom design" units to your exact requirements!



TV-245

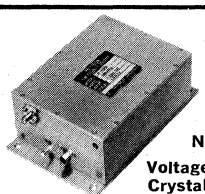
Temperature Compensated Voltage Controlled Crystal Oscillator — High stability without the use of an oven.

PH-229 & PH-230

L-C Voltage Controlled Oscillator— Proportional oven units offer stabilities of ± .001% and frequency deviations to ±10%.

NH-437

Voltage Controlled Crystal Oscillator —Proportional oven unit for FM and phase locked loop applications.

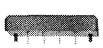


NH-443

Voltage Controlled Crystal Oscillator —High frequency 300 MHz to 600 MHz.

Model Number and Type	Center Frequency Range	Frequency Swing Ranges	Stability	Temperature Range (Centigrade)	Output Level	Input (DC)	Size (inches)	Price
Q-200 RC-VCO	20 Hz to 100 kHz	±10% and ±30%	±.5% ±2%	0 to +50 −40 to +60	Pulse, Square, Sine	+28V	2 x 2 x 4	$275.00 to $375.00
P-360 LC-VCO	1 kHz to 200 MHz	±1% to ±20%	±.2% to ±.4%	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$385.00 to $495.00
PH-229 LC-VCO	100 kHz to 200 MHz	±10%	±.01%/hr. ±.02%/day	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$525.00 to $795.00
PH-230 LC-VCO	100 kHz to 200 MHz	±2%	±.001%/hr. ±.02%/day	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$795.00 to $995.00
N-412 VCXO	1 kHz to 25 MHz	±.01% to ±.1%	±.002% to ±.005%	0 to +50	TTL Logic	+5V	2.56 x 2.94 x .88	$385.00 to $460.00
N-415 VCXO	1 kHz to 3.99 MHz	±.01% to ±.1%	±.002% to ±.005%	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$435.00 to $495.00
N-418 VCXO	4 MHz to 74.9 MHz	±.01% to ±.1%	±.002% to ±.005%	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$385.00 to $485.00
N-420 VCXO	75 MHz to 299.9 MHz	±.01% to ±.1%	±.002% to ±.005%	0 to +50	Sine 1 mw	+28V	3 x 5 x 2	$585.00 to $685.00
N-423 VCXO	300 MHz to 600 MHz	±.01% to ±.1%	±.002% to ±.005%	0 to +50	Sine 1 mw	+28V	3 x 6 x 2	$785.00
NH-437 VCXO	1 MHz to 74.99 MHz	±.01% to ±.1%	$\pm 1 \times 10^{-6}$ to $\pm 4 \times 10^{-7}$	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$535.00 to $635.00
NH-440 VCXO	75 MHz to 299.9 MHz	±.01% to ±.1%	$\pm 1 \times 10^{-6}$ to $\pm 4 \times 10^{-7}$	0 to +50	Sine 1 mw	+28V	2.75x2.75 x 4.63	$785.00 to $885.00
NH-443 VCXO	300 MHz to 600 MHz	±.01% to ±.1%	$\pm 1 \times 10^{-6}$ to $\pm 4 \times 10^{-7}$	0 to +50	Sine 1 mw	+28V	3 x 6 x 2	$985.00
SH-219 Wide-band VCXO	500 kHz to 100 MHz	±.25% to ±.1%	±.001% to ±.005%	0 to +50	Sine 1 mw	+28V	2.75x2.75 x 4.63	$975.00 to $1450.00
TEMPERATURE COMPENSATED VOLTAGE CONTROLLED OSCILLATORS								
TV-245	4 MHz to 19.99 MHz	±.005% to ±.1%	±.0005% to ±.01%	0 to +50	Sine 1 mw	+28V	1.63 x 3.75 x .88	$425.00 to $525.00
TV-246	20 MHz to 70 MHz	±.005% to ±.1%	±.0005% to ±.01%	0 to +50	Sine 1 mw	+28V	2.56 x 2.94 x .88	$495.00 to $595.00
MULTIPLIERS — AMPLIFIERS								
A-100 Power Amplifier	10 MHz to 600 MHz			0 to +50	Sine 1 watt	+28V	2 x 4 x 2	$380.00 to $540.00
A-103 Low Level Power Amplifier	10 MHz to 600 MHz			0 to +50	Sine 100 mw	+28V	2 x 4 x 2	$220.00 to $380.00
XA-100 & XA-103 Multiplier/Amp.	2 MHz to 600 MHz			0 to +50	X2, 3, 4, 6 5 mw	+28V	2 x 4 x 2	$260.00 to $380.00
A-105 High Power Amplifier	10 MHz to 50 MHz			0 to +50	Sine 10 watts	+28V	4 x 1.5 x 1.5	$565.00

NOTE 1. Control voltage for full deviation is ±3V peak. Input impedance is 1000 OHMS. Maximum deviation rate 15 kHz.
2. Amplifiers and multipliers require 1 mw input for full output.

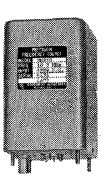


NH-412

Voltage Controlled Crystal Oscillator —Designed to direct-drive all popular types of micrologic. 25 nanosecond maximum rise and fall time.

TV-246

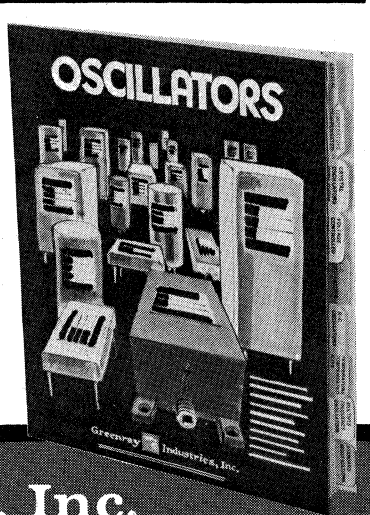
VHF Temperature Compensated Voltage Controlled Crystal Oscillator— Ideal for use with mixers or receivers high stability, low power consumption.



SH-219

Wide Band Voltage Controlled Crystal Oscillator — Uses special techniques for ±1% frequency deviation.

CALL OR WRITE FOR OUR COMPLETE 1973-74 CATALOG



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Greenray Industries, Inc.
840 West Church Road, Mechanicsburg, Pa.
Phone: 717-766-0223 TWX: 510-650-4939

OSCILLATORS and FREQUENCY STANDARDS

OVER 120 STANDARD MODELS IN OUR GIANT CATALOG. FREQUENCY RANGE COVERS FROM .01 Hz TO GREATER THAN 600 MHz, FOR ALL TYPES OF FREQUENCY CONTROL APPLICATIONS.

Model Number and Type	Frequency Range	Stability	Temperature Range (Centigrade)	Output Level	Input (DC)	Size (inches)	Price
L-217 LC	100 Hz to 1 MHz	±.5%	−40 to +70	Sine 1.5V RMS	+28V	2.56 x 2.94 x .88	$89.50
376000A LC	10 MHz to 250 MHz	±.3%	−30 to +60	Sine 1 mw	+28V	2 x 2 x 2	$199.50
Y-819 Crystal	1 Hz to 100 MHz	±.005%	0 to +70	TTL Logic	+5V	2 x 2 x .5	$69.50 to $219.50
Y-1074/1054 Crystal	5 MHz to 25 MHz	±.005%	0 to +70 or −55 to +125	TTL Logic	+5V	.9 x .56 x .35 dual—in-line	$69.50 to $99.50
Y-283-3 Crystal	70 kHz to 150 MHz	±.005%	−55 to +90	TTL or ECL Logic	+5V or −5.2V	2.25 x 1.62 x .75	$149.00 to $249.00
Y-367 Crystal	800 Hz to 150 MHz	±.005%	−40 to +70	Sine 1 mw	+28V	2 x 2 x 1.75	$111.00 to $156.00
Y-657A Crystal	12 MHz to 600 MHz	±.005%	−40 to +70	Sine 1 mw	+28V	1.5 x 3.8 x 1.5	$116.00 to $356.00
Y-906 Crystal	4 MHz to 150 MHz	±.003%	0 to +70	Sine 100 mw	+15V	2.38 x 1 x 1	$249.00 to $298.00
Y-1065 High Power	150 MHz to 600 MHz	±.002%	0 to +50	Sine 1 or 4 watts	+28V	4.5 x 3.38 x 2	$849.00 to $1152.00
Y-876A High Power	10 MHz to 50 MHz	±.003%	0 to +50	Sine 10 watts	+28V	4 x 1.5 x 1.5	$617.00
T-290/291/292 TCXO	10 kHz to 60 MHz	$\pm 4 \times 10^{-6}$	0 to +50	TTL Logic	+5V	1 x 2 x .5	$178.00 to $271.00
T-563—T-569 TCXO	3 MHz to 600 MHz	$\pm 1 \times 10^{-6}$ or $\pm 5 \times 10^{-7}$	0 to +50 or −30 to +70	Sine 1 mw	+28V	2 x 2 x .75 to 3 x 5 x 2	$259.00 to $830.00
T-316 TCXO	12 MHz to 600 MHz	$\pm 5 \times 10^{-6}$	−10 to +60	Sine 1 mw	+28V	1.5 x 1.5 x 3.75	$164.00 to $416.00
YH-859	12 MHz to 600 MHz	$\pm 1 \times 10^{-6}$	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$216.00 to $456.00
YH-841	40 kHz to 150 MHz	$\pm 1 \times 10^{-6}$	0 to +50	Sine 1 mw	+28V	2.56 x 2.94 x .88	$219.00 to $299.00
YH-845	10 MHz to 80 MHz	$\pm 1 \times 10^{-7}$	0 to +70	Sine 1 mw	+28V	1.41 x 2.84 x 1	$659.00
YH-650A	5 MHz to 10 MHz	$\pm 5 \times 10^{-8}$	0 to +50	TTL Logic	+5V	1 x 2.047 x 1	$550.00
YH-852	16 kHz to 70 MHz	$\pm 1 \times 10^{-8}$	0 to +50	Sine 1 mw	+28V	2 x 2 x 4	$359.00 to $395.00
YH-725	1 MHz to 50 MHz	$\pm 1 \times 10^{-8}$	0 to +50	TTL Logic	+5V	2 x 2 x 3	$359.00
YH-278A	40 MHz to 600 MHz	$\pm 1 \times 10^{-8}$	0 to +50	Sine 10 mw	+28V	3 x 6 x 2	$524.00 to $785.00
YH-522-1	1 MHz to 20 MHz	$\pm 1 \times 10^{-9}$	0 to +70	Sine 1 mw	+28V	2.2 x 2.2 x 4.25	$489.00
YH-522-45	20 MHz to 120 MHz	$\pm 1 \times 10^{-8}$	0 to +50	Sine 1 mw	+28V	2.2 x 2.2 x 4.25	$489.00
YH-855	1 MHz to 10 MHz	$\pm 1 \times 10^{-9}$	+20 to +55	Sine 1 mw	+28V	2.75 x 2.75 x 4.63	$690.00
YH-823	100 kHz 1 MHz 5 MHz	$\pm 5 \times 10^{-10}$	+15 to +35	Sine 1 mw	+28V	6.5 x 5.5 x 8	$2250.00
M-400 Multi-channel	1 MHz to 50 MHz up to 12 ch.	±.005%	−40 to +70	Sine 1 mw	+28V	2.56 x 2.94 x 3.063	$490.00
MH-260 Multi-channel	1 MHz to 150 MHz up to 4 ch.	$\pm 2 \times 10^{-6}$	0 to +50	Sine 1 mw	+28V	3.5 x 4 x 4	$845.00
M-391 Multi-channel	10 MHz to 150 MHz up to 20 ch.	$\pm 1 \times 10^{-6}$	0 to +50	Sine 10 mw	115V A.C. 60 Hz	Rack Panel	$975.00
MH-211A Multi-channel	5 MHz to 90 MHz up to 12 ch.	$\pm 1 \times 10^{-7}$	+10 to +50	Sine 1 mw	+28V	3.32 x 3.88 x 4.0	$890.00
YLM-200 Phase-Locked Loop	up to 600 MHz	Locked to external standard.	0 to +50	Sine 1 mw	+28V and +5V	6.75 x 5.38 x 2	Consult the Factory
M-409/410/411 Synthesizer	2000 ch. up to 200 MHz	$\pm 1 \times 10^{-6}$	0 to +50	Sine 10 mw	+12V and +5V	6 x 9 x 3	Consult the Factory

L-217

L-C Oscillators for printed circuit board mounting. Ideal where an AUDIO TONE or an RF signal is required. Used widely in test equipment.

Y-876A

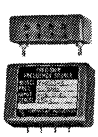
High Power Crystal Oscillator—10 watts output! Excellent for driving multipliers, etc.

Y-367

Crystal Oscillators for printed circuit mounting—3 kHz to 150 MHz.

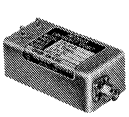
Y-819

Low Cost Logic Clock — Inexpensive high quality clock source.



Y283-3

Crystal Oscillators—designed to direct-drive all popular types of micrologic.

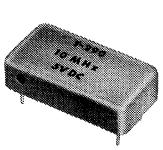


YH-650A

Miniature Oven Controlled Oscillator — High stability where size is extremely important.

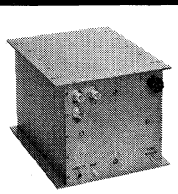
YH-725

High Stability 5 Volt Standard — For use with logic where stability is important.



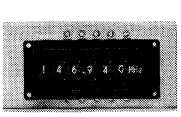
T-290

Miniature Temperature Compensated Crystal Oscillator — Excellent for portable equipment.



YH-823

High Stability Frequency Standard—Excellent Laboratory Standard.



M-411

Digital Frequency Standard — Up to 2,000 channels available in many ranges.

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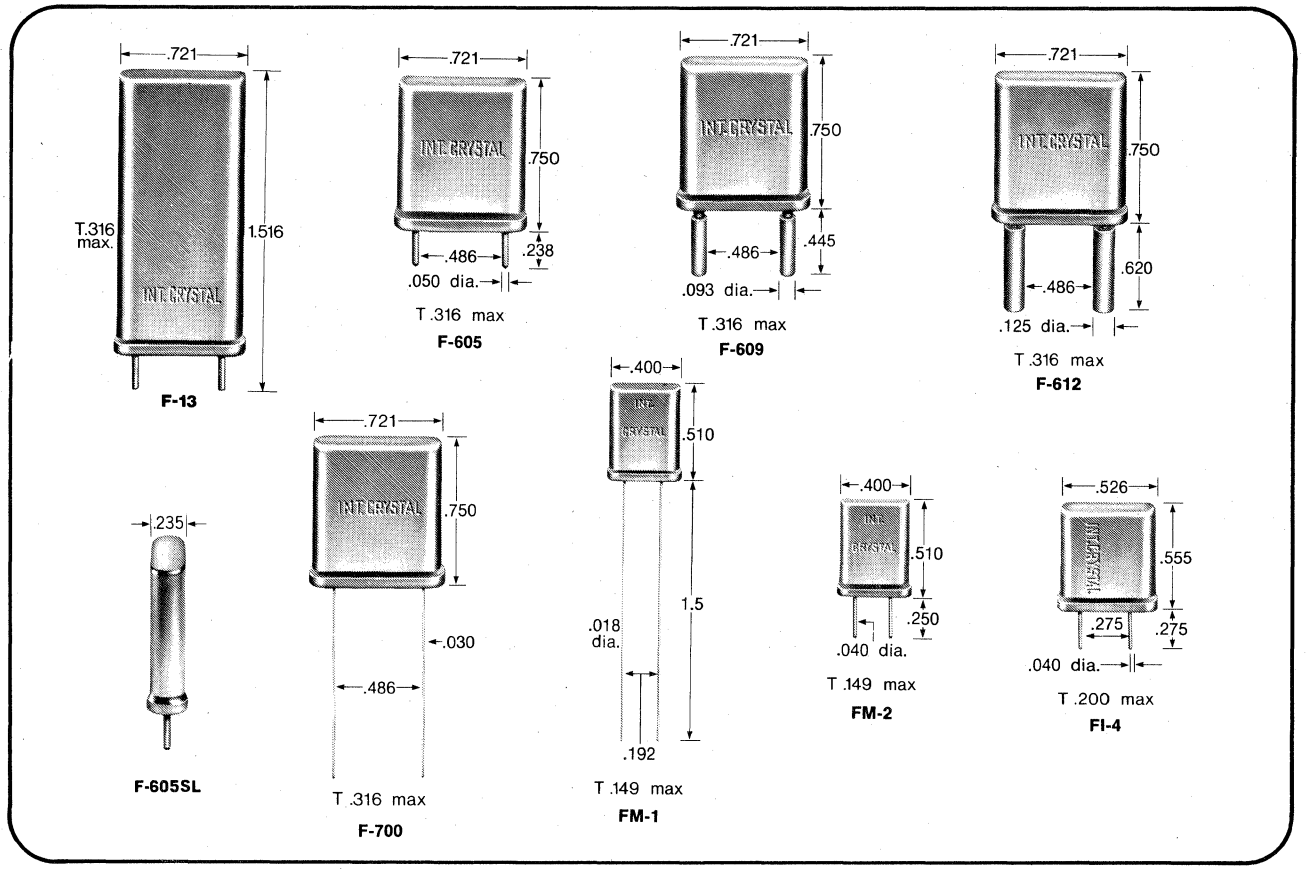
Crystals



Low frequency 70 KHz — 999 KHz

On this page we present our four* most popular crystal mountings and the data for the crystals available in these mountings according to the various frequency ranges.

mode of oscillation

70-184 KHz	Length shear 5°X
185-599 KHz	Edge shear CT & DT
600-999 KHz	Face shear AT

shunt capacitance 7 pf (Max.)

70-200 KHz	10000- 7000 ohms
200-500 KHz	6500-11000 ohms
800-999 KHz	625 ohms

drive (Max.)

70-499 KHz	2 milliwatts
500-999 KHz	10 milliwatts

REMEMBER: Just any crystal and just any oscillator will not combine to produce designated spot frequencies!

DESCRIPTION AND DATA: All of these crystals are of the plated, wire-mounted type. Low drift AT-cut blanks are used in these units above 600 KHz, and low drift CT cut blanks are used in units below 600 KHz; any crystal can be supplied for operation with or without an oven.

TYPE SPECIFICATIONS

1. **General Purpose** (GP) crystals will be calibrated to within ±.02% of frequency when operated into the customer's specified fundamental load capacitance only (32 pf will be used when none is specified). GP crystals 500-900 KHz will hold temperature tolerance of ±.005% from −30° to 60°C and ±.02% for frequencies below 500 KHz.
2. **Commercial Standard** (CS) crystals will be calibrated as noted below, as specified for operation in customer's load. CS crystals will hold temperature tolerance ±.003% −30° to 60°C above 500 KHz and ±.02% below 500 KHz.

CIRCUIT: As specified by customer. Crystals are available for all major two-way equipment and in most cases the necessary correlation data is on file. Where circuit is not specified, the crystal will be calibrated for operation into a load capacitance of 32 mmf. Typcal circuits for the different frequency ranges are shown on the following page.
The CS series of crystal units is available to commercial or military specifications demanding tight frequency tolerance, long term stability and low frequency response.

WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

A. Crystal frequency
B. Type GP or CS
C. Calibration temperature (Room Temperature or Over 60°C)
D. Holder (see above)
E. Circuit load and correlation data
Note: For GP specify 10, 20 or 32 pf. Do not specify equipment types in the case of GP crystals. These are made only to 10, 20 or 32 pf load. When circuit load is not specified crystals will be correlated for a 32 pf load.
F. Special holder markings (not available on GP type)

Consult our crystal sales engineers for special applications.

	TYPE				
	GENERAL PURPOSE (1)		COMMERCIAL STANDARD (2)		
Frequency	Calibration Tolerance .01%		Calibration Tolerance As Noted		
70- 99 KHz	$20.00	.01%	$22.25		
100-199 KHz	13.25	.01%	15.25	.0025%	$17.25
200-499 KHz	13.25	.005%	15.25	.0025%	17.25
500-849 KHz	37.25	.0025%	39.25		
850-999 KHz	13.25	.0025%	15.25		

*F-13, F-605, F-609, F-612.

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Medium frequency crystals 1,000 KHz — 22,000 KHz

FUNDAMENTAL TYPE

TYPE SPECIFICATIONS

1. **General Purpose** (GP) crystals will be calibrated to within ±.01% of frequency when operated into 10, 20 or 32 pf load capacitance only (32 pf will be used when none is specified).
   GP crystals will hold temperature tolerance of ±.005% from −30° to 60°C.
2. **Commercial Standard** (CS) crystals will be calibrated to either .0025% or .001% as specified for operation in customer's load. CS crystals will hold temperature tolerance ±.003% −30° to 60°C.
3. A calibration tolerance of ±.001% (or special) can only be obtained when a definite circuit load capacitance and drive level are specified. Where a definite load capacitance is not specified and correlation is required from a copy of the intended circuit a tolerance of ±.01% should be expected.
4. **High Accuracy** (HA) crystals are for use in circuits where tolerances better than ±.002% −30° to 60°C are required. Tolerances of .0005% over the range −30° to 60°C will require circuit compensation. Without compensation the range will be limited to −10° to 60°C. Compensators are not included with the crystals and tolerance is for crystals only and does not allow for any change in circuit parameters over the temperature range.

mode of oscillation
1,000-22,000 KHz Face shear AT

shunt capacitance 7 pf (Max.)
7 pf (Max.)

resistance
1,000- 1,499 KHz 490 ohms
1,500- 1,999 KHz 375 ohms
2,000- 2,999 KHz 270 ohms
3,000- 3,999 KHz 150 ohms
4,000-22,000 KHz 75 to 25 ohms

drive (Max.)
1,000- 9,999 KHz 10 milliwatts
10,000-22,000 KHz 4 milliwatts

WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

A. Crystal frequency
B. Type — GP, CS, or HA
C. Calibration tolerance — .0025% or .001% / Special (not required for GP as this type is supplied only in .01%).
D. Calibration temperature (room temperature or over 60°C, 75°C, 85°C)
E. Holder (see above)
F. Circuit load and correlation data
   Note: For GP specify 10, 20 or 32 pf. Do not specify equipment types in the case of GP crystals. These are made only to 10, 20 or 32 pf load. When circuit load is not specified crystals will be correlated for a 32 pf load.
G. Special holder markings (not available on GP type)

	TYPE				
	GENERAL PURPOSE (1)	COMMERCIAL STANDARD (2)		HIGH ACCURACY (4)	
	Calibration	Calibration Tolerance		Temperatur eTolerance −10° to +60°	
Frequency	Tolerance .01%	.0025%	.001%/CS-1 Special (3)	.002%	.0005%
1,000- 1,499 KHz	$8.25	$10.25	$12.25		
1,500- 2,999 KHz	6.15	7.15	8.15	$ 8.25*	
3,000-10,999 KHz	4.50	5.10	6.15	6.30	$ 9.50**
11,000-19,999 KHz	6.15	7.15	8.15	8.25	9.50
20,000-22,000 KHz	8.25	10.25	11.25	11.25	12.50

* Available 2,000-2,999 KHz ** FM Holder Available 6,000 to 22,000 KHz

High frequency crystals 10 MHz — 160 MHz

Crystals for use in military equipment can be supplied to conform to specifications of MIL-C-3098E

mode of oscillation
10- 60 MHz Face shear third mechanical overtone AT
61-110 MHz Face shear fifth mechanical overtone AT
111-140 MHz Face shear seventh mechanical overtone AT
141-160 MHz Face shear ninth mechanical overtone AT

shunt capacitance
7 pf (Max.)

resistance (Max.)
10- 14.9 MHz 60 ohms
15- 60 MHz 40 ohms
60-110 MHz 60 ohms
110-140 MHz 80 ohms
140-160 MHz 100 ohms

drive (max.)
2 milliwatts

TYPE SPECIFICATIONS

1. **General Purpose** (GP) crystals will be calibrated to within ±.01% of frequency when operated into the customer's specified circuit load only. When none is specified resonance will be used.
   GP overtone crystals will hold temperature tolerance of ±.005% from −30° to 60°C.
2. **Commercial Standard** (CS) crystals will be calibrated to either .0025% or .001% as specified for operation in customer's load. CS crystal will hold temperature ±.003% −30° to 60°C.
3. A calibration tolerance of ±.001% (or special) can only be obtained when a definite circuit load and drive level are specified. Where a definite load is not specified and correlation is required from a copy of the intended circuit a tolerance of .01% should be expected.
4. **High Accuracy** (HA) crystals are for use in circuits where tolerances better than ±.002% −30° to 60°C are required. Tolerances of .0005% over the range −30° to 60°C will require circuit compensation. With compensation the range will be limited to −10° to 60°C. Compensators are not included with the crystals and tolerance is for crystals only and does not allow for any change in circuit parameters over the temperature range.

WHEN ORDERING — SPECIFY THE FOLLOWING FOR EACH CRYSTAL

A. Crystal frequency
B. Type — GP, CS, or HA
C. Calibration tolerance — .0025% or .0001% / Special (not required for GP as this type is supplied only in .01%)
D. Calibration temperature — Room temperature or oven 85°C
E. Holder (see above)
F. Circuit load and correlation data — normal series resonate or anti-resonate
   Note: Do not specify equipment types in te case of GP crystals.
G. Special holder markings (not available on GP type)

	TYPE				
	GENERAL PURPOSE (1)	COMMERCIAL STANDARD (2)		HIGH ACCURACY (4)	
	Calibration	Calibration Tolerance (3)		Calibration Tolerance (3)	
Frequency MHz	Tolerance .01%	.0025%	CS-1 .001%/Special	.0025%	.001%/Special
10- 60 (3rd)	$ 4.90	$ 7.15	$ 8.25	$9.50	$11.00
61- 79 (5th)	6.10	11.25	12.25		
80-110 (5th)	8.15	15.25	16.25		
111-139 (7th)	10.15	15.25	16.25		
140-160 (9th)	15.25	18.25	19.25		

* Other dimensions same as F-605 ** Not supplied below 15 MHz † Available in FM-1 and FM-2 holder only above 20 MHz

how to order

Mail: International Crystal Mfg., Inc., 10 North Lee, Oklahoma City, Oklahoma 73102
Phone: Area Code 405 236-3741 Cable: INCRYSTAL
Western Union TELEX: 071-347 Bell System TWX: 910-831-3177

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HUGHES
FREQUENCY CONTROL DEVICES

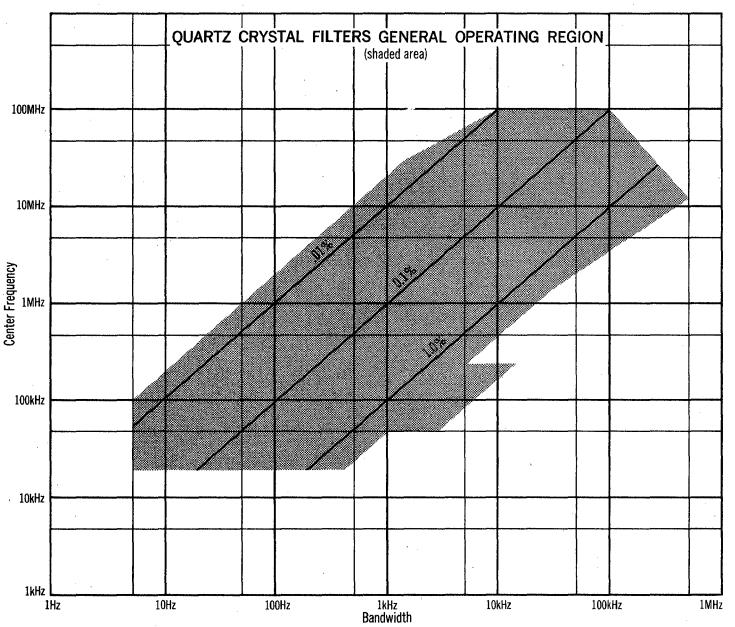
CRYSTAL FILTERS

As the nation's leading supplier of precision crystal filters, Hughes offers years of technical experience backed by the industry's most advanced production and test facilities. Thousands of Hughes crystal filters are currently in use in missiles, space vehicles, radar systems and communications equipment. Available in various frequencies, sizes and environmental standards, Hughes filter types include bandpass, single sideband, band rejection, contiguous comb doppler and thin-film monolithic.

Bandpass & Single Sideband Filters. Narrow passbands, steep shape factors and low insertion losses are characteristic of all Hughes bandpass and single sideband filters. General specifications include:

Center Frequency Range	250kHz to 100MHz
Fractional Bandwidth Range	0.002% to 6%
Shape Factor (60 db/3 db ratio)	As low as 1.15 to 1
Insertion Loss	Down to 0.1 db
Passband Ripple	Down to ±0.1 db

Note: Refer to the General Operating Regions Chart (right) to determine producible design combinations of bandwidth and center frequency.

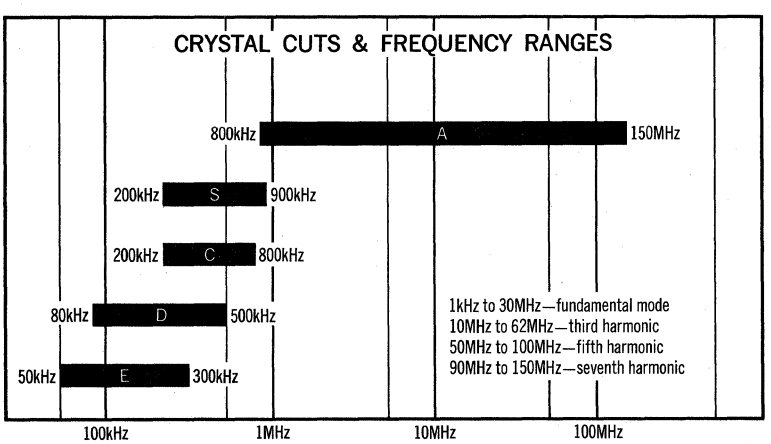


QUARTZ CRYSTALS

Hughes supplies a full range of low and high frequency quartz crystals from 250kHz up to 150MHz. Both standard and custom units in prototype or production quantities can be supplied for a variety of precision, frequency control applications.

Military Standard Crystals. Manufactured to MIL-C-3098E, Hughes military standard quartz crystal units are offered in a full range of low and high frequencies.

Coldweld Sealed Crystals. For applications requiring exceptionally high reliability and long term frequency stability, Hughes employs the Coldweld process for hermetically sealing the crystal enclosure. Only pressure is used in welding the cover to the base, thereby eliminating all possibility of contamination from fluxes, sparking or heating. Hughes Coldweld quartz crystals are available in 250kHz to 150MHz frequencies and in TO-5, HC-6 or HC-18 Coldweld holders.



Hughes is the country's leading supplier of precision crystal filters and related frequency control devices. A partial list of major programs using these products includes BMEWS, Apollo, Pioneer, Syncom, Surveyor, Mauler, Hawk, Minuteman, Talos, Phoenix and Standard Missile. A staff of competent engineers backed by the industry's most advanced quality control and test facilities, stands ready to handle your toughest assignment. Call collect or contact your nearest Hughes representative for assistance.

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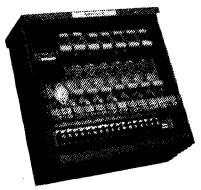
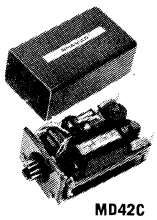
the tone technology people

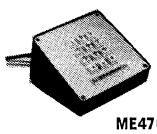
TOUCH-TONE* EQUIPMENT



MD47C



MD42C

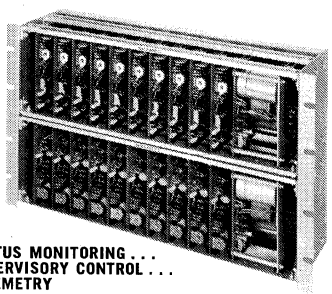


ME47C

Model	Function	Power Input	Enclosure	Output
ME47C	Touch-Tone Dial	12 VDC, 117 VAC	Attractive beige desk top housing	0.5 VRMS into 600 ohms
MD42C	Single Digit Receivers	12/24/48 VDC	Plug-in housing 5″ x 2⅞″ x 2⅛″	Receivers have 2 form C contacts. MD42P is programmable in the field to any of 16 digits.
MD42P		12/24/48 VDC, 117 VAC	NEMA Type 3, 6″ x 6″ x 4″	
MD42D				
MD47C	Twelve Digit Receiver	12/24/48 VDC, 117 VAC	NEMA Type 3, 10″ x 10″ x 4″	One form A contact for each of the 12 digits

* Touch-Tone is a registered Service Mark of AT&T Co.

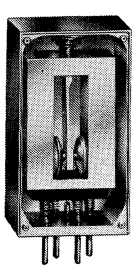
AM TONE SYSTEMS



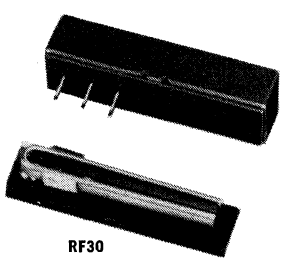
STATUS MONITORING . . .
SUPERVISORY CONTROL . . .
TELEMETRY

Model	Function	Special Features
ME401P	Tone Transmitter	Compatible with AM tone equipment on standard 100, 120 and 170 Hz channel spacing. Up to 20 channels of tone control can be provided on a voice frequency circuit.
MD403P	Tone Receiver	
MPS2P	Power Supply	24/48 VDC, 117 VAC input, 11 VDC output. One supply operates 20 transmitters or 10 receivers.
40T10	Card Cage for 19″ rack mounting	Holds 10 transmitters or 10 receivers and one power supply.
40H3	NEMA Type 3 wall mounted enclosure	Holds 5 transmitters or 5 receivers and one power supply.

RESONANT REED FILTERS



RF20



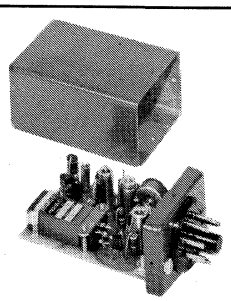
RF30

(SHOWN ACTUAL SIZE)

Model	Function	Frequency Range	Frequency Stability	Size	Special Features
RF20	Encoder/Decoder	67-3000 Hz	.0015%/°C (−30° to + 100°C)	1.1″ x .62″ x .395″	High stability encoder and decoder
RF20D	Tone Decoder	300-3000 Hz			RF20D resists shock and vibration.
RF30E	Tone Encoder	300-3000 Hz	.0035%/°C (−30° to +60°C)	1.26″ x .31″ x .31″	Low cost Small size
RF30D	Tone Decoder				
RF30U	Encoder/Decoder				

Bramco RF20 and RF30 filters are widely used in tone encoders and tone decoders where high stability, close tolerance, sharp selectivity and small size are required. Input and output connections are made to coils in the RF20 and to piezoelectric crystals in the RF30.

TONE MODULES—with plug-in RF20 reed filters



ME201C, MD201C, MD211C

Model	Function	Frequency Range	DC Power	Enclosure	Special Features
ME201C	Tone Oscillator	80-3000 Hz	12/24/48 volts	Plug-in housing 3¼″ x 2″ x 1½″	Wide frequency range, −40° to +85°C operation.
MD201C	Tone Decoder		12/24/48 volts		
MD211C	High Speed Tone Decoder	300-3000 Hz	12/24/48 volts		Follows 10 pulse per second tone signal, −40° to +85°C operation.
MD204C	Voice Immune Tone Decoder	2500-3000 Hz	12 volts	Plug-in housing 5″ x 2⅞″ x 2⅛″	Highly selective audio filter plus tone timing circuit prevents false response to voice or music signals.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

LEDEX

BRAMCO CONTROLS DIVISION, LEDEX INC.
550 SOUTH COLLEGE STREET, PIQUA, OHIO 45856 · PHONE (513) 773-8271

CRYSTAL OSCILLATORS AND TCXO'S (5 VOLT INPUT)

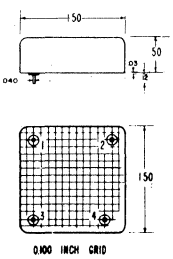
Series 5401 thru 5403 are crystal oscillators in the frequency range of 1 KHz to 20 MHz, intended for PC boards. They are specified in three stability grades of ±1, ±1.5 and ±10 ppm from 0 to 65°, and are available in choice of two packages — either flat pack (½" high) or compact (.81" high).

GENERAL SPECIFICATIONS:

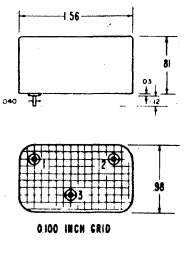
Input Voltage: +5 VDC
Frequency: 1 KHz to 20 MHz
Load: 10 TTL loads

Stability: 5401: ±1 ppm
5402: ±1.5 ppm
5403: ±10 ppm

5401-1



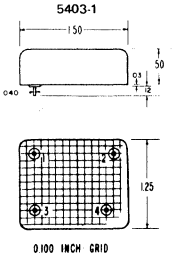
5401-2



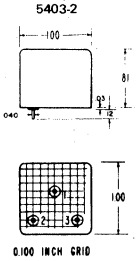
ASK FOR DETAILED LITERATURE

Economical OEM units may be modified to your equipment specifications.

5403-1

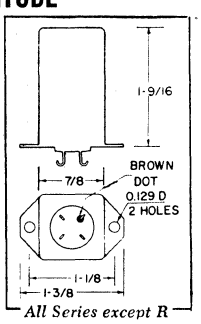


5403-2



OSCILLATORS FIXED OR SLIGHTLY VARIABLE FREQUENCY AND/OR AMPLITUDE

- **Sine wave frequencies from 50 Hz to 80 KHz**
- **Temperature: −25 to +55°C**
- **Size: ⅞" sq. x 1 9/16" high**
- **Each oscillator may be adjusted for your requirements of load, voltage output and input, etc.**
- **600 ohm balanced output available**
- **Extremely low distortion units available**



All Series except R

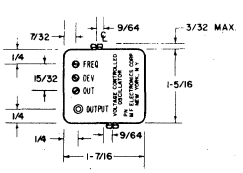
ELECTRICAL SPECIFICATIONS:

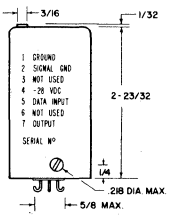
Series 101 and 102 are fixed frequency and amplitude units to be used as a signal source into a light load. These should be used where no field adjustments are required. Series 101 and 102 usually supplied with 4 pin solder hook terminals. If desired, specify NOVAL plug.

	Series 101	Series 101A	Series 102	Series 102A
Input Volts, DC	10.5-13.5	24-32	10.5-13.5	24-32
Input Current, ma.	10	10	10	10
Output Frequency	Fixed. Any frequency from 50 cycles to 80 KC			
Initial Frequency Accuracy per cent	±2½	±2½	±½	±½
Frequency Drift, maximum per cent	±2½	±2½	±1½	±1½
Maximum Load, kilohms	10	20	10	20
Output Voltage, VRMS, minimum	1	2	1	2
Change in Amplitude, maximum db.	±1	±½	±1	±½
Distortion, maximum, per cent	1	1	1	1

VOLTAGE CONTROLLED OSCILLATORS SERIES 300

- **Modular construction — easily repairable in the field**
- **MIL-E-16400E, Class 4, with temperature to 60°C**
- **High reliability; high MTBF; parts from MIL-STD-242**
- **Frequency stability 0.15% of frequency**
- **High deviation**





VOLTAGE TO FREQUENCY CONVERTERS

Series 321 (Positive Input Polarity, only); 322 (Negative Input Polarity, only); 323 (Positive or Negative Input).

Linearity: ±.1%; Temperature Coefficient: ±50ppm/°C. F.S., 0 to 65°C; Maximum Frequency: 10 KHz.

M F Electronics Corp.
118 EAST 25th STREET, NEW YORK, N.Y. 10010 • (212) 674-5360

PLUG IN CRYSTAL OSCILLATORS (DIP) 5404 AND 5405

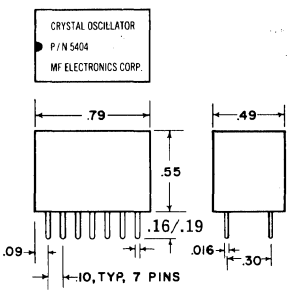
FREQUENCIES FROM 80 KHZ TO 50 MHZ

The 5404 and 5405, oscillator modules in the frequency range of 80 KHz to 50 MHz, are socket pluggable. Operating from +5 volts, they deliver outputs for DTL/TTL, and with the use of filters, can provide sine waves.

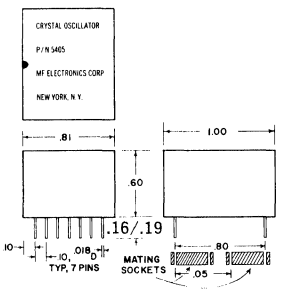
The 5404 generates a specified frequency from 5 to 50 MHz with an accuracy of ±.005% over a 0 to 65°C temperature range The 5405 generates a specified frequency from 80 KHz to 4.99 MHz, with an accuracy of ±.02%. All units can drive 10 TTL loads (7400 TTL). Units above 10 MHz can drive 10 TTL loads (74H00 TTL).

The higher frequency 5404 takes only the socket space of one IC DIP package, so it can be used to plug into standard sockets, such as those made by Barnes, Elco, Augat, etc. The 5405, which generates the lower frequencies, is approximately twice the size of the 5404, and occupies the space of two DIP packages, fitting directly into two DIP sockets which are spaced 0.5" apart. Both units will mate into the Augat High Density Packaging panels (8136).

Both 5404 and 5405 are economically priced, with inherent reliability. The accuracy specifications of ±.005 and ±.02% for the 5404 and 5405 respectively is probably adequate for 95% of all applications, and removes the requirement for an adjustment control. This realistic frequency tolerance is a contributing factor in lowering the price and increasing the reliability through parts reduction.

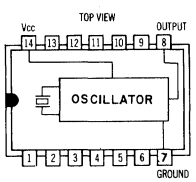


INPUT VOLTAGE: +5 VOLTS
CURRENT: 20 TO 40 MA, TYP.
TEMPERATURE: 0 TO 65°
OUTPUT: 10 TTL LOADS

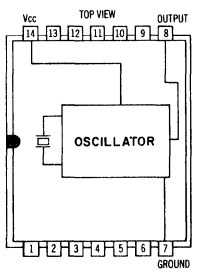


Frequency: 5 MHz to 50 MHz
Stability: 50 ppm, standard 25 ppm, special

Frequency: 80 KHz to 4.99 MHz
Stability: ±.02%, standard ±.01%, special

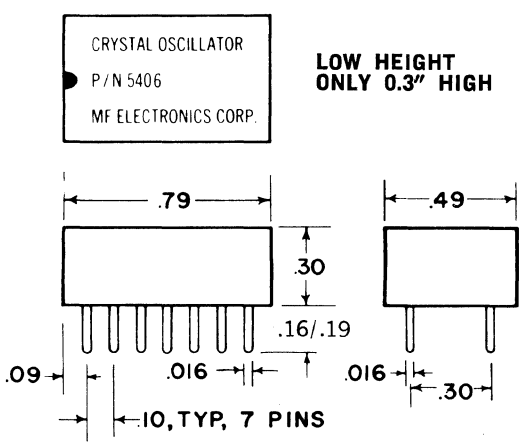


UNITS AVAILABLE WITH EXTENDED TEMPERATURE RANGE, EXTERNAL TUNING, ETC.



PLUG IN CRYSTAL OSCILLATOR (DIP) 5406

FREQUENCIES FROM 4 MHz TO 50 MHz



LOW HEIGHT ONLY 0.3" HIGH

INPUT VOLTAGE, Vcc	±5 volts ±5%
CURRENT	20 ma, typ. up to 10 MHz 40 ma, typ. over 10 MHz
FREQUENCY	4 to 50 MHz
FREQUENCY ACCURACY	See table below
OUTPUT	0-4 VDC, TTL
SYMMETRY	60-40 or better @ 1.5 volts
LOAD	Drives 10 TTL loads (7400) from 4 to 10 MHz, and 10 TTL loads (74 H00) above 10 MHz

Series	Temperature of Operation	Frequency Accuracy, all Conditions
5406	0 to +65°C	±.005% (±50 ppm)
5406-1	0 to +65°C	±.0025%
5406-2	−55 to +65°C	±.005%
5406-3	0 to +85°C	±.005%
5406-4	0 to +125°C	±.0075%
5406-5	−55 to +85°C	±.005%
5406-6	−55 to +125°C	±.0075%

M F Electronics Corp.
118 EAST 25th STREET, NEW YORK, N.Y. 10010 • (212) 674-5360

M-tron QUARTZ CRYSTAL PRODUCTS

M-tron Industries, Inc.
P. O. Box 630
Yankton, So. Dakota 57078
Phone: 605-665-9321

AT Cut Crystals/800 KHz-30 MHz Fundamental

General Specifications:

Mode of Oscillation = Fundamental

Control Parameters vs. Frequency

FREQUENCY	ESR	SHUNT CAP. (C_0)	PULLING RANGE
800KHz-2MHz	100-1000Ω	3.5-7 pf	15-25 ppm
2MHz-3MHz	10-100Ω	3.5-7 pf	12-20 ppm
3MHz-10MHz	8-60Ω	3.5-7 pf	12-20 ppm
10MHz-30MHz	6-24Ω	3.5-7 pf	12-20 ppm

Maximum Drive Level

800KHz-10MHz	10 Milliwatts
10+MHz-18MHz	5 Milliwatts
18+MHz-30MHz	2 Milliwatts

Motional Arm Component C_0/C_1 Ratio

Fundamental Mode Crystals: 190-400 depending on contour of the crystal blank.

Zero TC Point: Design variable from +25° C to +40° C

PRICE TABLE		COMMERCIAL	PRECISION	STANDARD MILITARY MIL-C-3098	
TYPE		CF-1	PF-1	CR-18 A/U	CR-27 A/U
Calibration Tolerance		±.002% @ 25° C	±.001% @ 25° C	–	±.002% @ 75° C ±1° C
Tol. over Temp. Range		±.005%, −30° to +65° C	±.003%, −30° to +65° C	±.005%, −55° to +105° C	± .0005%, +70° to +80° C
Holder*		HC-6/U, -18/U or -25/U	HC-6/U, -18/U or -25/U	HC-6/U	HC-6/U
FREQUENCY	800-999KHz	$9.50**	$11.50**	$12.50**	$14.25**
	1.0-1.999MHz	5.50	6.60	7.20	8.25
	2.0-4.999MHz	4.10	4.90	5.30	6.10
	5.0-12.999MHz	3.20	3.80	4.20	4.80
	13.0-21.999MHz	3.50	4.20	4.60	5.25
	22.0-25.999MHz	5.50	6.60	7.20	8.25
	26.0-29.999MHz	9.50	11.50	12.50	14.25

*Holder Selection: Below 3MHz, use HC-6/U only. Above 10MHz, Type CF-1 and PF-1 may be special ordered with SM-1 or HC-35/U (TO-5) holder. The following holders are available in cold-weld version: HC-6/U, HC-18/U, HC-25/U, HC-35/U.

**All prices shown are for a quantity of 10 pieces of one frequency.

AT Cut Crystals/10MHz-150MHz Overtone

General Specifications:

Mode of Oscillation: 3rd, 5th or 7th mechanical overtone depending on frequency

Control Parameters vs. Frequency

FREQUENCY	MODE OF OSC.	ESR	SHUNT CAP (C_0)	PULLING RANGE
10-17MHz	3rd Overtone	30-60Ω	3.5 to 7 pf	10-12 ppm
17-61MHz	3rd Overtone	15-40Ω	3.5 to 7 pf	10-12 ppm
50-125MHz	5th Overtone	30-60Ω	3.5 to 7 pf	7-10 ppm
125-150MHz	7th Overtone	40-100Ω	3.5 to 7 pf	5-7 ppm

Maximum Drive Level

10MHz-18MHz	5 Milliwatts
18MHz-150MHz	2 Milliwatts

Motional Arm Component C_0/C_1 Ratio

3rd Overtone Crystals	1710
5th Overtone Crystals	4750
7th Overtone Crystals	9300

Zero TC Point: Design variable from +27° C to +40° C.

PRICE TABLE		COMMERCIAL	PRECISION	STANDARD MILITARY MIL-C-3098		
TYPE		CH-1	PH-1	CR-55/U 3rd OT	CR-32A/U (3rd)	CR-56A/U (5th)
Calibration Tolerance		±.002% @ 25° C	±.001% @ 25° C	–	±.002% @ 75° ±1° C	–
Tolerance over Temperature Range		±.005%, −30° to +65° C	±.003%, −30° to +65° C	±.005%, −55° to +105° C	± .0005%, +70° to +80° C	±.005%, −55° to +105° C
Holder*		HC-6/U, -18/U or -25/U	HC-6/U, -18/U or -25/U	HC-18/U	HC-6/U	HC-18/U
FREQUENCY MHz	10-17 (3rd)	$3.60**	$4.30**	-**	$5.40**	-**
	17-61 (3rd)	3.40	4.10	$4.40	5.10	-
	61-75 (3rd)	4.25	5.10	-	6.40	-
	50-90 (5th)	4.10	4.90	-	-	$5.30
	90-125 (5th)	5.90	7.10	-	-	7.70
	125-150 (7th)	7.25	8.70	-	-	-

*Holder Selection: Use HC-6/U for 10-17MHz. Above 17MHz, use HC-18/U or HC-25/U. Above 30MHz, Type CH-1 and PH-1 may be special ordered with SM-1 or HC-35/U (TO-5). The following holders are available in cold-weld version: HC-6/U, HC-18/U, HC-25/U, HC-35/U.

**Prices shown are for quantity of 10 pieces of one frequency.

Ordering Information for AT Cut Crystals

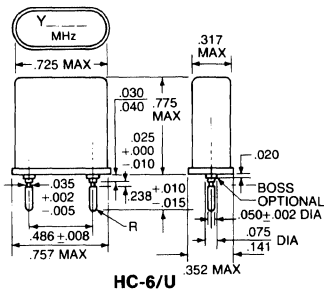
To order crystals from charts, specify the following:

1. Crystal frequency
2. Type (special tolerances available; please contact factory for pricing).
3. Drive level and circuit load capacitance. (If no load capacitance is specified, series resonant crystal will be supplied.)
4. Holder.
5. Can marking.

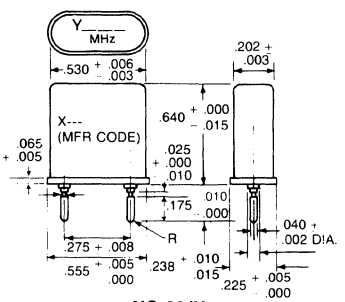
M-tron QUARTZ CRYSTAL PRODUCTS

M-tron Industries, Inc.
P. O. Box 630
Yankton, So. Dakota 57078
Phone: 605-665-9321

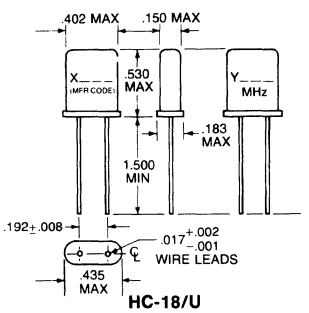
CRYSTAL HOLDERS



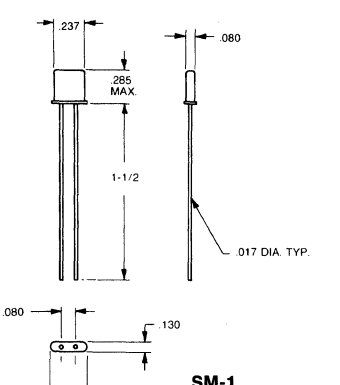
HC-6/U



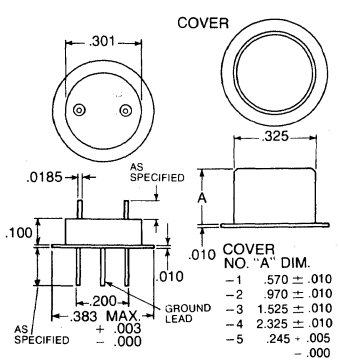
HC-32/U



HC-18/U
(Also HC-25/U with .040" x .238" pins)
Not for crystals under 3 MHz

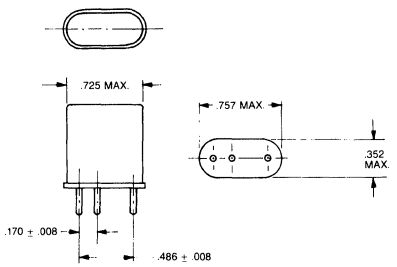


SM-1
Subminiature Holders
Not for crystals under 10 MHz



HC-35/U (TO-5 TYPE)
Not for crystals under 10 MHz

Temperature Compensated Crystal Resonators TCXR-4



An excellent alternative to the oven-controlled crystal.

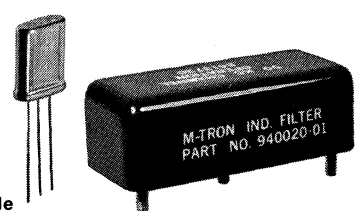
- Low power consumption
- High stability vs temperature

General Specifications

Frequency Range: 4.5MHz to 30MHz
Frequency Stability
Vs Temperature: May be specified from ±1 ppm to ±5 ppm over the temperature range –40° C to +75° C.
Vs Time: Long-term frequency drift less than 3 ppm/year.
Frequency Tolerance at 25° C: ±10 ppm
Drive Level: 0.5 MW Max.
Input Voltage Range: 5-20 VDC, 1% Regulation
Load Capacitance: 12-50 pf (see note #1)
Mode of Operation: Fundamental
NOTE #1: TCXR's can be designed for most antiresonant oscillator circuits. The load capacitance must be specified by the customer. Consult factory for oscillator design assistance.

Custom Designed Filters

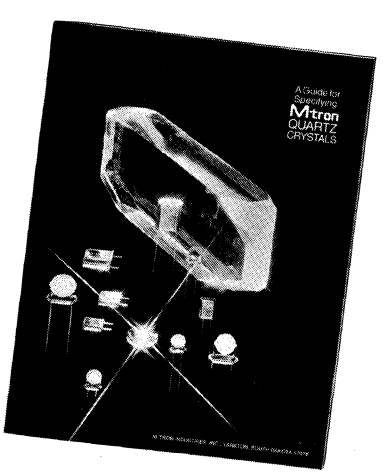
M-tron offers computer-designed discrete and monolithic "AT" cut crystal filters. Bandpass, comb, single sideband, band reject and linear phase filters are designed, built and tested using the latest available techniques and equipment. Send us your specifications for prompt quotation.



2-pole Monolithic
Multi-pole Discrete

General Specifications

Center Frequency: 1MHz to 30MHz
6db Bandwidth: .01% to .5% of center frequency
Ripple: To less than 0.5db
Insertion Loss: 1 to 6db
Shape Factor: To 1.4/1
Ultimate Attenuation: To 100db



FREE SPECIFICATION GUIDE

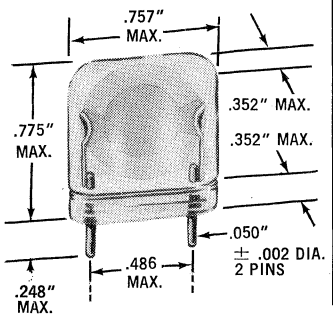
Write for comprehensive brochure containing complete information on products shown here. Contains many helpful charts, definitions, formulas.

McCOY ELECTRONICS COMPANY a subsidiary of OAK ELECTRO/NETICS CORP
MT. HOLLY SPRINGS, PENNSYLVANIA 17065 - Tel. 717—486-3411 - TWX: 510—650-3548

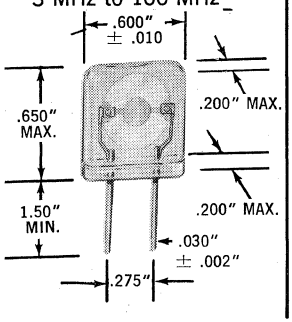
Quartz crystals are produced over the frequency range of 700 Hz to over 250 MHz, with development effort to 400 MHz. McCoy Electronics manufactures solder seal, glass, and cold weld crystals for oscillator and filter applications. A vast amount of knowledge of design capability in spurious suppression, temperature compensation, and pullability has been developed over the years, and benefits our customers by assuring that the industry's finest technology is at their disposal with every order. Crystals are available to tolerances as tight as ±.0025% over −55 to +105°C. TC charts shown on the opposite page may be used as a guide in determining the types of temperature curves that can be obtained.

PRECISION GLASS CRYSTALS

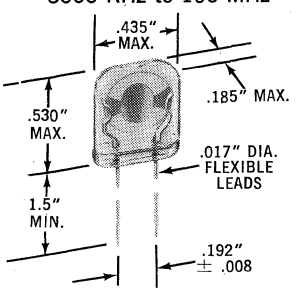
HOLDER SERIES G-1
Frequency Range:
2000 KHz to 100 MHz



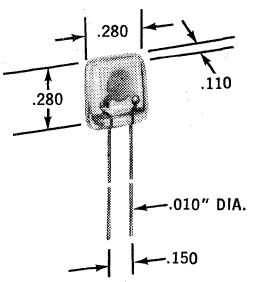
HOLDER SERIES G-30
Frequency Range:
3 MHz to 100 MHz



HOLDER SERIES G-20
Frequency Range:
5000 KHz to 100 MHz

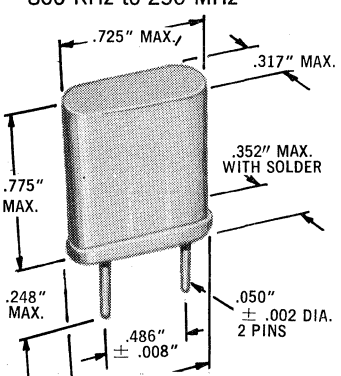


HOLDER SERIES MM
Frequency Range:
10 MHz to 250 MHz

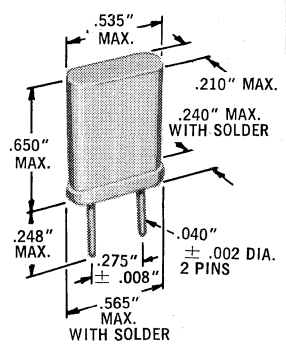


QUALITY METAL CRYSTALS

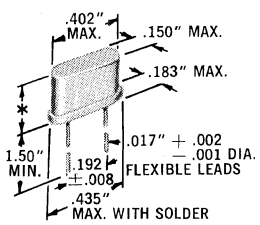
HOLDER SERIES M-1
Frequency Range:
800 KHz to 250 MHz



HOLDER SERIES M-25
Frequency Range:
1.5 MHz to 250 MHz



HOLDER SERIES M-20
Frequency Range:
2.0 MHz to 250 MHz



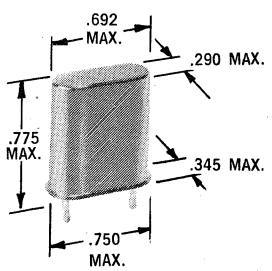
*Dimensions as shown with seated height as follows:

M-20 — .530"	M-20C — .360"
M-20A — .460"	M-20D — .315"
M-20B — .425"	M-20E — .250"

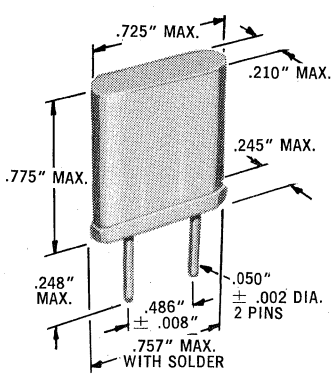
NOTE: Holder height of A thru E varies with frequency.

HIGH FREQUENCY CLEANSEAL CRYSTALS

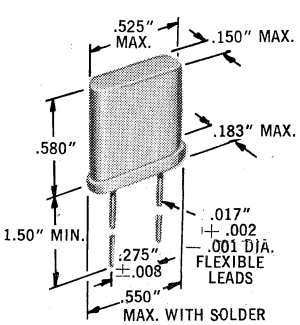
HOLDER SERIES W-1
Frequency Range:
1 MHz to 250 MHz



HOLDER SERIES M-35
Frequency Range:
500 KHz to 250 MHz

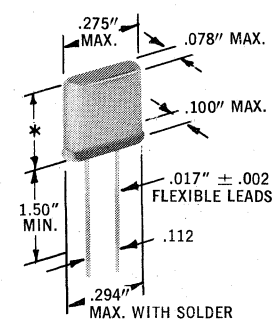


HOLDER SERIES M-40
Frequency Range:
2 MHz to 250 MHz



M-41 — Dimensions as shown, with .040" diam. pins, .238" long.

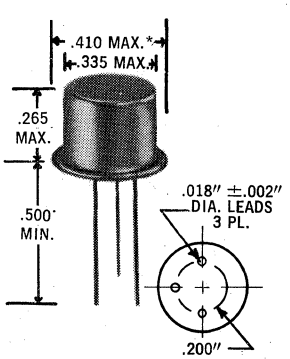
HOLDER SERIES M-60
Frequency Range:
12.5 MHz to 250 MHz



*Dimensions as shown with seated height as follows:

M-60 — .290"
M-60A — .240"

HOLDER SERIES W-6
Frequency Range:
10 MHz to 250 MHz



*Available at additional cost with flange trimmed to .370" maximum.

CONTINUED

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LOW FREQUENCY QUARTZ CRYSTALS

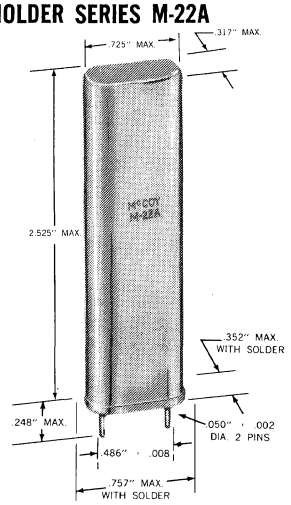
"Low Frequency" at McCoy is defined as the ten (10) variations of cuts that are used in designing crystals from 700 Hz to 700 KHz. The ability to meet sophisticated electrical and environmental requirements reliably has highlighted the growth of our low frequency capability and is the most complete offered in the industry today. Listed below are typical tolerances and holders available.

All units are custom designed and manufactured, and innovations are our specialty.

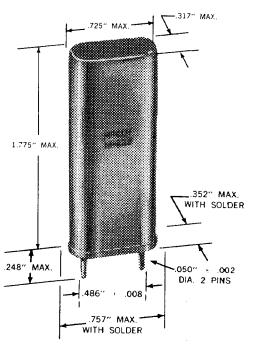
FREQUENCY DEVIATION WITH TEMPERATURE

TEMP RANGE °C		−55 +105	−55 +90	−40 +70	0 +50	+20 +40	+55 +65	+70 +80
Type Cut	Frequency Range	FREQUENCY DEVIATION ± P X 10^5						
JT	700 Hz 15 KHz	25	20	10	5	2	3	5
NT	4-150 KHz	20	15	10	5	2	2	2
5° X FLEX	4-150 KHz	60	50	25	10	4	6	8
5° X	50-250 KHz	25	20	12	3	2	3	3
MT	50-250 KHz	12	10	8	4	2	1	1
GT	80-300 KHz	NA	NA	2	1	0.25	0.25	0.5
BD	80-300 KHz	12	10	6	3	2	2	3
DT	80-550 KHz	12	10	8	4	2	1	1
CT	150-700 KHz	18	15	12	6	2	1	1
SL	200-700 KHz	10	8	5	3	2	1	1

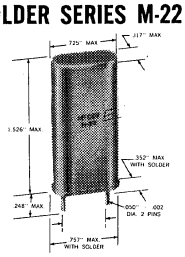
HOLDER SERIES M-22A



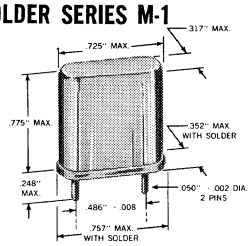
HOLDER SERIES M-22B



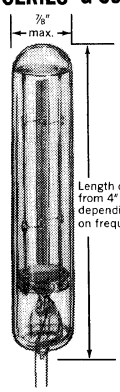
HOLDER SERIES M-22



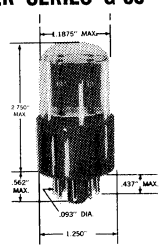
HOLDER SERIES M-1



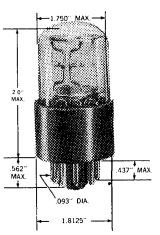
HOLDER SERIES G-65



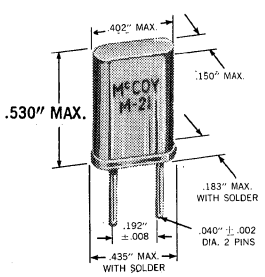
HOLDER SERIES G-90



HOLDER SERIES G-130

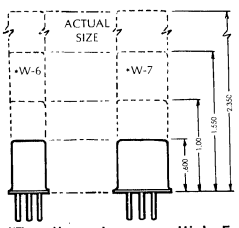


HOLDER SERIES M-21



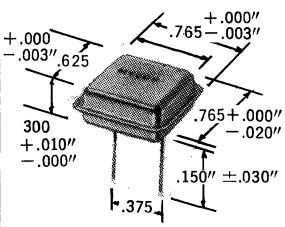
CLEANSEAL

HOLDER SERIES W-6 and W-7

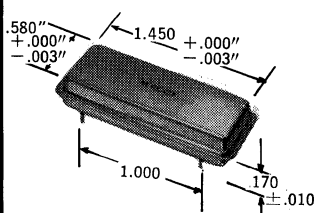


*For dimensions see High Frequency Cleanseal section on pages 3 and 4.

HOLDER SERIES W-10



HOLDER SERIES W-11



FREQUENCY RANGE

	McCOY TYPE HOLDER	JT	NT	5°X Flex	5°X	MT	GT	BD	DT	CT	SL
		FREQUENCY RANGE, KHz									
SOLDER SEAL	M-22A	700 Hz-1.5	4-10	4-12	50-70	—	—	—	—	—	—
	M-22B	1.5-4	10-15	12-15	70-80	—	—	—	—	—	—
	M-22	4-15	15-100	15-80	80-250	150-185	—	150-185	—	—	200-1000
	M-1	—	80-150	80-150	175-250	185-250	250-300	185-300	175-500	250-700	300-1000
	G-90	—	—	—	—	50-100	150-300	80-100	80-175	150-250	—
	G-65	—	—	—	—	100-250	—	100-150	—	—	—
	M-21	—	—	—	—	—		—	—	—	500-1000
	G-130	—	—	—	—	—	80-150	—	—	—	—
CLEANSEAL	W-6	1-15	4-15, 50-125	4-15, 50-125	60-250	—	—	—	350-500	500-700	350-1000
	W-7	1-15	4-15, 50-125	4-15, 50-125	60-250	100-250	250-300	100-250	230-500	300-700	175-1000
	W-10	—	100-125	100-125	—	—	—	—	230-500	300-700	350-1000
	W-11	3-15	15-100	15-100	85-250	100-250	—	100-250	—	—	175-350

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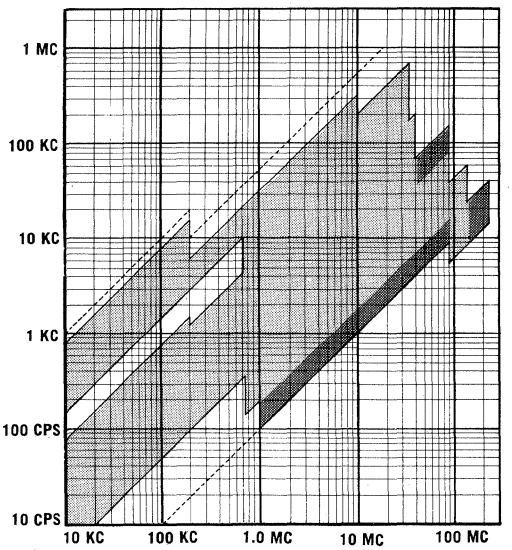
CRYSTAL FILTERS

It is most difficult indeed to cover McCoy's capability in crystal filters in a few pages. Conventional narrow, mid, and wide band filters from 1 KHz to over 200 MHz, and monolithic devices utilizing modern computer-assisted designs are produced to demanding specifications in miniature packages. Linear phase, switchable bandwidths, single side band, and notch filters are designed under the auspices of professional design engineers possessing years of experience, thus permitting maximum latitude in meeting difficult requirements.

Listed below is a brief cross section of the devices recently produced at McCoy Electronics, along with charts establishing guidelines for bandwidths available over the center frequency ranges produced.

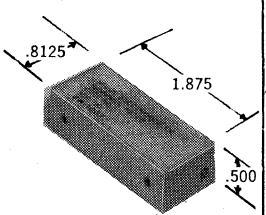
This logarithmic chart indicates the practical and theoretical possibilities in crystal filters. Read center frequency along X axis, bandwidth along Y axis. As a rule, filters selected near the middle of the "narrow and intermediate" band can be produced with the greatest variety of characteristics. Darkest areas show new bandwidths and higher frequencies available now.



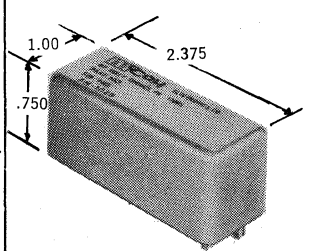
TYPICAL FILTERS AVAILABLE

Center Freq.	BW 3 db	BW 60 db	I L	Ripple	Impedance	Configuration
1.0000 KHz	10 Hz	40 Hz	6 db	1 db	10K ohms	FM-3954
5.0000 KHz	2 Hz	6 Hz	8 db	.5 db	10K ohms	FM-2877
55.0000 KHz	10 Hz	25 Hz	7 db	1 db	1K ohms	FM-1115
100.0000 KHz	2.7 Hz	3.4 KHz	3 db	.5 db	600 ohms	FM-3954
100.0000 KHz	10 Hz	100 Hz	3 db	.5 db	5K ohms	FM-1922
455.0000 KHz	300 Hz	1200 Hz	2 db	1 db	600 ohms	FM-1029
500.0000 KHz	3 KHz	5.4 KHz	4 db	1 db	1K ohms	FM-1590
1.0000 MHz	100 Hz	400 Hz	6 db	1 db	50 ohms	FM-1719
1.7500 MHz	3.05 KHz	3.90 KHz	5 db	1 db	500 ohms	FM-2873
1.7500 MHz	(BW 1 db) +300 to 3100 Hz (BW 15 db down) 1750 KHz (BW 40 db) —270 to —10 KHz		3 db	—	1000 ohms	FM-2853
2.0000 MHz	40 KHz	80 KHz	3 db	1 db	500 ohms	FM-1115
10.0000 MHz	30 KHz	75 KHz	3 db	1 db	50 ohms	FM-1029
17.0000 MHz	±115 KHz	±600 KHz	4 db	—	50 ohms	FM-2856-1
20.5000 MHz	50 KHz (6 db)	200 KHz	3 db	—	50 ohms	F-1007
25.5000 MHz	±24.5 KHz (6 db)	±30.6 KHz	4 db	—	500 ohms	FM-3318
30.0000 MHz	±22.5 KHz (6 db)	±45 KHz	2.5 db	1 db	2K ohms	F-1139
30.0000 MHz	80 KHz	160 KHz	5 db	1 db	50 ohms	FM-1058
39.0000 MHz	100 KHz	220 KHz	4 db	1 db	50 ohms	FM-1029
50.0000 MHz	25 KHz	62 KHz	6 db	1 db	50 ohms	FM-1029
60.0000 MHz	±50 KHz (6 db)	±600 KHz	4 db	1 db	(50 Ω in, 600 Ω out)	FM-2874
68.0000 MHz	30 KHz	300 KHz 30 db	6 db	± .5 db	50 ohms	FM-3956-1
75.0000 MHz	±5 KHz (.5 db)	±50 KHz	2 db	.5 db	500 ohms	FM-2562
77.0000 MHz	65 KHz	350 KHz	8 db	±.5 db	50 ohms	FM-4956-2
91.0000 MHz	±7 KHz	±50 KHz	2.5 db	± .5 db	50 ohms	FM-1513
109.0000 MHz	15 KHz	70 KHz 20 db	6 db	.5 db	200 ohms	FM-3922
125.0000 MHz	25 KHz	100 KHz	6 db	1 db	50 ohms	FM-1036
149.988 MHz	30 KHz	100 KHz 40 db	8 db	1 db	50 ohms	FM-1029
175.0000 MHz	30 KHz	300 KHz 40 db	4 db	1 db	50 ohms	FM-1948
200.0000 MHz	30 KHz	150 KHz 40 db	8 db	1 db	50 ohms	FM-2204

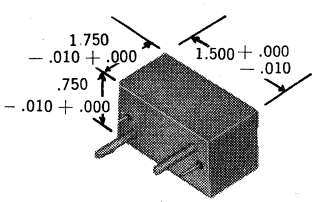
FM-1007



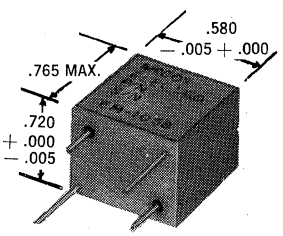
FM-1029



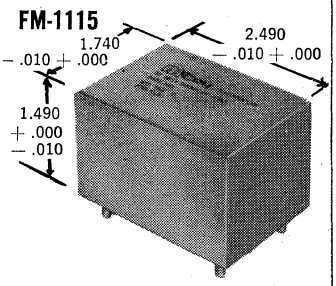
FM-1036



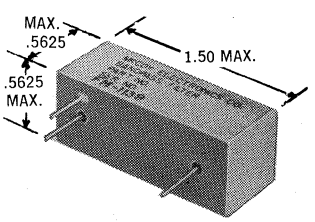
FM-1058



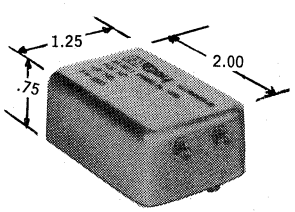
FM-1115



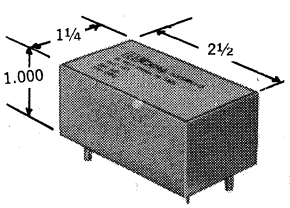
FM-1139



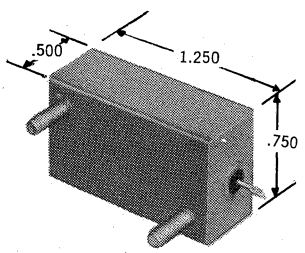
FM-1513



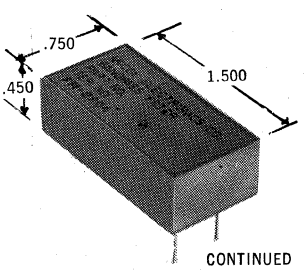
FM-1590



FM-1948



FM-2204



CONTINUED

McCOY ELECTRONICS COMPANY a subsidiary of OAK ELECTRO/NETICS CORP
MT. HOLLY SPRINGS, PENNSYLVANIA 17065 - Tel. 717—486-3411 - TWX: 510—650-3548

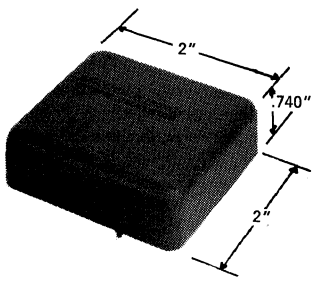
OSCILLATORS CONTINUED

MODEL MC162C2 Temperature Compensated Crystal Oscillator

Frequency Range: 12 KHz to 75 MHz

Temperature Range	Frequency Stability
0° to + 50°C	±0.5 PPM
0° to + 70°C	±1.0 PPM
−30° to + 60°C	±0.5 PPM
−40° to + 70°C	±1.0 PPM
−55° to +105°C	±5.0 PPM

Input Voltage: +12 VDC ± 2% and +5 VDC ± 5%
Output:
Sine Wave: 1 MHz to 75 MHz: 1 MW Minimum
Square Wave: 12 KHz to 25 MHz: TTL or DTL Compatible
Outside Trim: Available on Request
Package Size: 2" × 2" × .740" High
Mounting: 4 ea., 6-32 Threaded Inserts
Seal: Hermetic

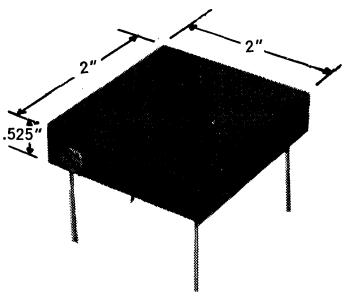


MODEL MC163X2 Temperature Compensated Crystal Oscillator

Frequency Range: 8.0 KHz to 28.0 MHz

Temperature Range	Frequency Tolerance
−30° to + 60°C	±0.5 PPM
−40° to + 70°C	±1.0 PPM
−55° to +105°C	±5.0 PPM

Input Voltage: +12 VDC ± 2% and +5 VDC ± 5%
Output: Sine or Square Wave Compatible with TTL or DTL Logic
Outside Trim: Available on Request
Package Size: 2" × 2" × .525" High
Mounting: 5 ea., .030" Dia. Wire Leads for PC Board Mounting
Seal: Hermetic

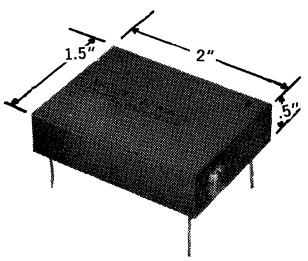


MODEL MC380A2 Temperature Compensated Crystal Oscillator

Frequency Range: 187.5 KHz to 25 MHz

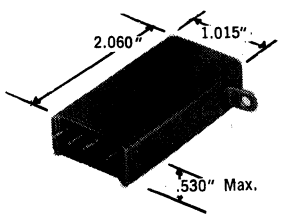
Temperature Range	Frequency Stability
0° to + 50°C	±0.5 PPM
−10° to + 70°C	±1.0 PPM
−30° to + 70°C	±2.0 PPM
−40° to + 85°C	±5.0 PPM

Input Voltage: +5 VDC ± 1%
Output: Square Wave Compatible with TTL or DTL Logic
Outside Trim: Available on Request 5 PPM Min. Total Pull
Package Size: 2" × 1.5" × .5" High
Mounting: Printed Circuit Mounting via 4 ea., .030" Dia. Wire Leads
Seal: Hermetic



MODEL MC200X1 Temperature Compensated Crystal Oscillator

Frequency Range: 10 MHz to 25 MHz
Temperature Range: −30° to +75°C
Frequency Tolerance: ±5 PPM
Frequency Accuracy at RT: 1 PPM Max.
Outside Frequency Trim Capability: ±20 PPM Minimum
Input Voltage: +9 VDC ± 1%
Output: 72 MV ± 2.0 db into a 50 Ω Load
Output Waveform: Sine
Package Size: 1.015" × .530" × 2.060" High Maximums
Mounting: Optional (Unit shown has mounting bracket)
Terminals: 4 ea., .040" Dia. Pins, .200" Long
Weight: 1.5 Ounces Maximum



MODEL MC260X2 Temperature Compensated Crystal Oscillator

Frequency Range: 2.0 MHz to 25 MHz
Frequency Tolerance: ±0.5 PPM
Temperature Range: −20° to +55°C
Input Voltage: +12 VDC ± 5%
Output Waveform: Sine
Output Power: 1 MW Minimum into a 50 Ω Load
Outside Trim: Available on Some Models
Package Size: 1.0" × 1.5" × .850" High
Mounting: 2 ea., 4-40 Studs
Terminals: 4 ea., .030" Dia. Wire Leads
Seal: Hermetic
Weight: Less than 2 Ounces

MODEL MC301X2 Temperature Compensated Crystal Oscillator

Frequency Range: 12.0 MHz to 85 MHz

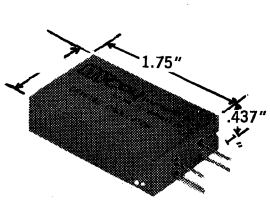
Temperatur Range	Frequency Tolerance
−10° to + 60°C	± 1.0 PPM
−55° to +105°C	±10.0 PPM

Input Voltage: +12 VDC ± 5% at 25 MA Max.
Output Waveform: Sine
Output Power: Typically 5 MW into a 50 Ω Load
Package Size: 1.0" × 2.0" × .6" High Maximum
Mounting: 4 ea., 4-40 Studs
(1) Terminals: 3 ea., .030" Dia. Wire Leads
Weight: Less than 3 Ounces
Seal: Hermetic

Note 1: The leads of the MC301X2 are brought out the side of the case. Another version (MC302X2) is available with the leads coming out the bottom of the case.

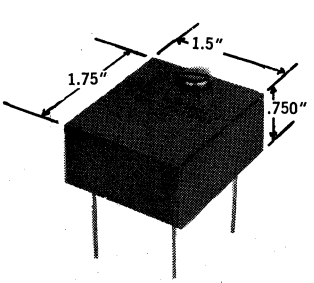
MODEL MC275X2 Temperature Compensated Crystal Oscillator

Frequency Range: 15 MHz to 25 MHz
Temperature Range: −40° to +70°C (Typical)
Frequency Stability: ±4 PPM (Typical)
Input Voltage: +17 VDC ± 1 VDC at 20 MA Maximum
Output: 1 VRMS ± 2 db into a 100 Ohm Load Sine Wave
Package Size: 1" × 1.75" × .437" High
Package Volume: .77 Cubic Inch
Termination: 4 ea., .030" Dia. Wire Leads
Mounting: 4 ea., #2-56 Inserts on 1" × 1.75" Surface
Seal: Hermetic



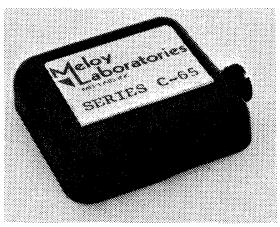
MODEL MC550C7 Temperature Compensated Voltage Controlled Crystal Oscillator (TCVCXO)

Frequency: 3.579545 MHz
Temperature Stability: ±0.0002%
Temperature Range: 0° to +50°C
Mechanical Trim: ±0.0003% @ 0 Volts on AFC
Input: +12 V ± 0.1% at 5 MA Max.
Output: 1.5 VP-P Min. Sine Wave
Load Impedance: 3.3K Ω Shunted by 22 Pf Capacitance
AFC Characteristics:
Pull Range: ±20 Hz Min. to ±40 Hz Max.
AFC Voltage: ±0.5 Volts
Package Size: 1.75" × 1.5" × .750" High
Seal: Hermetic



TO BE PRECISE **Meloy**

Specify Meloy Oscillators



CRYSTAL CONTROLLED OSCILLATORS

Frequency Range: 25K Hz to 50M Hz

SERIES	ACCURACY	INPUT	OUTPUT	SIZE	TERMINALS
C15	±0.05% (−30°C to 105°C)	5 to 28 VDC	Square Wave	1⅛″ x ¾″ x ⅝″	Solder Pin
C35	±0.005% (−55°C to 105°C)			1 17/64″ x 1 17/64″ x 1¾″	Octal Plug
C65	TCXO (3 MHZ to 20 MHZ) ±0.005% (−55°C to 105°C)			1 19/32″ x 1 19/32″ x .4″	Solder Pin
	VCXO (3 MHZ to 10 MHZ) (−20°C to 80°C)			1 19/32″ x 1 19/32″ x .5″	Solder Pin
C80	±0.005% (−55°C to 105°C)			2″ x 2″ x .4″	Solder Pin

TUNING FORK OSCILLATORS

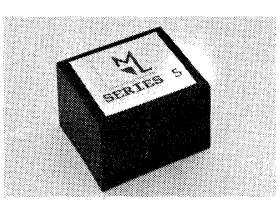
Frequency Range: 1Hz to 25000Hz

SERIES	ACCURACY	INPUT	OUTPUT	SIZE	TERMINALS
10	±0.005% @ 25°C ±0.02% (0 to 60°C) ±0.1% to .05% (−55° to 125°)	3 to 32VDC	Sine or Square Wave	1 29/32″ x 1 15/32″ x .4″	Loop or Solder Pin
10H				1 29/32″ x 1 15/32″ x 15/16″	
10HD				1 29/32″ x 1 15/32″ x 1 21/32″	
30	±0.1% (−55°C to 125°C) ±0.05% (−55°C to 85°C) ±0.02% (15°C to 35°C)	12 to 32VDC		1 17/64″ x 1 17/64″ x 1¾″	Solder Loop
31				1⅝″ x 1¾″ x ⅞″	Solder Pin
50	±0.1% (−55°C to 125°C) ±0.05% (−55°C to 125°C) ±0.01% (0 to 50°C) ±0.005% @ 25°C			1½″ x 1½″ x ⅜″	Solder Pin
50H				1½″ x 1½″ x 1½″	Octal Plug
51 52				1½″ x 1½″ x ⅜″	Solder Pin
80				2″ x 2″ x .4″	Solder Pin

TUNING FORKS

Frequency Range: 240Hz to 25000Hz

SERIES	ACCURACY	SIZE	TERMINALS
22	±0.05% (−55°C to 125°C) ±0.02% (15°C to 35°C)	11/32″ x ¾″ x 1 17/32″	Wire Leads
23	±0.02% (−55°C to 125°C) ±0.01% (−55°C to 85°C) ±0.005% (20°C to 30°C)	1 5/16″ x 1 5/16″ x ⅜″	Solder Pin
24	±0.05% (−55°C to 125°C) ±0.03% (−55°C to 85°C) ±0.01% (0 to 65°C)	1½″ x 1½″ x ⅜″	Solder Pin
27	Low Cost — 1000 pcs — Price less than $10.00 each. ±.1% 25°C ±10°	1″ x 1.5″ x .6″	Solder Pin



SOLID STATE OSCILLATORS

Frequency Range: 1Hz and up

SERIES 5

ACCURACY	INPUT	OUTPUT	SIZE	TERMINALS
±0.05% (25°C ±10°C) ±0.1% (−25°C to 85°C) ±0.5% (−40°C to 85°C)	6 to 28VDC	Square Wave	1″ x 1″ x 1″ or 1.6″ x 1.6″ x 1.5″	Solder Pin

Our units are ideally suited for use in ground, shipboard, airborne, and satellite equipment. Many variations of these and other series are available for both military and industrial applications. Our applications engineers would appreciate the opportunity of assisting you in selecting a model to meet your specific requirements.

For price and delivery information contact

Meloy Laboratories, Inc.
Instruments & Systems Division,
6715 Electronic Drive, Springfield, Virginia 22151

Dept. 103
Telephone: (703) 354-2600

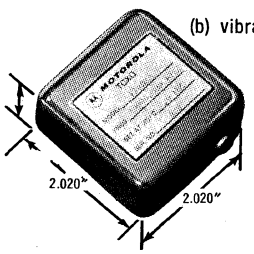
MOTOROLA INC. COMPONENT PRODUCTS DEPARTMENT

2553 N. Edgington St., Franklin Park, Ill. 60131 • Phone (312) 625-0020

Motorola offers its design and production facilities in the frequency components field to OEM manufacturers in the electronic industry. The standard products shown are available for production level deliveries; we also do custom design to your specifications. For further information contact the Component Products Marketing Manager at the above address.

MODEL K1098A TCXO

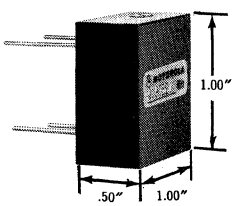
Frequency: 10 MHz
Input Voltage: +12V dc ±1V, Reg ±1%; 10 ma current drain
+ 5V dc ±.25V, Reg ±1%; 25 ma current drain
Output: TTL Compatible (Fan out of 10)
Stability: vs Temperature, $\pm 1 \times 10^{-7}$ from 0°C to 55°C
vs Input Voltage, $\pm 1 \times 10^{-8}$
vs Load Change, $\pm 1 \times 10^{-8}$
vs Time, $<3 \times 10^{-7}$/mo; $<1 \times 10^{-6}$/yr
Short Term Stability: 1×10^{-9}/sec rms
Trim Adjustment: Sufficient for 5 yrs aging Resolution 1×10^{-8}
Environmental: Unit will survive
(a) shock 40 G's for 11 ms
2 shocks in each of 3 planes
(b) vibration .06″ double amplitude 5-55 Hz
15 min sweep in each of 3 planes



K1098A

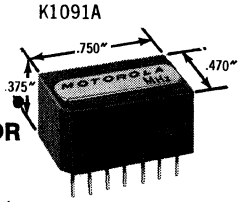
MODEL K1089A MINIATURE TCXO

Frequency Range: 5 MHz to 20 MHz
Voltage: 5, 9, 12, or 15 Volts dc
Input Power: 100 mW typical at 5V dc
Output: Square Wave (TTL compatible)
Operating Temperature: 0°C to 55°C
Frequency Stability vs. Voltage Change: $\pm 1 \times 10^{-6}$ for ±10%
Frequency Stability vs. Temperature: $\pm 2 \times 10^{-6}$
Frequency Stability vs. Load Change: $\pm 1 \times 10^{-6}$ for ±10%
Frequency Stability vs. Time: $\pm 2 \times 10^{-6}$ per year maximum
External Trim Adjust: ±10 parts per million
Mounting: Pins for PCB mounting with solder connection
Environmental: Unit will survive
(a) Shock: 40 G's, 11 msec
(b) Vibration: .06″ double amplitude 5-55 Hz



K1089A

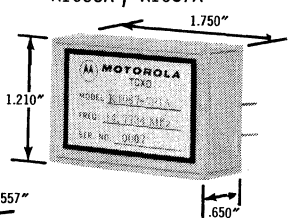
K1091A



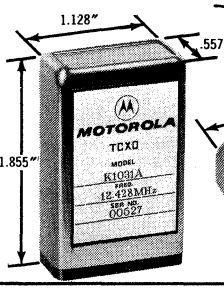
MODEL K1091A DIP CRYSTAL CLOCK OSCILLATOR

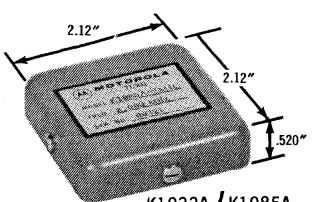
Frequency Range: 4 MHz to 20 MHz
Stability: ±.01% (0°C to 55°C)
Input: +5V dc ±0.5V, 250 mw Maximum
Output: TTL Compatible
No. Pins: 14, Dual inline, 0.10″ spacing

K1035A / K1087A



K1031A / K1034A





K1033A / K1085A

TCXO'S AND CLOCK OSCILLATORS

MOTOROLA MODEL	FREQ. RANGE	POWER VOLTS	POWER MW.	STABILITY VS. 1 YR.	STABILITY VS. 0 to 55°C
K1084A	2 MHz-20 MHz	5-15V	100mw	1×10^{-6}	$\pm 1 \times 10^{-6}$
K1085A	400 kHz-40 MHz	12-15V	225mw	1×10^{-6}	$\pm 1 \times 10^{-6}$
K1031A	4 MHz-20 MHz	5-15V	100mw	1×10^{-6}	$\pm 1 \times 10^{-6}$
K1087A	250 kHz-20 MHz	5-15V	100mw	1×10^{-6}	$\pm 1 \times 10^{-6}$
K1032A	2 MHz-20 MHz	5-15V	100mw	1×10^{-6}	$\pm 15 \times 10^{-6}$
K1033A	400 kHz-40 MHz	12-15V	225mw	1×10^{-6}	$\pm 15 \times 10^{-6}$
K1034A	4 MHz-20 MHz	5-15V	100mw	1×10^{-6}	$\pm 15 \times 10^{-6}$
K1035A	125 kHz-40 MHz	5-15V	100mw	1×10^{-6}	$\pm 15 \times 10^{-6}$
K1089A	5 MHz-40 MHz	5-15V	150mw	1×10^{-6}	$\pm 2.5 \times 10^{-6}$

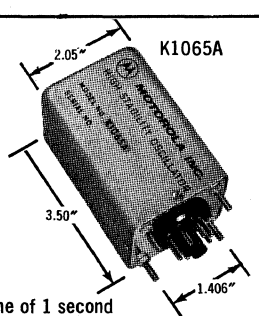
MODEL K1065A OVENIZED CRYSTAL OSCILLATOR

Output Frequency Range: 1-5 MHz
Power Input:
Turn On: 8 watts total
R.T. Typ.: 3 watts
Voltage Output: 1V rms into 1,000 ohms
Standard Wave Form: Sine
Distortion: Less than 5%
Temperature Range: −20°C to +55°C
Stability vs. Temperature: Less than 3×10^{-8}
Short Term Stability: 1×10^{-10} rms for average time of 1 second

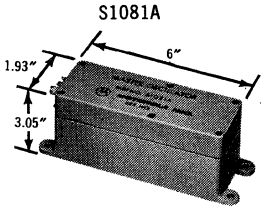
Warm-up	Typical
15 min.	1×10^{-6}
25 min.	1×10^{-7}
30 min.	3×10^{-8}

Input Voltage:
Oven: Selected voltage 18-30V dc
Oscillator: Selected voltage 12-30V dc
Stability vs. Voltage ±5%: $\pm 5 \times 10^{-9}$
Load Stability: $\pm 5 \times 10^{-10}$ for 1,000 ohms ±10%
Frequency Adj. Range: $\pm 2 \times 10^{-6}$
Resolution: 1×10^{-9}
Long Term Stability: 5×10^{-9}/day at time of shipment

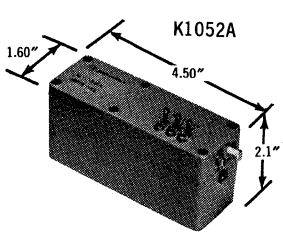
K1065A



S1081A



K1052A



HIGH PRECISION OSCILLATORS

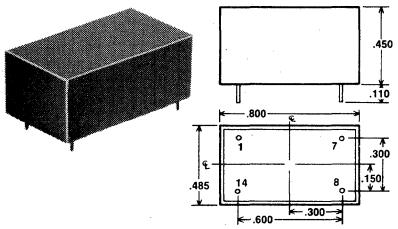
MOTOROLA MODEL	FREQ. RANGE	INPUT	POWER at 25°C	STABILITY VS. 24 HRS.	STABILITY VS. ± 2VDC CHANGE	TEMP.	SHORT TERM
S1081A	60 KHz-10 MHz	28V	3W	5×10^{-10}	$\pm 5 \times 10^{-10}$	3×10^{-8} −20°C to +55°C	1×10^{-10}
K1046A	3 MHz (2-4 MHz)	28V	4.5W	1×10^{-10}* 5×10^{-10}	$\pm 5 \times 10^{-10}$	5×10^{-11}/+10°C to +60°C	5×10^{-11}
K1052A	3 MHz (2-4 MHz)	28V	4.5W	1×10^{-10}* 5×10^{-10}	$\pm 5 \times 10^{-10}$	5×10^{-11}/+10°C to +60°C	5×10^{-11}
K1065A	1-5 MHz	18-30V dc	3W	5×10^{-9}	$\pm 5 \times 10^{-9}$	Less than 3×10^{-8} −20°C +55°C	1×10^{-10}

CMOS LOGIC CLOCK OSCILLATORS

48-HOUR SHIPMENT ON STANDARD FREQUENCIES (Indicated by *)

Monitor has CMOS! Monitor's new CMOS logic crystal-controlled oscillators are precision clocks with single and multiple outputs for today's CMOS logic applications. The units are complete and ready to plug into a DIP socket or circuit board. Why build them yourself when Monitor can supply standard frequencies in 48-hours at these low prices? And each unit is backed by 46 years of frequency control know-how.

978 SERIES / 3-10MHz / CMOS LOGIC CLOCK OSCILLATORS / 14-PIN DIP COMPATIBLE



Frequency Range: 3-10MHz
*Standard Frequencies: 4.194304MHz (1Hz binary multiple)
3.932160MHz (60Hz binary multiple)
4.096MHz (1MHz binary multiple)
Stability: ±.005%, −40 to +85°C
Normal Calibration: ±.01% @ 25°C ±5°C
Output: "0" = +.5V Max., "1" = 80% of supply voltage min.
Input: 3-15VDC, 3.0 MA Max.
Operating Temp. Range: −40 to +85°C
Leads: .019" dia. gold Dumet pins in 14-pin DIP compatible configuration
Material: Diallyl Phthalate

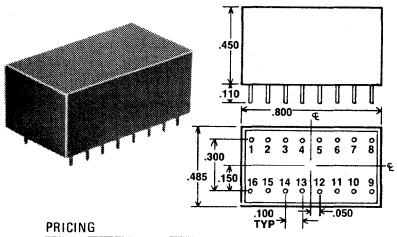
PIN CONNECTIONS:
1. Output
7. Common
8. Output
14. + Supply Voltage

PRICING

Quantity	Price	Quantity	Price Estimate
1	76.00	500	13.30
5	38.00	1000	11.40
10	28.50	5000	8.66
50	19.00		
100	15.20		

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

979 SERIES / 3-9MHz / MULTIPLE OUTPUT / CMOS LOGIC CLOCK OSCILLATORS / DIP 16-PIN PLUG-IN



FREQUENCY RANGE:
Up to 13 outputs in a single package. Output frequencies depend on crystal frequency (fo) selected between 3 and 9MHz. See example below and Pin Connections.

*Standard Frequency: 4.096MHz

EXAMPLE OF OUTPUT FREQUENCIES AVAILABLE USING A CRYSTAL FREQUENCY (fo) OF 4.096 MHZ

PIN	FREQUENCY	PIN	FREQUENCY
10	4.096 MHZ	13	16 KHZ
9	2.048 MHZ	12	8 KHZ
7	256 KHZ	14	4 KHZ
5	128 KHZ	15	2 KHZ
4	64 KHZ	1	1 KHZ
6	32 KHZ	2	500 HZ
		3	250 HZ

Stability: ±.005%, −40 to +85°C
Nominal Calibration: ±.005% @ 25°C ±5°C and 12VDC
Output: "0" = +.5V Max. "1" = 90% of supply voltage min.
Input: +5.5V to +15V, 5 MA Max. (Depends on Frequency)
Operating Temp. Range: −40 to +85°C
Leads: .020" x .012"
Material: Diallyl Phthalate

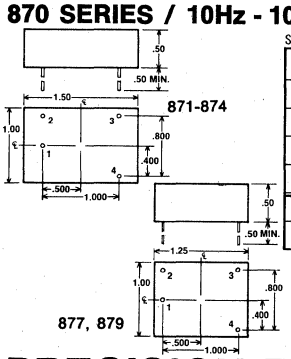
PRICING

Quantity	Price	Quantity	Price Estimate
1	90.00	500	16.75
5	45.00	1000	13.60
10	33.75	5000	10.12
50	22.50		
100	18.00		

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

PIN CONNECTIONS
1. Fo ÷ 4096
2. Fo ÷ 8192
3. Fo ÷ 16,384
4. Fo ÷ 64
5. Fo ÷ 32
6. Fo ÷ 128
7. Fo ÷ 16
8. Common
9. Fo ÷ 2
10. Fo (Xtal Freq.)
11. Common to pin 8
12. Fo ÷ 512
13. Fo ÷ 256
14. Fo ÷ 1024
15. Fo ÷ 2048
16. + Supply Voltage

870 SERIES / 10Hz - 10MHz / CMOS LOGIC CLOCK OSCILLATORS / PCB MOUNTING



SPECIFICATIONS / PRICING

Series	Frequency Range	*Standard Frequency	Output	Input	†Stability (0°-60°C)	1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
871	10 HZ - 149.9 HZ	10, 60 HZ	"0"=+.5V Max. "1"=90% of Supply V Min.	3-15V, 10MA	±.01%	104.00	52.00	39.00	26.00	20.80	18.20	15.60	11.70
872	150 HZ - 499.9 KHZ	—		10-15V, 10MA	±.005%	100.00	50.00	37.50	25.00	20.00	17.50	15.00	11.26
873	500 KHZ - 1.99 MHZ	1 MHZ		7.5-15V, 10MA	±.005%	92.00	46.00	34.50	23.00	18.40	16.10	13.80	10.35
874	2.0 MHZ - 10.0 MHZ	5, 10 MHZ		7.5-15V, 10MA	±.005%	84.00	42.00	31.00	21.00	16.80	14.70	12.60	9.46
877	100 KHZ - 700 KHZ	100 KHZ	"0"=+.5V Max. "1"=80% of Supply V	3-15V, <1MA	±.01% -25 to +75°C	82.00	41.00	30.75	20.50	16.40	14.35	12.30	9.22
879	2.0 MHZ - 10.0 MHZ	5, 10 MHZ		3-15V, <3MA	±.005% -25 to +75°C	78.00	39.00	29.25	19.00	16.60	13.65	11.70	8.78

Operating Temperature Range:
871-874, 0-60°C
877, 879, −25 to +75°C
† Nominal Calibration : 871-874 & 879, ±.005% @ 25°C ±5°C
877, ±.01% at 25°C, ±5°C

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

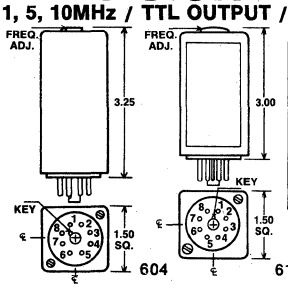
Leads: .025" Dia. gold Dumet
Material: Diallyl Phthalate

PIN CONNECTIONS
1. N/C
2. Common
3. Output
4. + Supply Voltage

PRECISION FREQUENCY STANDARDS

1, 5, 10MHz / TTL OUTPUT / PARTS IN 10^{-9} STABILITY

48-HOUR SHIPMENT ON STANDARD FREQUENCIES (Indicated by*)



SPECIFICATIONS / PRICING

Type	*Standard Frequency	Input Osc.	Input Oven	Stability (Long Term)	Temperature Stability/Range		1	5	10	50	100	Estimates 500	Estimates 1000	Estimates 5000
604	1 MHZ	24-30V, 25 MA	115VAC, 7 watts	$\pm3\times10^{-9}$/Day	$\pm2\times10^{-9}$/°C	-25 to +55°C	157.00	141.00	91.70	72.05	65.50	59.00	58.00	54.50
614 615 616	1 MHZ 5 MHZ 10 MHZ	5V± 10%, 15 MA	12-15V, 3 watts	$\pm5\times10^{-9}$/Day	$\pm1\times10^{-9}$/°C	-25 to +55°C	132.00	93.50	77.00	60.50	55.00	46.00	43.00	39.80
624 625 626	1 MHZ 5 MHZ 10 MHZ		24-30V, 80 MA	$\pm7\times10^{-9}$/Day	$\pm5\times10^{-9}$/°C	0 to 55°C	118.00	83.30	68.60	53.90	49.00	43.00	38.50	36.00

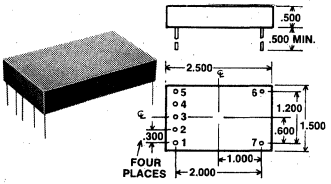
Material: Gold anodized aluminum

PIN CONNECTIONS
1. 115VAC
2. +5V Supply
3. N/C
4. (Pos.) 12-15V Supply
5. (Neg.) 12-15V Supply
6. 115VAC
7. Signal Output
8. Osc./Oven Common

Other frequencies, stabilities and temperature ranges available on special order.

COMPUTER TERMINAL CLOCK

SO-3631-1 AND -2 / LOW AND HIGH BAUD RATES



*Standard Frequencies and Baud Rates:

PIN	SO-3631-1 Baud Rate	SO-3631-1 Frequency	SO-3631-2 Baud Rate	SO-3631-2 Frequency
1	110	1,760 HZ	600	9,600 HZ
2	150	2,400 HZ	1200	19,200 HZ
3	300	4,800 HZ	2400	38,400 HZ
4	600	9,600 HZ	4800	76,800 HZ
5	1200	19,200 HZ	9600	153,600 HZ

PRICING

Type	1	5	10	50	100	ESTIMATES 500	1000	5000
SO-3631-1	98.00	49.00	36.75	24.50	19.60	17.15	14.70	11.02
SO-3631-2	88.00	44.00	33.00	22.00	17.60	15.40	13.20	9.40

Stability: ±.01%, 0 to 70°C
Nominal Calibration: ±.005% @ 25°C
Output: "0" = .5V Max., "1" = 2.7V Min.
Input: SO-3631-1 +5V, 200 MA
SO-3631-2 +5V, 150 MA
Operating Temp. Range: 0 to 70°C
Leads: #22 AWG (.025 Dia.) gold Dumet
Material: Diallyl Phthalate

Other frequencies, stabilities and temperature ranges available on special order.

PIN CONNECTIONS:
1. See
2. Standard
3. Frequencies
4. Table
5.
6. Common (−)
7. +5VDC

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MONITOR PRODUCTS COMPANY, INC.
815 FREMONT AVE. / SOUTH PASADENA, CALIFORNIA 91030 / (213) 682-3761

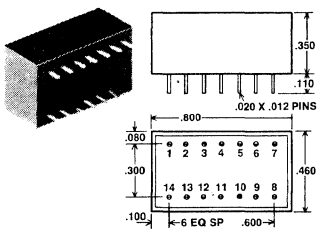
46 Years of Frequency Control Know-How

TTL LOGIC CLOCK OSCILLATORS

48-HOUR SHIPMENT ON STANDARD FREQUENCIES (Indicated by *)

Monitor expands its line of TTL logic crystal-controlled oscillators by adding new economy models and offering a wider range of frequencies, stabilities, temperature ranges and availability. There's single and multiple output units for DIP and circuit board mounting. And standard frequencies are available for 48-hour shipment. With delivery like this you don't have to maintain a costly inventory.

968, 969 SERIES / 1-20MHz / MULTIPLE OUTPUT/TTL LOGIC CLOCK OSCILLATORS/ DIP 14-PIN PLUG-IN



Frequency Range:	1-20MHz basic frequency (fo)
*Standard Frequencies,	1.0, 2.0, 4.0, 8.0 and **16.0MHz in same unit 1.25, 2.5, 5.0, 10.0 and **20.0MHz in same unit **basic frequency
Stability:	±.005%, 0 to 70°C
Nominal Calibration:	±.005%, @ 25°C ±5°C
Output:	"0" = +.5V Max., "1" = 2.7V Min.
Input:	+5VDC, 35MA
Operating Temp. Range:	0 to 70°C
Leads:	.020" x .012"
Material:	Diallyl Phthalate

PIN CONNECTIONS:

968	969
1. +5VDC	fo ÷ 2
2. fo ÷ 8	Gnd.
3. +5VDC	Gnd.
4. +5VDC	N/C

968	969
5. fo ÷ 2	+5VDC
6. fo ÷ 2	TP
7. Common	fo
8. fo	fo ÷ 8
9. fo ÷ 4	fo ÷ 4

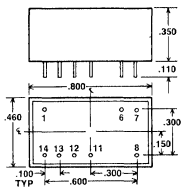
968	969
10. +5VDC	Gnd.
11. +5VDC	fo ÷ 16
12. fo ÷ 16	fo ÷ 2
13. +5VDC	TP
14. +5VDC	fo

PRICING

Series	1	5	10	50	100	ESTIMATES 500	1000	5000
968	90.00	45.00	33.75	22.50	18.00	15.75	13.50	10.12
969	80.00	40.00	30.00	20.00	16.00	14.00	12.00	9.00

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

967 SERIES / 15-35MHz / TTL LOGIC CLOCK OSCILLATORS



Frequency Range:	15-35MHz
*Standard Frequencies:	16 and 20 MHz
Stability:	±.005%, 0-70°C
Nominal Calibration:	±.005% @ 25°C ±5°C
Output:	"0" = +.5V Max., "1" = 2.7V Min.
Input:	5 VDC ±10%, 30 MA
Operating Temp. Range:	0 to70°C
Leads:	.020" x .012"
Material:	Diallyl Phthalate

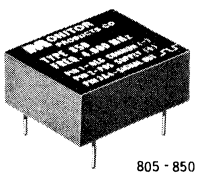
PIN CONNECTIONS:
1. +Supply Voltage
6. Output
7. Common (—)
8. Common (—)
11. Output (Compl.)
12. Output
13. Output
14. + Supply Voltage

PRICING

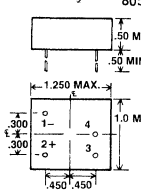
Quantity	Price	Quantity	Price Estimate
1	72.00	500	12.60
5	36.00	1000	10.80
10	27.00	5000	8.10
50	18.00		
100	14.40		

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

800 SERIES / LOW PROFILE / 225KHz-24.99MHz / TTL LOGIC ECONOMY CLOCK OSCILLATORS



805 - 850



1. NEGATIVE COMMON 3. SIGNAL OUT
2. POSITIVE SUPPLY 4. SIGNAL OUT

SPECIFICATIONS / PRICING

Series	Frequency Range	Output	OSC Input VDC	Typical OSC Current Drain MA	Dimension (Inches) L W H	*Typical Stability (0°-60°C)	1	5	10	50	100	Estimates 500	1000	5000
805	50 HZ - 900 KHZ	Logic 0: +.2V±.2V Logic 1: +2.8V Min.	5 ± 10%	150	1.5x1.5x.750	±30 PPM	98.00	49.00	36.75	24.50	19.60	17.15	14.70	11.02
810	16 KHZ - 80 KHZ			30	1.87x1.25x.5	±80 PPM	90.00	45.00	33.75	22.50	18.00	15.75	13.50	10.12
815	25 KHZ - 80 KHZ			75	1.25x1.0x.5	±60 PPM	88.00	44.00	33.00	22.00	17.60	15.40	13.20	9.90
820	80 KHZ - 900 KHZ			15		±60 PPM	86.00	43.00	32.25	21.50	17.20	15.05	12.90	9.68
830	900 KHZ - 1.5 MHZ			25		±30 PPM	70.00	35.00	26.25	17.50	14.00	12.25	10.50	7.88
840	1.5 MHZ - 3.5 MHZ			15			51.00	25.50	19.12	12.75	10.20	8.92	7.65	5.74
845	3.5 MHZ - 10.0 MHZ						59.00	29.50	22.12	14.75	11.80	10.32	8.80	6.64
850	10.0 MHZ - 40.0 MHZ						68.00	34.00	25.50	17.00	13.60	11.90	10.20	7.65

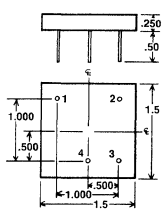
*Nominal Calibration: ±50 PPM @ 25°C
Available to −55°C as type 750 series.

***STANDARD DELIVERY:** 50 HZ, 60 HZ, 400 HZ, 1 KHZ, 10 KHZ, 100 KHZ, 500 KHZ, 1 MHZ, 2.0 MHZ, 4.0 MHZ, 5.0 MHZ, 10 MHZ, 20 MHZ.

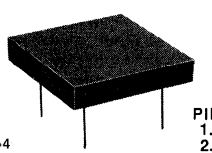
MONITOR HAS HUNDREDS OF OTHER FREQUENCIES AVAILABLE FOR 72 HOUR DELIVERY. CHECK WITH US FOR YOUR REQUIREMENT.

SPECIFICATIONS / PRICING

Series	Frequency Range	*Standard Frequency	Output	Input (VDC)	Stability (0°-60°C)	1	5	10	50	100	Estimates 500	1000	5000
861	225 KHZ - 999 KHZ	—	"0" = +.5V Max. "1" = 2.7V Min. Load: 10 TTL Gates	+5V ± 10%, 40 MA	±.005% Nominal Calibration: ±.005% @ 25°C	90.00	45.00	33.75	22.50	18.00	15.75	13.50	10.12
862	1 MHZ - 3.999 MHZ	1, 2 MHZ		+5V ± 10%, 25 MA		76.00	38.00	28.50	19.00	15.20	13.30	11.40	8.55
863	4 MHZ - 15.99 MHZ	4, 5, 10 MHZ		+5V ± 10%, 20 MA		66.00	33.00	24.75	16.50	13.20	11.55	9.90	7.42
864	16 MHZ - 24.99 MHZ	—		+5V ± 10%, 20 MA		72.00	36.00	77.00	18.00	14.40	12.60	10.80	8.10



861-864



OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

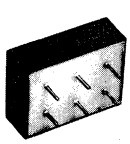
PIN CONNECTIONS:
1. +5V (Supply)
2. Common (—)
3. Output
4. Output (Compl.)

Leads: .025" Dia. gold Dumet
Material: Diallyl Phthalate

750 SERIES: FULL AMBIENT DIGITAL CLOCKS 50Hz — 40MHz

All of the above 800 Series is available in extreme environment military specification configurations as the 750 Series. Call factory for pricing and delivery.

900 SERIES: .350 TALL DIP PLUG-IN: 50Hz — 125MHz



SPECIFICATIONS / PRICING

Series	Frequency Range	Output	OSC Input VDC	Typical OSC Current Drain MA	Dimension (Inches) L W H	*Typical Stability (0°-60°C)	1	5	10	50	100	Estimates 500	1000	5000
900	50 HZ - 7.9 KHZ	Logic 0: +.2V±.2V Logic 1: +2.8V Min.	5 ± 10%	150	2.0x1.0x.5	±100 PPM	124.00	62.00	46.50	31.00	24.80	21.70	18.60	13.95
905	8 KHZ - 999 KHZ			90	•	±60 PPM	112.00	56.00	42.00	28.00	22.40	19.60	16.80	12.60
910	1 MHZ - 10 MHZ			50	1.0x.75x.5	±30 PPM	86.00	43.00	32.25	21.50	17.20	15.05	12.90	9.68
915	10 MHZ - 25 MHZ						90.00	45.00	33.75	22.50	18.00	15.75	13.50	10.12
920	25 MHZ - 75 MHZ						96.00	48.00	36.00	24.00	19.20	16.80	14.40	10.80
925	75 MHZ - 125 MHZ						98.00	49.00	36.75	24.50	19.60	17.15	14.70	11.02
930	1 MHZ - 10 MHZ			50	1.0x.75x.350	±30 PPM	98.00	49.00	36.75	24.50	19.60	17.15	14.70	11.02
935	10 MHZ - 25 MHZ			50	1.0x.75x.350	±30 PPM	102.00	51.00	58.25	25.50	20.40	17.85	15.30	11.48
940	25 MHZ - 75 MHZ			70	1.0x.75x.350	±30 PPM	106.00	53.00	39.75	26.50	21.20	18.55	15.90	11.92
945	75 MHZ - 125 MHZ			70	1.0x.75x.350	±30 PPM	110.00	55.00	41.25	27.50	22.00	19.25	16.50	12.38

*Nominal Calibration: ±50 PPM @ 25°C
Full Ambient Devices Available at Additional Cost

•905 Series: 8-50 KHZ 1.75"x1.0"x.5"
50-990 KHZ 1.5" x1.0"x.5"

***STANDARD DELIVERY:** 1 MHZ, 2 MHZ, 4 MHZ, 5 MHZ, 10 MHZ, 20 MHZ.

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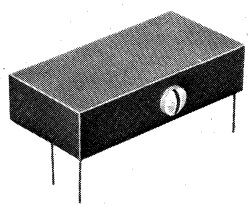
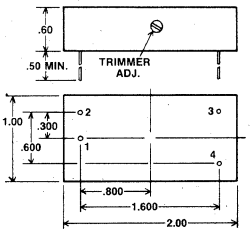
46 Years of Frequency Control Know-How

TCXO TEMPERATURE COMPENSATED OSCILLATORS





48-HOUR SHIPMENT ON STANDARD FREQUENCIES (Indicated by*)

TTL, CMOS OR SINE WAVE OUTPUT

Monitor's Temperature Compensated Crystal Oscillators provide a choice of TTL, CMOS or sine wave outputs for instrumentation and industrial uses where power, space and weight restrictions preclude the use of an oven for temperature stabilization.

PIN CONNECTIONS

EO1, 2, 3, 4	EO5, 6
1. + Logic Supply	1. N/C
2. Common (—)	2. Common (—)
3. Output	3. Output
4. + TCXO Supply	4. + TCXO Supply

SPECIFICATIONS

Series	*Standard Frequency	Output		Input (VDC)	Stability (0°-60°C)	PRICING 1	5	10	50	100	Estimates 500	1000	5000
E01	1, 5 or 10 MHZ	TTL	"0" = +.5V Max. "1" = 2.7V Min. 10 TTL Load	TCXO = +10 to +15V ±5%, 5MA Logic = +5V ±10%, 15MA	±5 PPM	213.00	142.00	106.50	71.00	56.80	44.70	42.60	31.95
E02	1, 5 or 10 MHZ			TCXO = +10 to +15V ±2%, 5MA Logic = +5V ±10%, 15MA	±1 PPM	228.00	152.00	114.00	76.00	60.80	53.70	45.60	34.20
E03	1, 5 or 10 MHZ	SINE WAVE	1VPP, 1K	TCXO = +10 to +15V ±5%, 5MA Logic = +5V ±10%, 15MA	±5 PPM	216.00	144.00	108.00	72.00	57.60	50.40	43.20	32.40
E04	1, 5 or 10 MHZ			TCXO = +10 to +15V ±2%, 5MA Logic = +5V ±10%, 15MA	±1 PPM	231.00	154.00	115.50	77.00	61.60	53.90	46.20	34.65
E05	1, 5 or 10 MHZ	CMOS	"0" = +.5V Max. "1" = 80% of Supply V Min.	TCXO=+10 to +15V±5%, 10 MA	±5 PPM	219.00	146.00	109.50	73.00	58.40	51.10	43.88	32.85
E06	1, 5 or 10 MHZ			TCXO=+10 to +15V±2%, 10 MA	±1 PPM	234.00	156.00	117.00	78.50	62.40	54.60	46.80	35.10

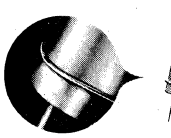
Leads: .025" Dia. gold Dumet
Material: Diallyl Phthalate
Operating Temp. Range: 0°C to +60°C
Frequency Adjustment: ±10PPM
Long Term Stability: 2PPM/Year

OTHER FREQUENCIES, STABILITIES AND TEMPERATURE RANGES AVAILABLE ON SPECIAL ORDER.

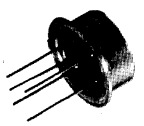
KOLDWELD STABILITY RELIABILITY CRYSTALS

Monitor's KTO Series Frequency Control Crystals are an extension of Monitor's capability in applying KOLDWELD techniques to crystal packaging. These high reliability, low aging crystals offer precision frequency control in a subminiature package (TO-5 transistor package). The KX type crystals conform to the dimensions and requirements of standard military type HC holders and are idealy suited to extreme environments. The KX type can be used as replacements for standard HC-6, HC-18 and HC-13 mil-spec units.

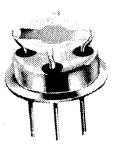
MONITOR ALSO MANUFACTURES A COMPLETE LINE OF CRYSTALS (HC-6/U, HC-18/U, HC-13/U, HC-25/U) TO MIL-C-3098 (4 KHz-200 MHz). WRITE FOR OUR 40 PAGE CRYSTAL SPECIFICATION HANDBOOK.



MC18

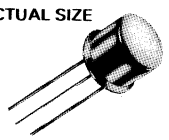


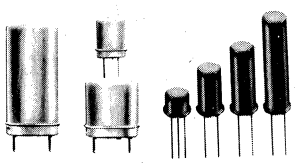
KT08



KT05 SHOWN WITH CASE REMOVED

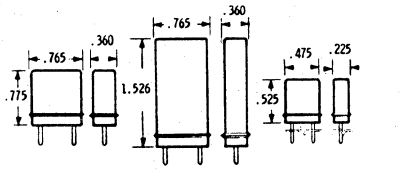
KT05 ACTUAL SIZE



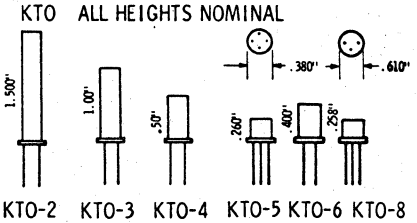


KOLDWELD CRYSTALS

	Cut Type	Nominal Freq. TCL Available #STD	Series Resistance Range in Ohms	Typical L in henries	Typical C_o in pf	Typical C_1 in pf	Average Capacity Ratio	Recommended Drive Level in mw	Aging Typical x 10^{-6} per day after: 1 Wk.	5 Wks.	10 Wks.
KX-13 Series											
16-100KC	NT	6	5-100K	1000	7.0	.007	900	.05	40		7
90-200KC	E	7	.4-5K	30	8.0	.05	130	.1	50		8
200-300KC	DD	3	.2-5K	28	8.0	.018	450	.1	50		8
KX-6 Series											
90-200KC	NT	6	5-50K	270	6.0	.006	900	.05	40		7
200-250KC	E	7	1-5K	25	3.0	.02	130	.1	60		9
200-500KC	DT	5	1-8K	30	3.0	.007	350	.1	50	30	9
300-700KC	DD	3	1-5K	10	4.0	.01	350	.1	50		8
400-900KC	CT	9	1-8K	8	4.0	.009	400	.1	50		8
1.5-3.0MC	AT	4	10-300	.45	4.0	.01	300	.05	5	1	.4
3-150MC	AT	4	3-80	—	5.0	—	*	.05	7	2	.6
KX-18 Series											
5-11.9MC	AT	4	3-50	.03	4.0	.015	300	.05	7	3	.6
12-150MC	AT	4	3-80	—	5.0	—	*	.05	7	3	.8
KTO-2 Series											
16-100KC	NT	6	5-80K	800	8.0	.009	900	.05	50	30	9
KTO-3 Series											
60-200KC	NT	6	5-60K	550	7.0	.007	900	.05	50	30	9
120-350KC	E	7	.5-5K	10	8.0	.07	130	.1	50	30	9
325-600KC	DD	3	.2-5K	25	4.0	.009	450	.1	50		8
KTO-4 KTO-8 Series											
350-455KC	E	7	1-5K	16	2.0	.015	130	.1	50	30	9
600-700KC	DD	2	.5-5K	9	3.0	.017	450	.1	50		8
KTO-5 Series											
455-524KC	E	9	1-5K	7	2.0	.015	130	.1	60	40	9
525-649KC	DT	7	1-10K	12	2.0	.005	400	.1	60	40	9
650-1000KC	CT	9	1-8K	8	2.0	.005	400	.1	60		9
9-11.9MC	AT	4	3-40	.025	5.0	.016	300	.05	7	3	.6
12-150MC	AT	4	3-80	—	5.0	—	*	.05	7	3	.8
KTO-8 Series											
2-8MC	AT	4	3-300	—	4.0	.015	300	.05	5	1	.5



KX-6 KX-13 KX-18



KTO-2 KTO-3 KTO-4 KTO-5 KTO-6 KTO-8

MONITOR PC

MONITOR PRODUCTS COMPANY, INC.

815 FREMONT AVE. / SOUTH PASADENA, CALIFORNIA 91030 / (213) 682-3761

46 Years of Frequency Control Know-How

FILTERS/CRYSTAL & LC

ORIGINATORS OF THE "INITIAL FILTER ANALYSIS CONCEPT."

Monitor's "Initial Filter Analysis Concept" can save you many hours of time, and money when specifying crystal filters.

With the increasing complexity of today's communication requirements, the initial specification of filter characteristics becomes difficult. Over or under specification can lead to significantly increased costs in the end item. Misconceptions between supplier and customer as to the exact letter of the specification can also be costly.

Purchasing's job becomes almost impossible when price versus capability must be evaluated. It can be extremely costly to choose the lowest bidder if he does not understand and have the capability of producing the network required.

To this end, Monitor would like to present for your consideration, the INITIAL FILTER ANALYSIS CONCEPT. Essentially, the concept entails taking the preliminary filter specifications based on system requirements, and designing a device to best approximate or completely satisfy the specification.

With the "INITIAL FILTER ANALYSIS" the customer receives a computer analysis in plot and tabloid form, ending in recommendations and a summary. The following is a typical "INITIAL FILTER ANALYSIS,"

Figure 1	Plot and tabulation of Amplitude, delay, phase and impedance driving point. (Note examples below.)
Figure 2	If required or desired, complete pulse response in plot and tabulation. (Note examples below.)
Summary & Recommendations	Comments are supplied as to considerations that should be taken for environmental extremes, size, packaging conditions, and if appropriate, recommended modifications of specification for cost reduction.

With Monitor's "INITIAL FILTER ANALYSIS CONCEPT," confidence of design can be assured. Please call or write Monitor Products for complete details.

Figure 1. Amplitude and delay Response

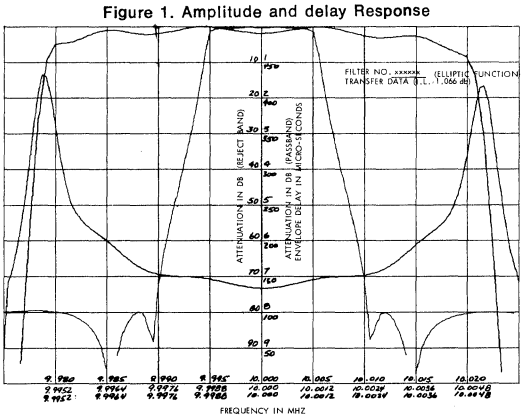
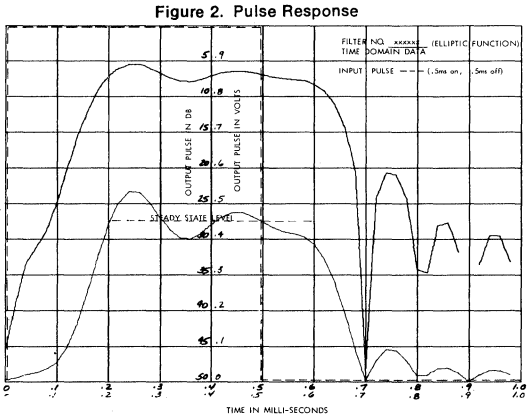


Figure 2. Pulse Response



INPUT FILE?DATA
TIME?N
TRAN,DRIVE,COMB?T
FREQ?N

Filter No. XXXX (Elliptic Function)
Transfer and Driving Point Tabulation

LOSS 8.06453 118.915 DEG 1.00000E+07 HZ

FREQUENCY HZ	ATTEN DB	DELAY MICROSEC	PHASE DEGREES	IMPEDANCE DRIVING POINT OHMS	DEGREES	DB
9975002	54.91	7.34	-90.97	1539	-88.28	8.86
	49.68	12.35	-79.86	1088	-88.50	11.55
		15.37	-66.02	555	-88.28	17.13
10005500		19.21		115	82.07	30.71
10006000	4.51				87.69	11.76
10006501	5.36	84.98	-160.11			5.03
10007002	6.31	84.26	-144.95	22760		
10007500	7.36	83.67	-130.00	13723	-60.22	
10010001	14.15	75.32	-62.21	2429	-84.71	5.94
10012500	22.30	55.90	-11.90	74	-56.62	34.55
10015001	30.27	38.72	22.95	1401	87.60	9.60
10017499	37.54	27.59	47.78	2654	87.04	5.25
100200	Actual insertion loss 7.06637DB-6.000DB			92	86.08	3.34
100224	Insertion loss = 1.06637DB			15	84.94	2.31
100250000				0.34	83.61	1.69

FREQ?YP

EXAMPLE OF PRINTOUT

INPUT FILE?DATA
TIME?N
TRAN,DRIVE,COMB?T
FREQ?N

Filter No. XXXX (Gaussian)
Transfer and Driving Point Tabulation

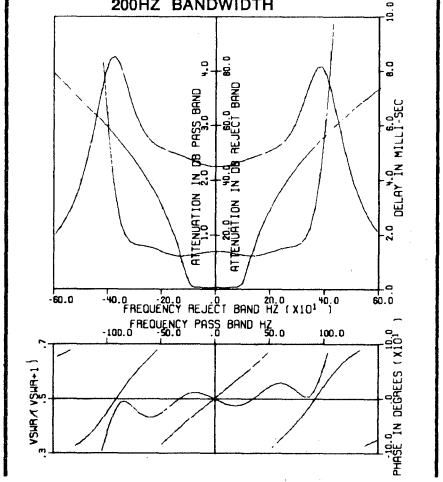
LOSS 7.06637 169.149 DEG 1.00000E+07 HZ

FREQUENCY HZ	ATTEN DB	DELAY MICROSEC	PHASE DEGREES	IMPEDANCE DRIVING POINT OHMS	DEGREES	DB
9975002	79.62	1.91	-164.90	977	-88.78	3.88
	79.27	2.18	-162.93	943	-88.81	3.54
		2.55	-160.55	903	-88.85	3.76
10005500		2.73		852	-88.89	4.04
10006000	16.63	145.77			-88.94	4.46
10006501	24.48	102.16	82.67			5.13
10007002	31.43	65.24	100.42	24001		
10007500	37.83	46.61	108.81	9844	-74.47	
10010001	71.72	21.55	128.20	3429	-85.32	.57
10012500	80.72	218.09	-35.52	2552	-86.67	.84
10015001	96.72	316.36	159.20	2188	-87.21	1.05
10017499	82.22	397.67	157.10	1984	-87.50	1.21
100200	Actual insertion loss 8.06453DB-6.000DB			953	-87.68	1.34
100224	Actual = 2.06453DB			761	-87.81	1.44
100250000		2.19	164.30	1691	-87.91	1.53

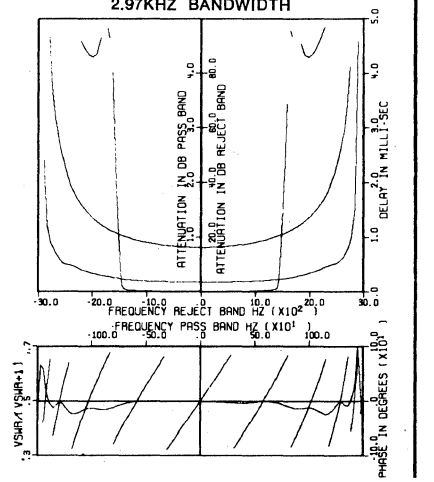
FREQ?YP

EXAMPLE OF PRINTOUT

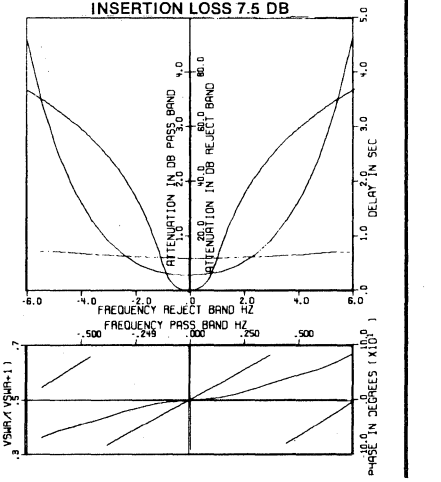
FOUR POLE — FOUR ZERO
200HZ BANDWIDTH



SSB FLTR
2.97KHZ BANDWIDTH



FOUR POLE — NO ZERO
1.5HZ BANDWIDTH 100KHZ
INSERTION LOSS 7.5 DB



MONITOR PC

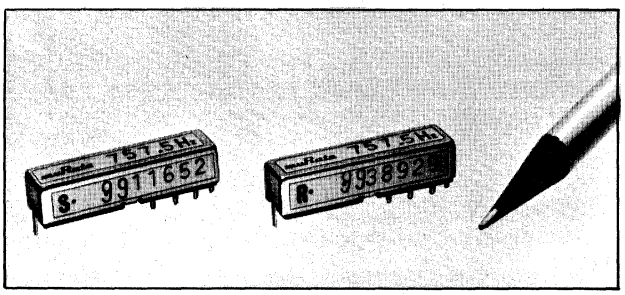
MONITOR PRODUCTS COMPANY, INC.

815 FREMONT AVE. / SOUTH PASADENA, CALIFORNIA 91030 / (213) 682-3761

46 Years of Frequency Control Know-How

SUBMINIATURE PIEZOELECTRIC TUNING FORKS

muRata MICROFORK® TYPES EFM-R & S



The Types EFM-R and S are piezoelectrically driven subminiature tuning forks particularly suited for commercial control applications. The EFM-R is strictly a receiving or decoding unit. The EFM-S is a transmitting or coding unit only.

Both units are extremely compact and designed to provide long term precision and reliability. Many specific frequencies, including those listed on the right and all standard E.I.A. frequencies from 288.5 Hz to 3,000 Hz, are available in standard units. Non-standard frequencies are also available on special order.

SPECIFICATIONS (Identical for both units)

Frequency Range	288.5 to 3000 Hz
Frequency Accuracy	288.5 to 999 Hz; ±0.5 Hz 1000 to 3000 Hz; ±1.0 Hz
Input and Output Impedance	300KΩ
Insertion Loss*	10dB max.
Temperature Coefficient of Frequency	3.5 X 10^{-5}/°C max.
Temperature Range	−20 to +60°C
Weight (approx.)	0.16 oz. (4.5g)

* Insertion Loss = $20 \text{ Log } \frac{E_1}{E_2} - 6$ (dB)

STANDARD FREQUENCIES (Hz)

367.5	532.5	697.5	862.5	1000
382.5	547.5	712.5	877.5	1500
397.5	562.5	727.5	892.5	1700
412.5	577.5	742.5	907.5	1900
427.5	592.5	757.5	922.5	2100
442.5	607.5	772.5	937.5	2300
457.5	622.5	787.5	952.5	2500
472.5	637.5	802.5	967.5	2700
487.5	652.5	817.5	982.5	2900
502.5	667.5	832.5	997.5	
517.5	682.5	847.5		

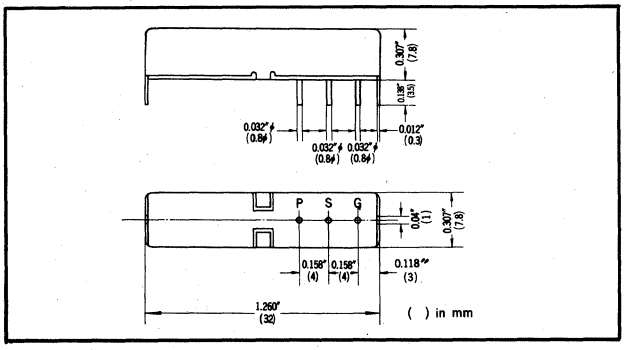
E.I.A. Standard Frequencies from 288.5 to 3,000 Hz are also available. Non-standard frequencies within the above frequency range are available on special order.

Ordering: Specify model, type and frequency.
Example: EFM-R-367.5 or EFM-S-367.5

APPLICATIONS

- ☐ Tone Signaling
- ☐ Coding and Decoding
- ☐ Alarm Systems
- ☐ Garage Door Openers
- ☐ Sound Multiplexing
- ☐ Remote Control Systems
- ☐ Paging Systems
- ☐ Traffic Signal Controllers

DIMENSIONS



muRata

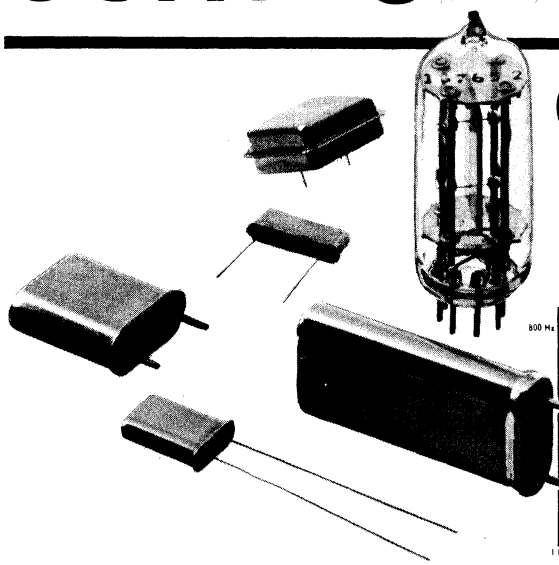
MURATA CORP. OF AMERICA
2 Westchester Plaza, Elmsford, New York 10523, U.S.A.
Phone: 914-592-9180 • Telex: 137332

MURATA MFG. CO., LTD.
Nagaokakyo-City, Kyoto, Japan • Phone 075-921-9111
Cable Address "MURATA KYOTO," TELEX 5429901

NEL FREQUENCY CONTROL DEVICES

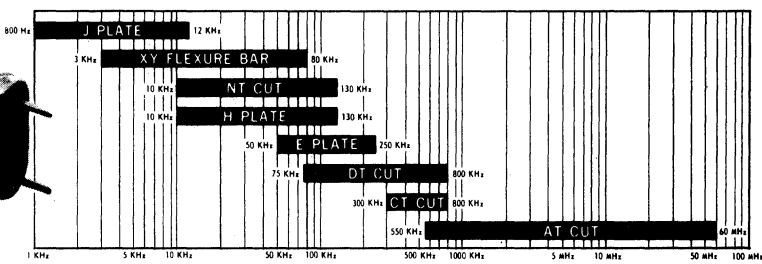
Write for catalog and pamphlet on "Writing Crystal Specifications".

Write for new catalog and pamphlet on "Writing Crystal Specifications"



CRYSTALS

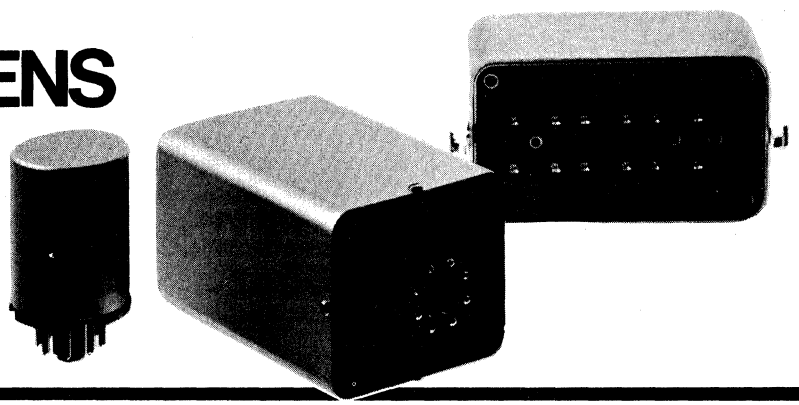
Leadership in the design and manufacture of low frequency crystals enables us to provide the widest variety in choosing the proper crystal for your application. Dependable quality and producible specifications help you to keep your production schedules. Complete spectrum coverage from under 1 KHz to over 50 MHz means one source that can handle most applications. For technical information, see our catalog.

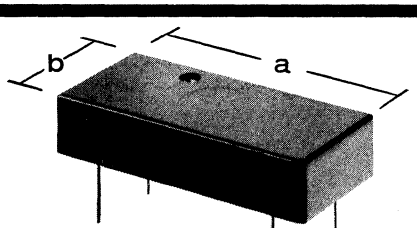


OVENS

Crystal and component ovens that employ dynamic thermal design and utilize the best components and construction techniques. Either standard or custom designs to provide optimum performance for your application. Contact us for details.

Electronic or Thermostatic Control





Oscillator Dimensions

Type Designation	Dimension "a"	Dimension "b"
TO – 2110	2.1"	1.0"
TO – 1510	1.5"	1.0"
TO – 1107	1.1"	0.7"

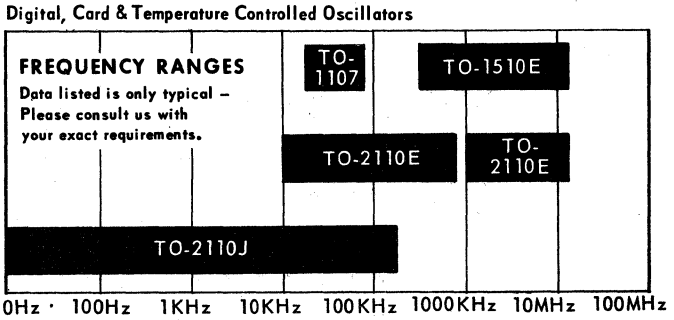
Unit height is indicated by suffix letter, in .1" increments. A = .1", B = .2" etc.

Standard Supply Voltage: 5V

Standard Output: TTL & DTL Compatible

OSCILLATORS

Northern Engineering offers a complete line of Digital, Card & Temperature Controlled Oscillators



Complete application assistance followed by prompt, dependable delivery of reliable frequency control devices will help ensure the success of your product. Contacting our sales representative or factory will bring a rapid, useful response. The value of our service is enhanced by allowing us to work with you early in the design stage.

Northern Engineering Laboratories... INC.

SEE OUR SPECIFICATIONS IN VSMF MICROFILM CATALOG FILE

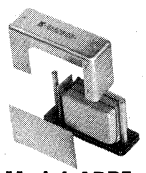
357 Beloit Street. Burlington, Wisconsin 53105 Phone: Area Code 414 763-3591

Please contact us with your needs.

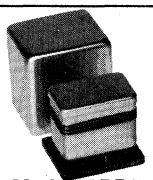
ovens

PROPORTIONAL CONTROL CRYSTAL OVENS

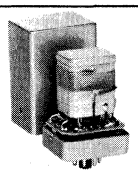
New technology in circuit design now provides low cost proportional control crystal ovens. High reliability, low sustaining power consumption and noiseless operation. A representative few of many available models are shown. Available in standard temperatures and voltages.



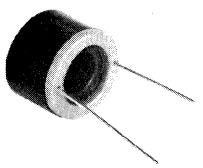
Model ADP5
A side access oven for 5 HC-6/U crystals. For AC/DC operation. Wire leads for circuit board mounting.



Model ADP4
For 4 HC-6/U crystals, has center shield. For AC/DC operation. Wire leads for circuit board mounting.



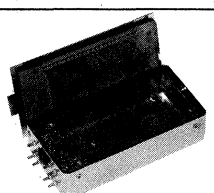
Model PC2-20
A precision oven for 2 HC-6/U crystals or components. Octal base. 115 VAC. Models for DC voltages available.



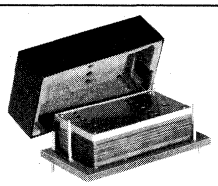
Model T05P
For T05 crystal, Transistor or I.C. 5, 12 or 24 VDC. A wide range of temperature models.

PROPORTIONAL CONTROL COMPONENT OVENS

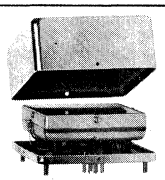
Ovenaire offers a complete line of component ovens, from PCB mount mini-ovens for solid state and IC designs to large cavity area ovens for more sophisticated systems. A few of many available standard designs are shown. Custom design capabilities to meet most exacting requirements.



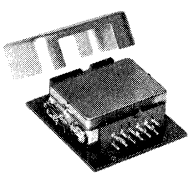
Model CO-1142
Cavity area 2 13/16" x 4" x 13/16" high. 24V DC. Temperature +60°C to +85°C, factory set.



Model CO-1139
Cavity area 2½" x 4½" x 1¼" high. 12V DC. Temperature +60°C to +85°C, factory set.



Model CO-1128
Cavity area 2½" x 2½" x ⅝" high. 28V DC or 115V AC. Temperature +60°C to +85°C factory set.

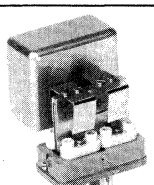


Model CO-1090
Cavity area 2 47/64" x 2 21/64" x 1 3/32" high. 28V DC or 115V AC. Temperature +60°C to +85°C factory set.

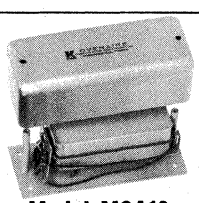
THERMOSTAT CONTROL OVENS

For more than a decade, Ovenaire has been recognized as the leader in thermostat controlled ovens. This proud reputation continues with a full line of crystal and component ovens featuring the reliable snap action thermostat.

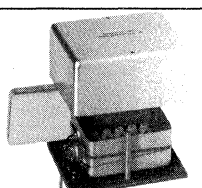
Model SA2
For 2 HC-6/U crystals. Fast warmup, low power. 6 to 28V AC/DC. All standard temperatures.



Model SA4
For 4 HC-6/U crystals. Fast warmup, low power. 6 to 28V AC/DC. All standard temperatures.



Model MSA12
For 12 HC-25/U crystals. Minimal cycling. Circuit board mount. Standard, AC/DC voltages and temperatures.



Model SA12
For 12 HC-6/U crystals. Wire leads or terminals. Standard AC/DC voltages and temperatures.

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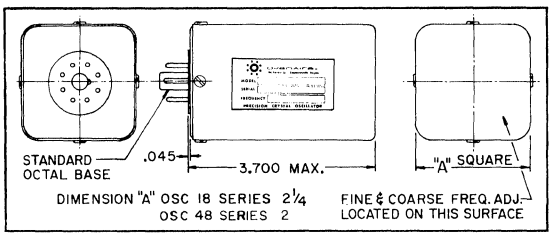
Kidde

frequency control devices

Ovenaire has the capabilities, experience and production techniques to meet the most exacting crystal oscillator requirements. From high precision military requirements to volume production for competitively priced systems. Select a standard design series from the tables on these pages or contact us for special requirements.

OSC 18 SERIES
HIGH STABILITY CRYSTAL OSCILLATORS



FEATURING:

- Precision Glass Enclosed Crystals
- High Gain DC Proportional Oven
- Low Power – 3 Watts at +25° C
- Designed for Hi-Impact Shock
- Now in 6th Year of Production
- Unbeaten for Price and Performance

Options –
Logic Output, VCXO Control, Supply Voltage:
+12 VDC, +15 VDC, +28 VDC

STABILITY CLASS		HIGH PRECISION	PRECISION	HIGH	HIGH	EXTENDED FREQUENCY
FREQ. RANGE		1 or 3 MHz	1 MHz	0.5 to 2 MHz	1 to 5 MHz	5 to 30 MHz
PART NO.		OSC 18-6	OSC 18-2	OSC 18-1	OSC 18-5	OSC 18-7
OUTPUT		1 VOLT RMS MINIMUM SINE WAVE INTO 500 OHMS				0.7v RMS INTO 50 Ω
STABILITY	LONG TERM	$1x10^{-8}$/WK	$3x10^{-9}$/DAY	$7x10^{-9}$ PER DAY		$3.5x10^{-6}$/YR
	SHORT TERM	$2x10^{-10}$RMS	$\pm 5x10^{-10}$P-P	$5x10^{-10}$RMS	$\pm 5x10^{-9}$P-P	—
	AMBIENT	0 to +55°C $<1x10^{-8}$	−20 to +55°C $2x10^{-10}$/°C	−20 to +55°C $1x10^{-9}$/°C	−20 to +65°C $<5x10^{-7}$	−20 to +65°C $5x10^{-9}$/°C
	VOLTAGE	$5x10^{-10}$/1%	$5x10^{-10}$/1%	$5x10^{-9}$/1%	$2x10^{-8}$/1%	$3x10^{-8}$/1%
	LOAD	$5x10^{-10}$/1%	$1x10^{-9}$/1%	$2x10^{-9}$/1%	$2x10^{-8}$/5%	$5x10^{-8}$/5%
WARM-UP FROM +25° C		$1x10^{-7}$ IN < 20 MIN	$1x10^{-7}$ IN < 30 MIN	$2x10^{-7}$ IN < 30 MIN	$5x10^{-7}$ IN < 30 MIN	$5x10^{-7}$ IN < 20 MIN
FREQ. ADJUSTMENT		COARSE AND FINE PISTON TRIMMERS		SINGLE PISTON TRIMMER		
INPUT POWER		24 VDC WITH 10 WATTS MAXIMUM DURING WARM-UP				

Technical data subject to change

PRINTED CIRCUIT MOUNT CRYSTAL OSCILLATORS 1MHz to 150MHz

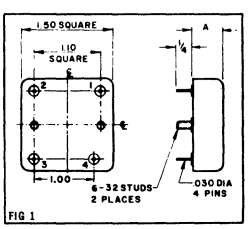
FREQUENCY RANGE (MHz)		1 to 6	>6 to 10	>10 to 25	>25 to 60	>60 to 150
TOLERANCE		±0.001%			±.0012%	±.0015%
TEMP. RANGE		0°C to +60°C				
SERIES NO.	* LOGIC	OSC 51-1-1	OSC 51-1-2	OSC 51-1-3	OSC 51-1-4	—
	SINE	OSC 51-2-1	OSC 51-2-2	OSC 52-2-1	OSC 52-2-2	OSC 52-2-3
LOGIC	SUPPLY VOLTAGE	+5V DC ±5%				
	SYMMETRY	50/50 ±20%	50/50 ±20%	50/50 ±20%	50/50 ±30%	—
	LOGIC HIGH	3VP @3Ma	3VP @3Ma	3VP @5Ma	3VP @5Ma	—
	LOGIC LOW	±0.4V @5Ma				—
	RISE TIME	<50 NS	<15 NS	<10 NS	<5 NS	—
	FALL TIME	<50 NS	<15 NS	<10 NS	<4 NS	—
	CONFIGURATION	FIGURE 1				—
	HEIGHT DIM A	.625	.50			—
SINE	SUPPLY VOLTAGE	+12V DC ±5%				
	OUTPUT VOLTAGE	1 VRMs ±30%		+10 DBM ±3db		
	LOAD	1 KΩ Resistive		50Ω Resistive		
	HARMONIC LEVEL	−30 DB		−25 DB		
	CONFIGURATION	FIGURE 1		FIGURE 2		
	HEIGHT DIM A	.625	.50	1.00		

ORDERING INFORMATION

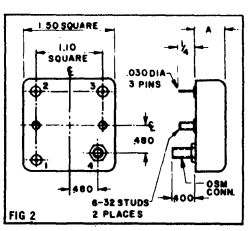
Specify Series Number and Desired Frequency
Example: 8.3 MHz Logic Unit would be OSC 51-1-2 (8.3 MHz)

● EXTENDED CAPABILITY

- LOGIC LEVELS TO 60 MHz
- SINE COVERAGE TO 150 MHz
- FAST PROTOTYPE SERVICE
- LOW COST
- SMALL SIZE
- RELIABLE



Pin Connections
PIN 1 +VSUP PIN 3 OVDC
PIN 2 OVDC PIN 4 OUTPUT



Pin Connections
PIN 1 +VSUP PIN 3 OVDC
PIN 2 OVDC OSM OUTPUT

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frequency control devices

OVEN STABILIZED OSCILLATOR SERIES

Ovenaire produces many types of ovenized crystal oscillators to meet widely varying performance needs. Your ovenized oscillator requirement can be customized from one of these proportionately controlled standards.

Available in sine and square wave output.

SERIES	OSC 11	OSC 24	OSC 32	OSC 29	OSC 70
MAJOR FEATURE	AC or DC SMALL SIZE	FAST WARM-UP	LOW OVEN POWER	EXTENDED FREQ. COMPACT SIZE	
FREQUENCY	1 to 22 MHz	1 to 10 MHz	2 to 10 MHz	5 to 25 MHz	22 to 150 MHz
OUTPUT	1 VOLT RMS INTO 500 OHMS			1v RMS 300Ω	+10 dbM 50Ω
OPTIONAL OUTPUT	LOGIC	LOGIC	LOGIC	LOGIC	NONE
AMBIENT RANGE °C	−20° to +60°	−30° to +55°	0° to +55°	−20° to +60°	−10° to +60°
AMBIENT STABILITY	$5x10^{-9}$/°C	$5x10^{-10}$/°C	$1x10^{-9}$/°C	$1x10^{-8}$/°C	$2x10^{-8}$/°C
WARM-UP FROM 0°C	$\pm1x10^{-6}$ IN 30 MIN	$\pm5x10^{-7}$ IN 5 MIN	$\pm5x10^{-7}$ IN 45 MIN	$\pm1x10^{-6}$ IN 30 MIN	$\pm1x10^{-6}$ IN 30 MIN
POWER — COLD START	10 to 15W	25 WATTS	3.6 WATTS	8 WATTS	8 WATTS
POWER — STEADY STATE +25°	APPROX. 3.5W	2 WATTS	1 WATT	APPROX 2.5 WATTS	
POWER — SUPPLY VOLTAGE	115V AC 24V DC	24V DC	24V DC	28V DC	28V DC
OSCILLATOR SUPPLY	12 to 24V DC	24V DC	24V DC	15V DC	15V DC
TRIM RANGE	MECHANICAL AND/OR ELECTRICAL TRIM AVAILABLE				
SIZE	FIG 1	FIG 2	FIG 2	FIG 3	FIG 3 or FIG 4

FIG. 1

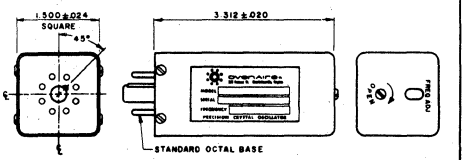


FIG. 2

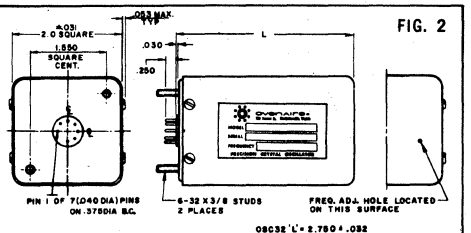


FIG. 3

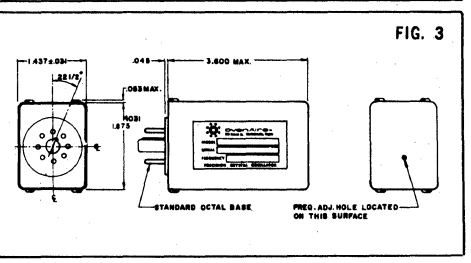
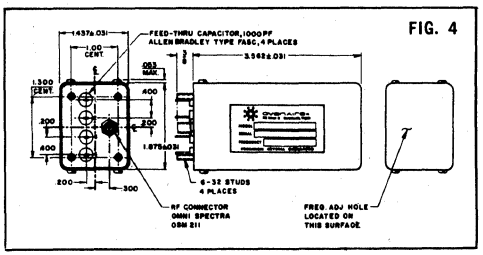
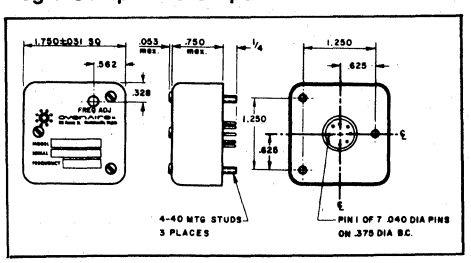


FIG. 4



TCXO SERIES

Logic Compatible Output —



Supply Voltage +12 VDC. (+5 VDC to +20 VDC Optional)

PART NO.	OSC 37-1-1	OSC 37-2-1	OSC 37-3-1	OSC 37-1-2	OSC 37-2-2
FREQUENCY	1 to 5 MHz	5.01 to 10 MHz	1 to 5 MHz		5.01 to 10MHz
AMBIENT RANGE	0°C to +55°C		−5°C to +60°C	−10°C to +65°C	
AMBIENT STABILITY	$\pm2x10^{-6}$ REF +25°C		$\pm1x10^{-6}$ REF +25°C	$\pm1.5x10^{-6}$ REF +25°C	
AGING RATE	$1x10^{-6}$/YR	$2.5x10^{-6}$/YR	$1x10^{-6}$/YR		$2.5x10^{-6}$/YR
TRIM RANGE	$\pm5x10^{-6}$	$\pm8x10^{-6}$	$\pm4x10^{-6}$	$\pm5x10^{-6}$	$\pm8x10^{-6}$

VCXO SERIES

AVAILABLE IN VARIOUS PHYSICAL CONFIGURATIONS

- Frequency Range 5 to 50 MHz
- ±0.005% to ±0.03% Deviation
- ±100 PPM to 0.2 PPM Stabilities
- Low Distortion F.M. Oscillators
- Oven and Non-Oven Models
- Compact Size

Technical data subject to change

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Breakthru at Ovenaire 2 to 40 MHz

OSC 44-2 SERIES——PCB MOUNT

OVENIZED CRYSTAL OSCILLATOR PERFORMANCE AT TCXO PRICES

- PROPORTIONAL OVEN CONTROL
- CHOICE OF THREE PACKAGES
- DETAILED PERFORMANCE SPECIFICATION
- LOW AGING GLASS ENCLOSED CRYSTAL
- ALSO AVAILABLE WITH LOGIC OUTPUT
- LOW OVEN POWER
- COMPACT, WEIGHS 4 OZ.
- SINEWAVE OUTPUT
- PRECISION PISTON TRIMMER

FREQUENCY (MHz)		2.0 to 5.0	5.01 to 12.0	9.5 to 13.5	13.51 to 40
PART NO. (FREQ. BAND)		OSC 44-2-1	OSC 44-2-2	OSC 44-2-3	OSC 44-2-4
CRYSTAL TYPE		FUNDAMENTAL		3rd OVERTONE	
OUTPUT (MIN)		1.0 Volts RMS	1.0 Volts RMS	0.35 Volts RMS	0.35 Volts RMS
LOAD (±5%)		300 Ohm	300 Ohm	50 Ohm	50 Ohm
AGING (TYPICAL) AFTER 90 DAYS		1×10^{-6}/Year	2.5×10^{-6}/Year	1.5×10^{-6}/Year	2.5×10^{-6}/Year
TRIM	MINIMUM RANGE	±7 PPM	±10 PPM	±6 PPM	±8 PPM
	TYPICAL RANGE	±11 PPM	±14 PPM	±9 PPM	±11 PPM
	TYPICAL RESOLUTION	$\pm 3 \times 10^{-8}$	$\pm 4 \times 10^{-8}$	$\pm 2.5 \times 10^{-8}$	$\pm 3 \times 10^{-8}$
PRICE (QTY 5-9)		$98**	$98**	$127**	$127**

- AMBIENT STABILITY —— $\pm 4 \times 10^{-7}$ MAXIMUM FROM -10°C TO +60°C REF +25°C
- OSCILLATOR VOLTAGE STABILITY —— 1×10^{-7} PER 5% VOLTAGE CHANGE
- OVEN VOLTAGE STABILITY —— 6×10^{-8} PER 5% VOLTAGE CHANGE AT +25°C
- SHORT TERM STABILITY —— 1×10^{-9} RMS PER 10 SECONDS OR BETTER
- WARM-UP —— FROM +25°C TO WITHIN 1.5 PPM IN LESS THAN 10 MINUTES
- OVEN POWER DURING WARM-UP —— 4.5 WATTS MAXIMUM
- STEADY STATE OVEN POWER —— 1.6 WATTS TYPICAL AT 25°C
- OVEN SUPPLY —— CHOOSE FROM +15 VDC, +20 VDC, +24 VDC, +28 VDC ±10%
- OSCILLATOR SUPPLY —— +12 VDC OR +15 VDC ±5% AT 15 mA TYPICAL

OVENAIRE CAN SUPPLY YOUR PRODUCTION REQUIREMENT

MOUNTING SURFACE PROVIDES PCB PINS AND THREADED INSERTS.

PACKAGE	MOUNTING SURFACE	HEIGHT
X	2.50" x 1.70"	1.31"
Y	1.75" x 1.25"	2.75"
Z	2.56" x 1.19"	1.90"

PROTOTYPES AVAILABLE IN 2 TO 4 WEEKS ON STANDARD FREQUENCIES.

ORDERING INFORMATION
Example: —— OSC 44-2-3 (FREQ. BAND) Y (MECH. PKG.) at 10Mhz (FREQUENCY) +24VDC (OVEN B+) +12VDC (OSC B+)

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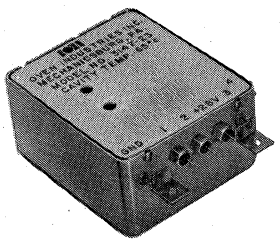
ovens

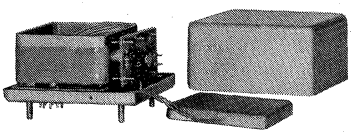
GENERAL COMPONENTS REFERENCE DIODES LASER
PRINTED CIRCUITS THERMOCOUPLES CRYSTALS
MICROWAVE COMPONENTS TRANDUCERS

CAVITY SIZES	STABILITY	D.C. OVEN POWER	A.C.	ENVIRONMENT DESIGNS FOR:		CUSTOM MODIFICATIONS
FROM .182" x .300" x .750" TO 2' x 2' x 2' (or larger)	TO ±.0005 DEGREE/DEGREE	5-40 VOLTS DIGITAL (SOLID STATE) PROPORTIONAL	8.3 - 117 VOLTS 50 - 400 Hz ZERO CROSSING PROPORTIONAL	SPACE GOVERNMENT	INDUSTRIAL COMMERCIAL	THERMOSTATS

THE 3147 SERIES

- DC PROPORTIONAL CONTROL CIRCUITRY
- COMPLETELY SOLID STATE
- EFFICIENT PACKAGING

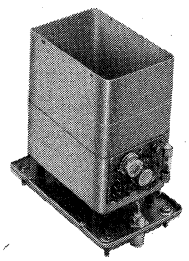


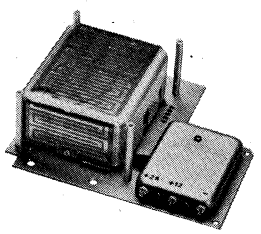


- OVER 20 PROVEN THERMAL DESIGNS
- RUGGED PACKAGE FOR HIGH SHOCK AND VIBRATION ENVIRONMENTS
- WIDE VARIETY OF APPLICATIONS

Typical customer applications of this low profile device for temperature stabilizing:

- *Oscillator Circuits*
- *Filters*
- *Reference Diodes*
- *Operational Amplifiers*
- *Crystals*
- *Thermocouple References*
- *Microwave Circuitry*
- *Tuned Circuits*
- *Small Delay Lines*





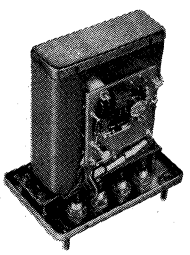
Oven Industries has listed cross sectional specifications for some of the more popular versions of this oven series as a short form catalog. Find the unit most suited for your application and order by model number.

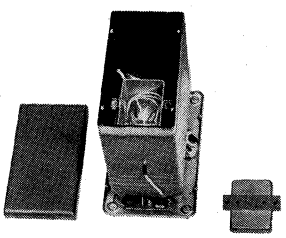
Engineers requiring additional technical information for exact applications — CONTACT the factory or our Sales Representative for a design review.

Cavity Size	Case Size	Temperature Degree C Cavity	Stability	Ambient	Power Supply	Header	Mounting	Model Number	Prices 1-3 Units
1.950X1.950X1.000	2.562X2.937X1.500	+65	±.008	FIXED	28VDC ± 1%	8 PIN HOOKED	(4) 6-32 STUDS	3147-1	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+75	±1.0	-55 to +60	12VDC	21 PIN HOOKED	(4) 6-32 STUDS	3147-2	$119.75
1.950X1.950X1.000	2.562X2.937X1.500	+65	±.008	FIXED	-24VDC ± 1%	FLY LEADS	(4) 6-32 STUDS	3147-3	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+50	±.008	FIXED	24VDC ± 1%	11 PIN TURPET	(4) 6-32 STUDS	3147-4	$129.25
1.950X1.950X1.000	2.562X2.937X1.500	+40	±.003	FIXED	28VDC	(2) 11 PIN HOOKED	(4) 6-32 STUDS	3147-5	$114.50
1.950X1.950X1.000	2.562X2.937X1.500	+70	+1.0	+15 to +50	28VDC	(2) 14 PIN PLUGS	(4) 6-32 STUDS	3147-8	$123.85
1.950X1.950X1.000	2.562X2.937X1.750	+90	±0.5	0 to +80	28VDC	(6) FILTERCONS & OSM 211	(4) 6-32 STUDS	3147-9	$125.50
1.950X1.950X1.000	2.562X2.937X1.500	+50	±0.25	-20 to +35	24VDC	8 PIN HOOKED	(4) 6-32 STUDS	3147-10	$114.25
1.950X1.950X1.000	2.562X2.937X1.500	+70	±0.5	-10 to +60	-21 to -28VDC	9 PIN MINATURE	(4) 6-32 STUDS	3147-11	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+45	±.008	FIXED	24VDC ± 1%	11 PIN TURPET	(4) 6-32 STUDS	3147-13	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+65	±0.25	-20 to +50	28VDC ± 1%	5 PIN PIERCED & FLY LEADS	(4) 6-32 STUDS	3147-14	$109.25
1.950X1.950X1.000	3.000X3.500X2.500	+75	±0.1*	+15 to +65	12VDC ± 1%	8 PIN HOOKED	(4) 6-32 STUDS	3147-16	$133.00
1.700X1.700X.625	2.562X2.937X1.250	+50	±1.0	+15 to +35	28VDC ± 10%	9 PIN MINATURE	(4) 6-32 STUDS	3147-17	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+75	±0.5	-20 to +60	28VDC ± 1%	21 PIN HOOKED	(4) 6-32 STUDS	3147-18	$114.25
1.950X1.950X1.000	3.000X3.500X2.500	+65	±0.1	0 to +50	15VDC	21 PIN HOOKED	(4) 6-32 STUDS	3147-19	$140.00
1.950X1.950X1.000	2.562X2.937X2.000	+65	±0.5	0 to +50	28VDC	21 PIN HOOKED	(4) 6-32 STUDS	3147-20	$115.00
1.950X1.950X1.000	2.562X2.937X1.500	+75	±0.5	-10 to +60	28VDC	8 PIN PLUG	(4) 6-32 STUDS	3147-21	$109.25
1.950X1.950X1.000	3.000X3.500X2.500	+75	±0.1	+15 to +65	24VDC	8 PIN HOOKED	(4) 6-32 STUDS	3147-22	$133.00
1.950X1.950X1.000	2.562X2.937X1.500	+65	±2.5	-10 to +50	28VDC ±.25V	TERMINALS & RIGID COAX ACCESS	MOUNTING BRACKETS	3147-23	$109.25
1.950X1.950X1.000	2.562X2.937X1.500	+65	±.05	FIXED	-24VDC ± 1%	8 TERMINALS	(4) 4-40 STUDS	3147-24	$145.00

* TEMPERATURE STABILITY: (°C/°C) (± 0.005°C/°C)

MANY ADDITIONAL MODIFICATIONS ARE READILY AVAILABLE

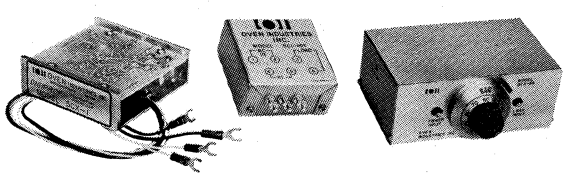




UNIQUE, NONCOMPETITIVE SERVICE

We invite you to explore new ideas with the assurance of complete confidence. OVEN INDUSTRIES, INCORPORATED is an independent company which is NOT in the Oscillator or Crystal business.

temperature controllers



A.C.	D.C.	PROBES
DIGIPROP Zero Crossing 117 to 440 Volts RMS 50 to 400 Hz Full Proportional Or On-Off Adjustable Bandwidth 1 Phase and 3 Phase Wye or Delta Up to 40 AMPS/Phase Industrial OEM and Government Use	5-40 Volts Temperature Stabilized Very High Reliability Fully Proportional Government & Space Use Industrial OEM	**TEMPERATURE RANGES** -65° C to +425° C -85° F to +800° F **SHAPES** Coated Beads With Leads Metal Tubes Metal Plates

WRITE FOR YOUR FREE COPY OF CATALOG NO. 0273 ON OVENS AND TEMPERATURE CONTROLLERS TODAY!

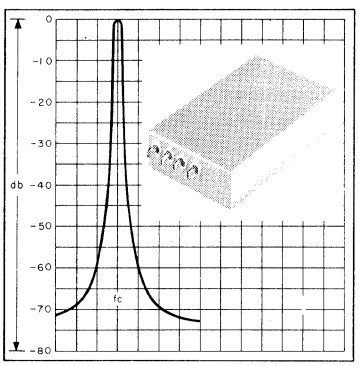
OVEN INDUSTRIES, INC.
1106 E. SIMPSON RD. P.O. BOX 229
MECHANICSBURG, PA. 17055 PH. (717) 766-0721 Cable: "OVENMETRIC"

ISO-FORK® OSCILLATORS

Output frequencies from 1.0 to 20,000 Hz. Absolute frequency accuracies from ±.10% to ±.001%. Operating temperature ranges up to from −55°C to +100°C depending upon accuracy. Wide choice of DC inputs from 5 to 28 volts and output waveshapes such as logic-clock, square or sine. Full MIL shock and vibration environmental capability, hermetically-sealed designs. Also ultra low current versions, miniature sizes, specials to suit either your performance or packaging requirements.

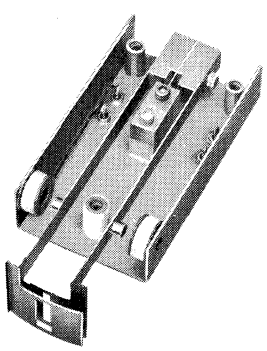
ISO-FORK® FILTERS

Narrow-band, band-pass, frequencies from 1,000 to 20,000 Hz. Butterworth 3 db bandwidths from .04% to .40% of center frequency, 60 db to 3 db shape factor 32 to 1, center frequency stability better than ±.001%/°C. 2 pole or 4 pole stagger-tuned with active circuitry to stabilize bandwidth and provide insertion gain of 100 (40 db) at center frequency. 1K input Z, up to 1.0 volt rms output into 10K, dynamic range greater than 72 db, +15 VDC input at 20 Ma. Specials to suit your requirements.



ISO-FORK® OPTICAL MODULATORS

Frequencies from 40 to 1,000 Hz... for modulating or chopping either light or energy beams. May often be used to replace motor driven choppers, offering weight and power savings plus no need to lubricate. Particular design and construction provides exceptional fork balance and high resistance to shock and vibration for most MIL specs. Tine ends may be fitted with shutters, lenses, or mirrors to suit your special requirements, various drive circuits available.



The Iso-Fork® is a modern, unique, high-performance concept of the conventional tuning fork. Our products are widely used in designs ranging from test sets to computers to electro-optical systems... from laboratory to satellites... for commercial, industrial, or military applications.

Philamon® INCORPORATED

90 HOPPER STREET / WESTBURY, NEW YORK 11590 / PHONE: (516) 333-1700 / TWX: 510-222-4749

MONOLITHIC CRYSTAL FILTERS

For the best in monolithic and tandem monolithic crystal filters, talk to the leader and only specialist in the field. If you're now using standard crystal filters, or if you've been holding off because of cost, size or performance, we'd like to show you how monolithics can do the job better for less. We've been making them longer (since 1967) and making more of them than anyone else.

STANDARD MODELS

For low cost, take our 10.7 MHz and 21.4 MHz integrated crystal filters. All models are available off-the-shelf. All feature tandem monolithic construction for minimum size and high stopband performance. Our 10.7's and 21.4's are available in upright, flatpack, p.c. assemblies or sets of monolithic units for assembly on your own board.

Guide to Standard 10.7 MHz Models

13 kHz Bandwidth	15 kHz Bandwidth	30 kHz Bandwidth	No. Poles (Resonators)	Dimensions WxLxH
2194F	2195F	2196F	2	.185x.432x.45
1463	1464	1465	4	.47x.59x.60
1466	1467	1468	4	.63x.89x.23
1469	1470	1471	6	.47x.59x.60
1472	1473	1474	6	.63x1.32x.23
1475	1476	1477	8	.50x.75x.60
1478	1479	1480	8	.63x1.75x.23
1433	1434	1435	8	1.02x2.39x.52

Models 1433 - 35 interchange with commonly used conventional crystal filters.
Standard European configurations are also available.

Guide to Standard 21.4 MHz Models

13kHz Bandwidth	15 kHz Bandwidth	30 kHz Bandwidth	No. Poles (Resonators)	Maximum Dimensions WxLxH (in.)
2249F	2250F	2251F	2	.185x.432x.45
1617	1618	1619	4	.47x.59x.60
1620	1621	1622	4	.63x.89x.23
1623	1624	1625	6	.47x.59x.60
1626	1627	1628	6	.63x 1.32x.23
1629	1630	1631	8	.50x.75x.60
1632	1633	1634	8	.63x 1.75x.23

PTI also offers standard models at many other popular frequencies including 5.26, 6.46, 8.0, 16.9, 20.0, 30.0, 32.0, 75 and 156 MHz.

CUSTOM MODELS

The same cost saving techniques of PTI standard integrated crystal filters can be applied to your high volume custom requirements in I-F filtering, spectrum clean-up, parametric up-conversion and front-end filtering, just to name a few. PTI engineers will work with you from start to finish to meet your specific requirements from 5 to 300 MHz. They'll be glad to discuss performance characteristics, packaging and cost. Prototypes are usually available within 4 to 6 weeks. Specification forms are yours for the asking. Write or call. If you have questions about monolithics, we've got the answers.

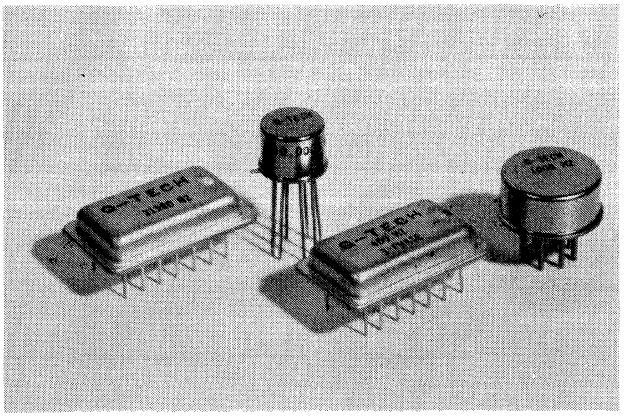
Piezo Technology Inc.
2400 Diversified Way
Orlando, Florida 32804
305-425-1574
TWX 810-850-4136

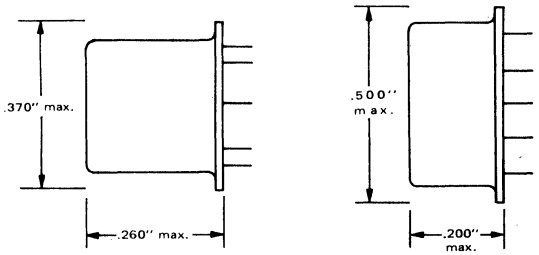
The standard in monolithic crystal filters

Q-Tech Corporation

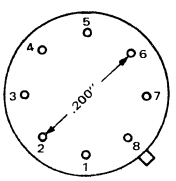
PIONEERS IN HYBRID TECHNOLOGY
STATE OF THE ART DEVELOPMENT

MINIATURE CRYSTAL CONTROLLED OSCILLATORS

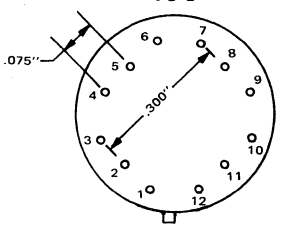




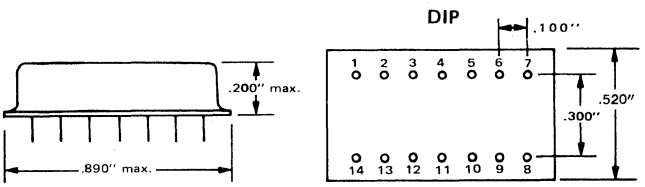
TO-5



TO-8



DIP



A unique design technique has been utilized to produce these reliable crystal controlled clock oscillators which have an output capable of driving a multiple TTL or CMOS load. Q-Tech clock oscillators will start under any combination of temperature and voltage. The use of hybrid technology, combined with thin film circuitry, results in an exceptionally high degree of reliability. This, together with optimum three and four point mounting of the quartz crystal results in a unit capable of withstanding high levels of shock and vibration. Life tests at 85°C resulted in 300,000 hours MTBF.

Q-Tech Clock Oscillators are available in 3 types: TO-5 (8 lead), TO-8 (12 lead), and DIP (14 or 16 lead). The TO-5 unit covers a limited frequency range, while the TO-8 and DIP both have an extremely wide output frequency range for an extensive variety of applications.

	TTL	CMOS
Output		
Wavefore - Square	≤60-40 Symmetry*	50-50 Symmetry
Risetime & Falltime	Less than 10 nsec. @ 10 MHz	100-200 nsec
Level - "1"	2.8 Volts Min.	Supply Voltage
Level - "0"	0.4 Volts Max.	0
Fan Out	10 TTL Loads (54H/74H)	10 CMOS Loads
Phasing	Single, Complementary, or 3 Phase**	—
Supply Volts	+5.0 ±.5 Volts	+5 to +15 Volts

*50-50 Symmetry available below 12 MHz **DIP only

Frequency Range	Typical Tolerances
TO-5 — 500 KHz to 25 MHz	±.005% to −55°C to +125°C ±.0005% to 0°C to +50°C
TO-8 or DIP — 1 Hz to 25 MHz	±.005% to −55°C to +125°C ±.0005% to 0°C to +50°C
Frequency Stability (aging)	5×10^{-6} to 30 days 1×10^{-5} to 1 year
Frequency Stability vs. Input Volts	2×10^{-6} for 10% change
Frequency Stability vs. Load	1×10^{-6} for 20% change
Provision for Gated Output is available	
Multiple Output Frequencies available	
Fine Tuning by External Capacitors available	

HIGH PERFORMANCE CRYSTAL FILTERS

Q-Tech Corporation specializes in supplying your difficult crystal filters. Our computer aided designs and network optimization techniques can satisfy your most stringent specifications. Typical filter types available are delay corrected crystal filters and crystal equalizers, contiguous comb sets, phase matched filters and controlled input impedance filters.
If you've had trouble getting the quality you need, let us see if we can help you.

11529 WEST PICO BOULEVARD • LOS ANGELES, CALIFORNIA 90064 • PHONE (213) 473-1105

REEVES-HOFFMAN

Described are typical units of commonly used types. Descriptive data, including measured capabilities, furnished on request. If your need concerns types and parameters not shown, please contact our plant.

Available with special C_0, C_1, and L_1 for filter applications • temperature coefficients to your specifications • pre-aging to guarantee stability of high precision units • special designs for high shock and vibration. All units meet mil-3098 requirements. Special high precision units, with aging characteristics up to 2×10^{-11} per day, are available in standard frequencies of 1, 2.5 and 5 MHz.

CRYSTALS

Frequency Range	Frequency Tolerance/Temperature Range			Holder Size (Military)*
	−55°C to +105°C	−40°C to +85°C	0°C to +50°C	
.85 to 50 kHz	±0.02%	±0.015%	±0.01%	HC-6, HC-13, HC-14
1 to 14 kHz	±0.02%	±0.015%	±0.01%	HC-13
14 to 150 kHz	±0.015%	±0.010%	±0.008%	HC-6, HC-13, HC-14, HC-17
90 to 300 kHz	±0.025%	±0.018%	±0.01%	HC-6, HC-13, HC-17
200 to 500 kHz	±0.012%	±0.008%	±0.003%	HC-6, HC-14, HC-17, HC-21(**)
200 to 800 kHz	±0.009%	±0.005%	±0.003%	HC-6, HC-13, HC-14, HC-17
250 to 800 kHz	±0.018%	±0.015%	±0.008%	HC-6, HC-14, HC-17
500 to 1,400 kHz	±0.005%	±0.004%	±0.0025%	HC-6, HC-14, HC-17
1.4 to 20 MHz	±0.004%	±0.004%	±0.002%	HC-6, HC-14, HC-17, 511, 512
10 to 200 MHz	±0.004%	±0.003%	±0.002%	HC-6, HC-13, HC-14, HC-17, HC-18

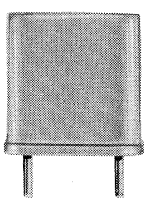
* All units listed are also available in T-5 ½ glass holder.

** Also available in T-9 glass bulb.

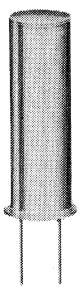
QUARTZ CRYSTAL HOLDERS

CW—Coldweld
SS—Solderseal

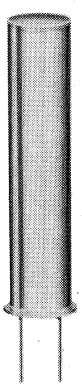
RH-13 (SS)



RH-6 (SS)

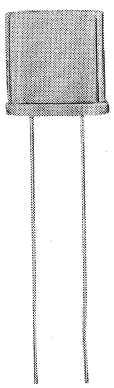


A-3 (CW)

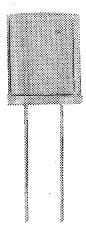


A-2 (CW)

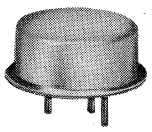
A-5 (CW)



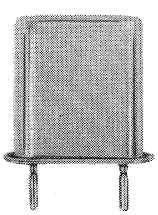
RH-512 (SS)



RH-18 (SS)

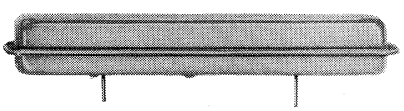


C (CW)

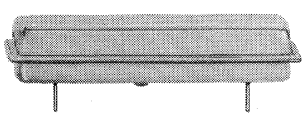


DA (CW)

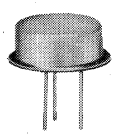
Illustrations show actual sizes



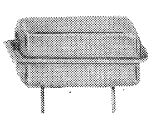
E-1 (CW)



E-2 (CW)



B-5 (CW)



E-3 (CW)

REEVES-HOFFMAN

DIVISION OF DCA

400 WEST NORTH STREET, CARLISLE, PA. 17013

REEVES-HOFFMAN CRYSTAL FILTERS

Note: The frequencies and bandwidths indicated are not to be considered production limitations. Variations of these filters can be made over the frequency range of approximately 10 kHz to 30 MHz (or higher).

BAND PASS

Center Frequency	3 dB Bandwidth	Shape Factor	Impedance (Ohms)	Size (in.) (L x W x H)
8 kHz	4 Hz	50:1 @ 40 dB	600	1.82 x 1.5 x 5.0
100 kHz	2 Hz	4:1 @ 60 dB	3K	4.25 x 2.0 x 3.82
250 kHz	100 Hz	3:1 @ 60 dB	8K	2.0 x 2.0 x 3.5
455 kHz	200 Hz	10:1 @ 60 dB	2K	3.5 x 1.5 x 2.0
700 kHz	1000 Hz	10:1 @ 80 dB	2.5K	1.5 x 1.5 x 3.5
1.75 MHz	400 Hz	5:1 @ 60 dB	1K	1.0 x 1.5 x 1.5
1.75 MHz	110 Hz	2:1 @ 60 dB	200	3.75 x 1.75 x 1.25
3.0 MHz	400 Hz	6:1 @ 60 dB	5K	3.0 x 2.0 x 1.5
4.0 MHz	1200 Hz	10:1 @ 70 dB	50	3.5 x 1.5 x 1.5
* 9.0 MHz	5400 Hz	2:1 @ 60 dB	470	1.5 x .75 x .32
*10.7 MHz	2700 Hz	2:1 @ 60 dB	470	1.5 x .75 x .32
*10.7 MHz	13 kHz	2:1 @ 60 dB	470	1.5 x .75 x .32
10.7 MHz	800 Hz	1.5:1 @ 60 dB	600	2.0 x 2.0 x 1.0
11.5 MHz	120 kHz	4:1 @ 40 dB	2K	1.5 x 1.5 x 1.0
20.0 MHz	30 kHz	1.7:1 @ 60 dB	1K	1.5 x 1.5 x 1.0
*25.0 MHz	26 kHz	3:1 @ 50 dB	2K	1.75 x .70 x .50
30.0 MHz	25 kHz	3:1 @ 60 dB	2K	1.5 x 1.5 x 1.0

* "MINILITH," Reeves-Hoffman monolithic design.
† Reeves-Hoffman "Hi-Fidelity" SSB design.

SINGLE SIDE BAND

Center Frequency	3 dB Passband	Min. Attenuation	Insertion Loss	Passband Variation	Impedance (Ohms)
250 kHz	−230 to −7730 Hz	60 dB	6.0 dB	3 dB max.	3K
250 kHz	+240 to +7740 Hz	60 dB	6.0 dB	3 dB max.	3K
1750 kHz	−350 to −3040 Hz	70 dB	6.0 dB	1.5 dB	3K
1750 kHz	+350 to +3040 Hz	70 dB	6.0 dB	1.5 dB	3K
†1743.71 kHz	−3255 to −5935 Hz	70 dB	3.0 dB	.5 dB	220
†1750.00 kHz	−255 to −3035 Hz	70 dB	3.0 dB	.5 dB	220
†1750.00 kHz	+255 to +3035 Hz	70 dB	3.0 dB	.5 dB	220
†1756.29 kHz	+3255 to +5935 Hz	70 dB	3.0 dB	.5 dB	220
* 9.0 MHz	(6 dB) +500 to +3000 Hz	60 dB	3.0 dB	1.5 dB	470
* 9.0 MHz	(6 dB) −500 to −3000 Hz	60 dB	3.0 dB	1.5 dB	470
*10.7 MHz	+500 to +3200 Hz	60 dB	2.0 dB	2.0 dB	470
*10.7 MHz	−500 to −3200 Hz	60 dB	2.0 dB	2.0 dB	470

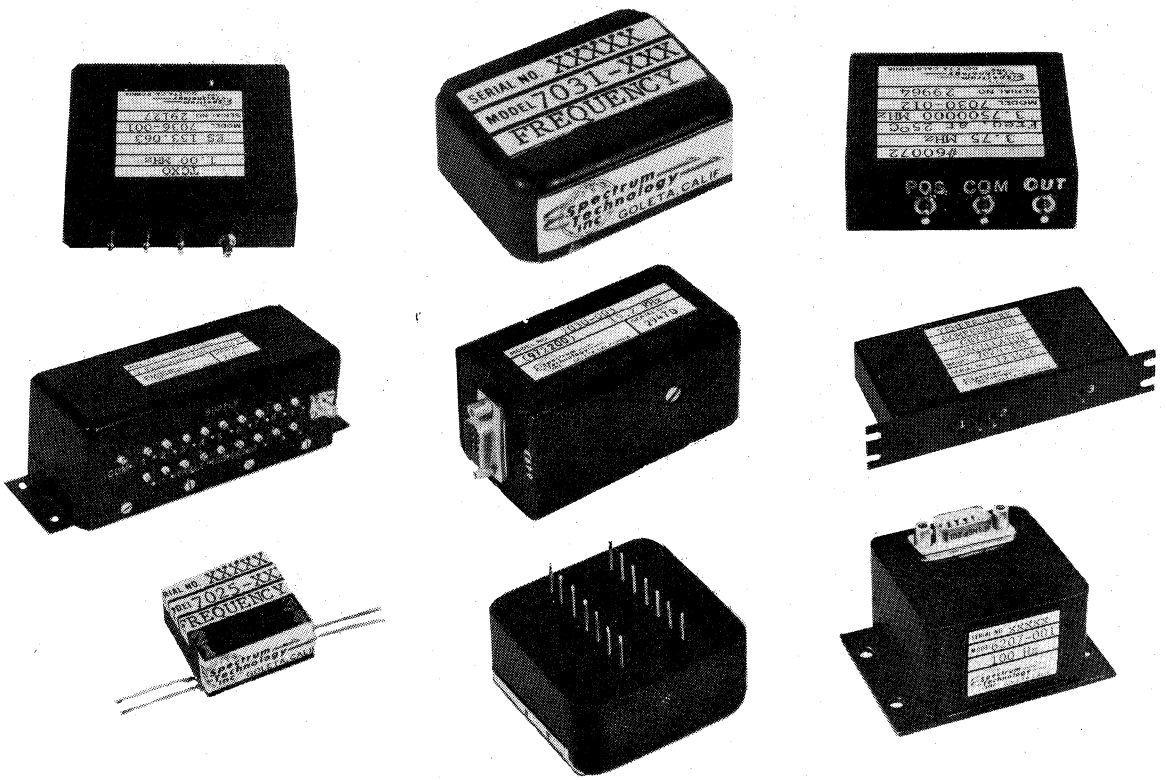
REEVES-HOFFMAN CRYSTAL OSCILLATORS

Note: Parameters shown are not production limitations. Custom designing is available from 1 Hz to 200 MHz. Stability, aging, output voltage, waveform, and environment to your specifications.

Frequency	Aging	Output	Supply Voltage	Temp. Range	Size in.) (L x W x H)
60 Hz	3×10^{-8}/day	1v, rms	12v, ac	10°C to 60°C	4 x 4.7 x 4.9
400 Hz	25×10^{-6}/yr.	sq. wave	24v, dc	−32°C to +52°C	1.75 x 1.75 x 4.33
100.000 kHz	3×10^{-8}/day	1v, rms	28v, dc	−40°C to +70°C	1.88 x 1.44 x 3
90-650 kHz	25×10^{-6}/yr.	1v, rms	30v, dc	−30°C to +55°C	1.290 dia. x 4.062
1000.000 kHz	1×10^{-9}/day	1v, rms	28v, dc	0°C to 65°C	2 x 2 x 4.75
2500.000 kHz	2×10^{-11}/day	100 kc 1.0 mc 5.0 mc 1v, rms	24v, dc	0°C to 40°C	Rack mount 5¼" panel
5000.000 kHz	1×10^{-8}/wk	55mv	12v, dc and 26v, dc	0°C to 60°C	8.5 x 5 x 5

Spectrum Technology Frequency Control Devices

• Oscillators • XTAL • TCXO • Logic Clock • Standard, Modified or Custom Designs



In-depth offering. Spectrum Technology, leader in the design and manufacture of oscillators and timing systems, offers a broad range of standard frequency control devices or can adapt existing designs to exactly satisfy your particular requirement. Some of our more popular designs are described here. Write or call for complete product line information or help with your specific requirement.

Standard types include Temperature Compensated Crystal Oscillators, Crystal Controlled Oscillators, and Integrated Circuit Logic Clocks. Special Devices and Systems include Oscillator/Modulator Assemblies, Gated Oscillators, and Multiple Frequency Oscillators.

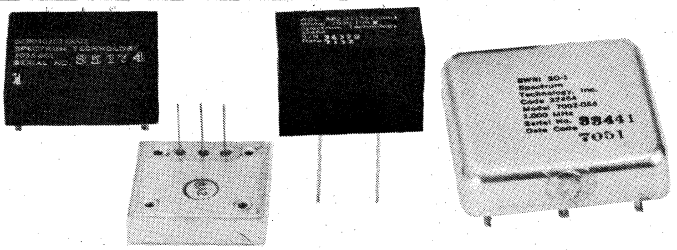
Spectrum Technology specializes in proven reliability design for devices featuring • Subminiature Size • Extreme Low Profiles • Low Power Consumption • High Stability • Output Frequencies or Pulse Rates from One Pulse per Hour to Beyond the 100 MHz Region. Standard packages are available in both hermetically sealed and epoxy housings for printed circuit mounting or dual-in-line circuit packaging cards.

Typical applications for Spectrum Technology devices include: Computers, Distance Measuring Equipment, Video and Sound Recording Constant Speed Drivers, Seismological Recording and Sensing Systems, Aircraft Fuel Flow Computers, Air Inlet Controls, Inertial Guidance Computers, Communication Satellites, Ground Support Systems, Tracking Systems, Torpedo Control Systems, Manned Space Applications including timing systems for heart rate monitors and time base reference for measurement of mass spring constant oscillation rates, etc.

Standard quality control measures at Spectrum Technology exceed the requirements of MIL-I-45208A for inspection systems and MIL-C-45662A for equipment calibration. Workmanship and soldering standards are in accordance with Requirements 5 and 9 of MIL-STD-454B.

High reliability programs are performed to specific customer requirements and incorporate special quality control measures based on program requirements. For these "High Reliability" oscillators we use proven, conservative circuit designs, established reliability "ER" components and all soldering is performed by trained and certified personnel in accordance with the requirements of N.H.B. 5300.4(3A). Specific traceability is provided which maintains traceability of all procured components and assembly and test inspection points on a unit serialized basis. Processing specifications include special screening on crystal units as well as production screening and testing during the manufacturing process, including final high temperature burn-in of the completed unit.

High Reliability Applications: Spectrum Technology has supplied many Crystal Oscillator/Logic Clocks and TCXO's for High Reliability applications for aircraft, communication satellites and space applications. Specific programs for which items have been produced include Skylab, Apollo Sixteen Experiment, and Logic Clocks for the control systems computer of the F-15. Capabilities include ruggedized design of both crystal unit and package, use of proven established reliability parts, failure prediction and analysis, 100% production screening tests, burn-in, and complete component procurement and in-process traceability. Environmental levels proven by continuing tests include 50g sine vibration, 0.2g²/Hz random vibration, 4000g acceleration and 1500g shock. 100% production screening tests include these plus thermal shock, temperature cycling, and leak test on an "as specified basis."



Low Cost Crystal Oscillator/I.C. Logic Clock:

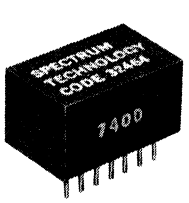
Designed specifically for commercial crystal oscillator/I.C. Logic Clock applications, this series offers a wide range of accuracy vs. temperature ranges. Printed circuit mounting.

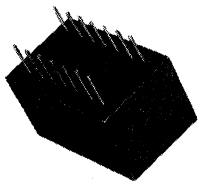
SERIES 7031 — Frequency: 200 kHz to 20 MHz; **Temperature:** 0 to 70°C; **Accuracy:** to .005%; **Output:** Logic "0" = +0.5V Max. Sink 5 ma, Logic "1" = +3.0V Min. Source 1 ma; **Package:** 1.25″ x 1″ x .5″.

Dual In-Line Crystal Oscillator/I.C. Logic Clock:

Designed for digital applications where single DIP unit is required for space considerations. This economical unit plugs into standard TO-116 socket or DIP pin pattern. Standard TTL output with +5V d-c input.

SERIES 7400 — Frequency: 3 MHz to 25 MHz; **Stability:** ±0.005% over 6 standard ranges up to −55°C to +105°C; **Package:** 0.50″ x 0.80″ x 0.45″. Epoxy package is standard. Hermetically sealed package available as Series 5400.

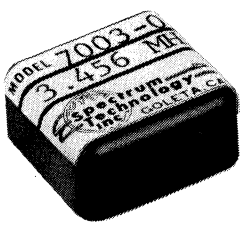


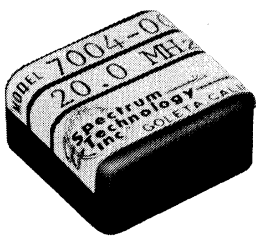


Dual In-Line Hermetically Sealed Crystal Oscillator/I.C. Logic Clock:

Designed for digital applications where single DIP unit is required for space considerations. This unit plugs into standard TO-116 socket or DIP pin pattern. Standard TTL output with +5V d-c input.

SERIES 5400 — Frequency: 3 MHz to 25 MHz; **Stability:** ±0.005% over 6 standard ranges up to −55°C to +125°C; **Package:** 0.56″ x 0.90″ x 0.40″. Hermetically sealed package.





Sub-Miniature I.C. Logic Clock Crystal Oscillator:

These tiny oscillators supply clocking signals for use in digital computer applications where space and power are limited. Simple design uses premium quality components in high shock, high vibration environments, including aircraft, shipboard, oceanographic, missiles, or mobile.

SERIES 7003—Frequency: 3 MHz to 100 MHz; **Accuracy:** ±10 PPM at 25°C; ±50 PPM, −55°C to +125°C; **Package:** .88″ x .88″ x .45″. Four pin mounting to printed circuit board. Hermetically sealed.

SERIES 7004 — Frequency: 200 kHz to 100 MHz; **Package:** .88″ x .88″ x .50″. Dual-In-Line compatible.

Low Profile (1/4″ Thick) Crystal Oscillator I.C. Logic Clock:

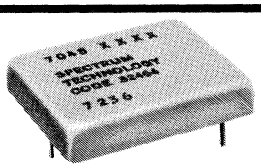
This series is designed for application in card rack systems where spacing is a critical requirement. The 1/4″ maximum package thickness provides two fold improvement over most standard oscillator packages.

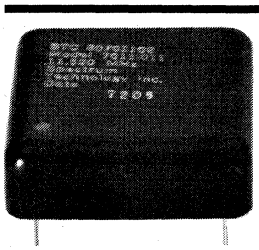
SERIES 7042 — Frequency: 1.00 kHz to 25 MHz **Stability:** ±0.005% over 6 standard ranges up to −55°C to +125°C; **Output:** TTL; **Package:** 1.5″ x 1.5″ x 0.25″. Hermetically sealed. Also available in epoxy package for commercial application.

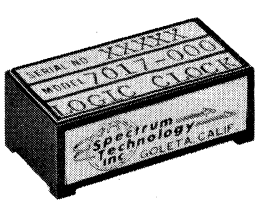
Low Profile (1/4″ Thick) Crystal Oscillator I.C. Logic Clock:

This series is designed for application in card rack systems where spacing is a critical requirement. The 1/4″ maximum package thickness provides two fold improvement over most standard oscillator packages.

SERIES 7048 — Frequency: 180 kHz to 25 MHz; **Stability:** ±0.005% over 6 standard ranges up to −55°C to +125°C; **Output:** TTL; **Package:** 1.0″ x 1.25″ x 0.25″. Hermetically sealed. Also available in epoxy package for commercial application.







Crystal Oscillator I.C. Logic Clock:

This series of low power consumption I.C. Logic Clocks provides logic level outputs for computer systems. Series 7017 provides both Q and $\overline{Q}$ outputs.

SERIES 7011 — Frequency: 187.5 kHz to 25 MHz; **Temp. Range:** Commercial to full −55°C to +125°C; **Package:** 1.5″ x 1.5″ x 0.5″ — p-c mount.

SERIES 7017 — Frequency: 187.5 kHz to 25 MHz; **Stability:** ±0.005%; **Output:** TTL, Q and $\overline{Q}$; **Temp. Range:** −55°C to +125°C; **Input:** +5V d-c; **Package:** 1.2″ x .6″ x .5″ — p-c mount.

Temperature Compensated Crystal Oscillators:

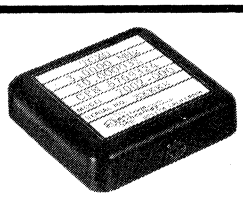
Designed for applications where no warm-up time or oven power is available, and minimal size and weight are important to the user. Thermistor-varactor compensation networks and Silicon IC active devices provide optimum performance. Excellent long-term stability results from use of glass-enclosed or cold weld quartz crystal. PCB Mounting, hermetically sealed.

Stability: To ±3 x 10^{-7}, 0°C to +50°C
To ±1 x 10^{-6}, −55°C to +75°C

SERIES 7000 — Frequency: 10 kHz to 20 MHz, TTL, DTL output; **Package:** 2″ x 2″ x .63″.

SERIES 7001 — Frequency: 100 kHz to 20 MHz, TTL, DTL or sine wave output; **Package:** 2″ x 2″ x .75″.

SERIES 7002 — Frequency: 2.7 MHz to 20 MHz, TTL, DTL output; **Package:** 2″ x 2″ x ½″.



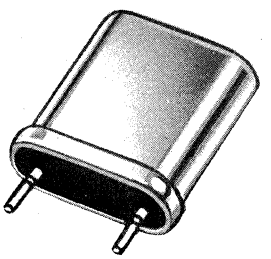
Spectrum Technology Inc

300 FREDERICK LOPEZ ROAD • P.O. BOX 948 • GOLETA, CALIFORNIA 93017
TELEPHONE (805) 964-7791 • FEDERAL SUPPLIER CODE NO. 32464

quartz crystals for frequency control

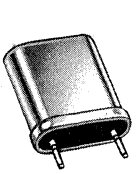
PRECISION EXCEEDING MIL SPECIFICATIONS

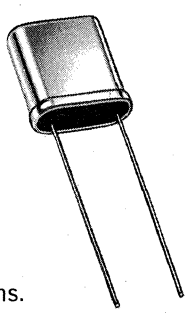
For over 25 years, Sherold has been a major producer of quartz frequency control crystals. It produces to Mil-spec requirements, and also industrial and commercial applications. The types include fundamental and overtone for aircraft, vehicular, man-pack, business-band, CB and marine radios. It also produces for instrumentation and time base applications. Only several type holders are illustrated here, but custom packages can be specified per requirements.



SC 6 **SC 8**

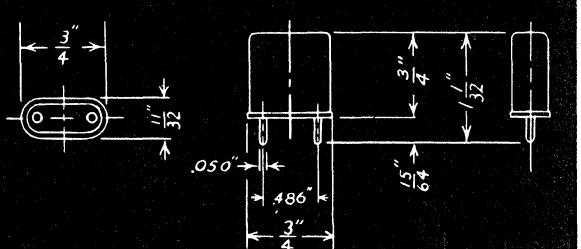
FREQUENCY RANGE:
200 KHZ TO 150 MHZ





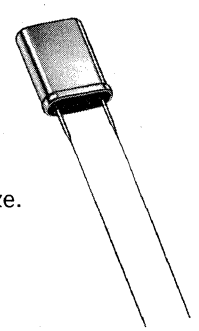
Metal plated and hermetically sealed in military type HC-6/U holder. Very low resistance, low drift, rugged construction. Available in 25 military types. Shown here actual size.

SC-8 is identical to SC-6 except for 2-inch tinned wire leads for soldered-in applications.



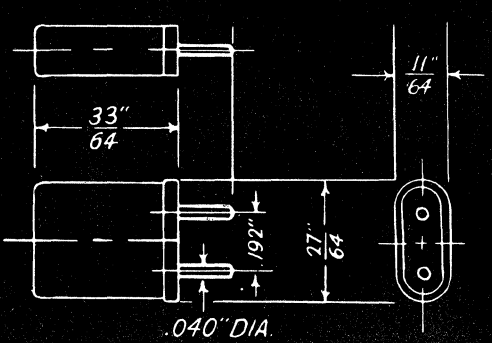
SC 106 **SC 100**

FREQUENCY RANGE:
3 MHZ TO 150 MHZ



Subminiature hermetically-sealed plated unit. Smallest space requirements of any hermetic crystal available. Weight approximately 1/25 ounce. Shown actual size.

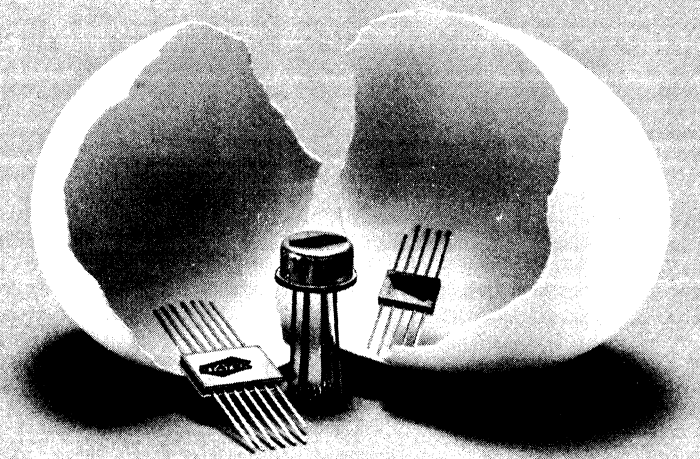
SC-106 is identical to SC-100 except designed for plug-in application with .040 diameter pin.



sherold crystals division tyco

1510 McGEE KANSAS CITY, MO. 64108 TEL. (816) 842-9792 TWX: 910 771-2181

We Make The Smallest Low Frequency Crystals & Crystal Products...



STATEK CORPORATION

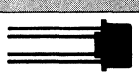
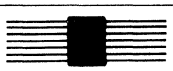
• CRYSTALS — OSCILLATORS — FILTERS • ULTRA MINIATURE • LOW COST
• HYBRID COMPATIBLE • WITHSTANDS HIGH VIBRATION & SHOCK

SPECIFICATIONS

Product	†Package	*Typical Voltage — DC	*Typical Current — ma	Features
CRYSTALS				
SX-1	A, B, C	Contact STATEK for product information		
OSCILLATORS				
SQUAREWAVE				
SQXO-2	A	+ 5 V	0.5 to 5	TTL and CMOS
LQXO-1	A, B	+ 5 V	0.02 to 0.1	Low Power
LQXO-2	A, B	+12 V	0.05 to 0.5	Low Power
Timers (divided output)				
DQXO-1	B	+ 5 V	0.02	10kHz to 1 Cycle/Mo.
DQXO-2	B	+12 V	0.1 to 0.3	
SINEWAVE				
SSXO-1	A, B	±6 V to ±12 V	3.6	Op Amp Design
LSXO-1	A, B	±6 V to ±12 V	0.6	Low Power
LSXO-4	A	5 V	0.1	Single Supply
FILTERS				
SSXF-1	A	±6 V to ±12 V	3.6	Buffered Input and Output
SSXF-2	A	±6 V to ±12 V	1.8	Nulling Capability for Increased Off Frequency Rejection
LSXF-1	A, B	±6 V to ±12 V	0.6	Low Power Version of SSXF-1
LSXF-2	A, B	±6 V to ±12 V	0.3	Low Power Version of SSXF-2
Special Options	A, B, C	—	—	All Filters Available as Single or Double Pole

*For specific voltage and current specifications contact STATEK Corporation direct.

†PACKAGE INFORMATION

Package	Description		Dimensions
A	TO-5		.326″ dia. x .20″ max.
B	Flatpack		¼″ x ⅜″ x .07″
C	Flatpack		¼″ x ¼″ x .07″

GENERAL SPECIFICATIONS

Typical Accuracy Values	16kHz	40kHz	100kHz
0 to +50°C	±0.02%	±0.025%	±0.03%
−20 to +60°C	±0.025%	±0.03%	±0.04%
−40 to +85°C	±0.035%	±0.045%	±0.055%
−55 to +125°C	±0.06%	±0.07%	±0.08%

Better Specifications Available on Request

FREQUENCY RANGE: 10kHz to 600kHz

SHOCK RESISTANT: to greater than 1000g

VIBRATION RESISTANT: to greater than 50g (over 10-2000Hz)

HYBRID CAPABILITY: Hybrid mounting of crystals and all product assembly is performed in Statek's thin film hybrid facility. If you are interested in hybrid design or have special applications for hybrid crystals, contact Statek for specific information.
Specifications may change without notice.

GENERAL INFORMATION

STATEK'S CRYSTALS and CRYSTAL PRODUCTS are unique in that they are . . . smaller . . . more rugged . . . more reliable . . . and less costly. STATEK provides total capability to produce . . . from small to large volume . . . to special and customer engineered units . . . for commercial, industrial, and military applications. For specific in-depth product and application information or assistance, call STATEK direct.

Patent #3,683,213 / Patents Pending

STATEK CORPORATION, 1200 Alvarez Avenue, Orange, California 92668, (714) 639-7810

T.M.C. SYSTEMS (ARIZ.) INC.
930 W. 23rd ST. • TEMPE, ARIZONA 85281
PHONE (602) 967-7874
TWX 910-950-1943

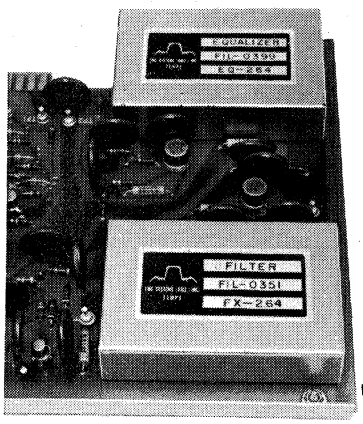
CREATIVE LEADERS IN COMPONENTS FOR COMMUNICATION TECHNOLOGY

CRYSTAL FILTERS

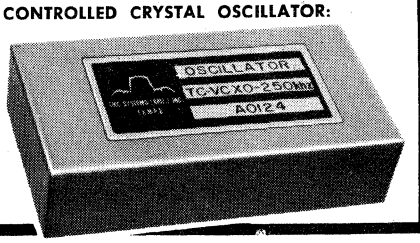
DCA and/or MIL-STD-188 Type Crystal Filters that provide required amplitude and envelope delay characteristics without use of separate equalizers are available at Carrier Frequencies of 100KHz through 1750KHz for both two and four channel applications.

Standard and custom designs for bandpass, band reject, phase matched filters plus discriminators are available at frequencies of 10KHz through 30MHz.

BANDPASS FILTERS & DELAY EQUALIZERS FOR VOICE, RTTY MULTI-PLEX OR DATA TRANSMISSION.



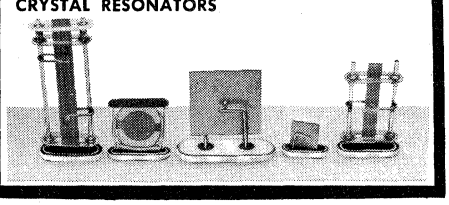
TEMPERATURE COMPENSATED VOLTAGE CONTROLLED CRYSTAL OSCILLATOR:



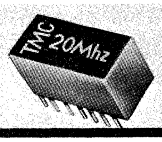
CRYSTAL OSCILLATORS

Fixed frequency, voltage controlled, temperature compensated or ovenized. Standards, miniaturized and custom designs available from 5Hz through 100MHz.

10 KHz TO 60 MHz STANDARD OR CUSTOM CRYSTAL RESONATORS



MINIATURIZED CRYSTAL OSCILLATOR

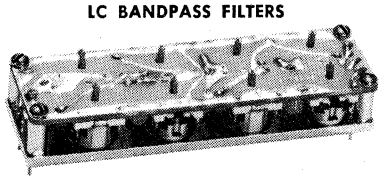


MAGNETIC COMPONENTS AND RESONATORS

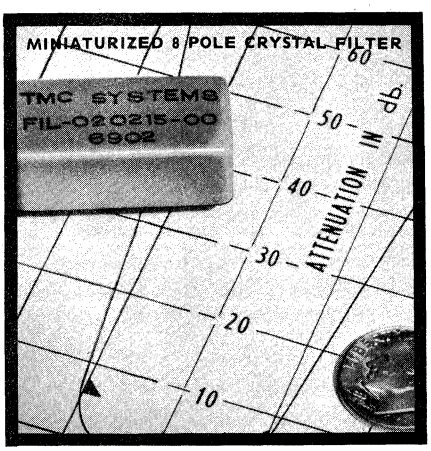
Lowpass, highpass, bandpass, band reject and prescribed transfer function characteristics available from 1Hz to 150MHz.

Custom resonator design and production is available for frequencies from 10KHz through 30MHz.

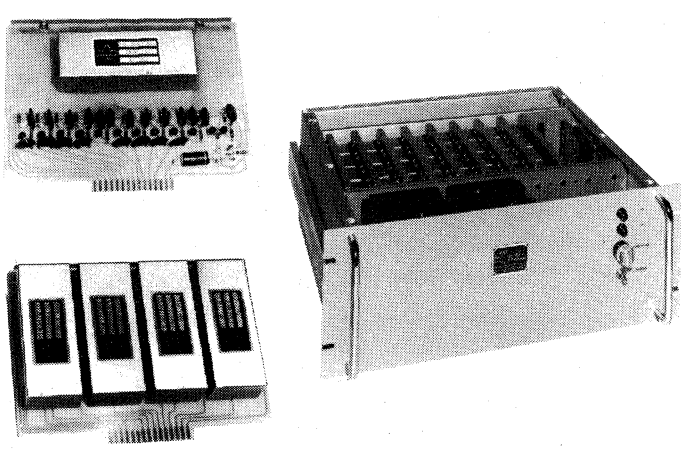
LC BANDPASS FILTERS



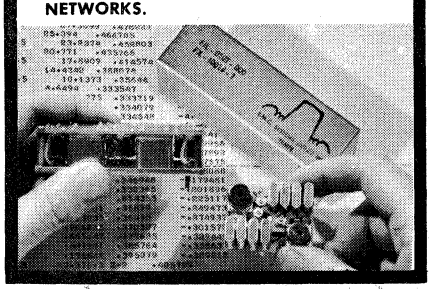
MINIATURIZED 8 POLE CRYSTAL FILTER



COMB FILTER ASSEMBLY 32 CHANNELS



COMPUTER OPTIMIZED DESIGNS OF CRYSTALS, OSCILLATORS AND FILTER NETWORKS.



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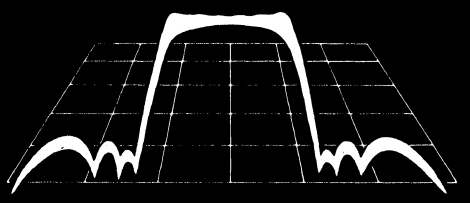


This is a partial listing of available designs. Modified or Custom designs are available for your specific application. Contact our local representative (see yellow section) for technical or sales assistance.

Center Frequency	Passband	Stopband Bandwidth	Case Size in Inches	Insertion Loss (dB)	Source & Load Z (Ω)	Part Number
10.000 KHz	75 Hz USB	250 Hz at 40 dB	1.5 x 4 x 3	10	1K	FIL-0228
16.000 KHz	40 Hz	2 KHz at 30 dB	2 x 2 x .80	4.5	600	FIL-0055
19.275 KHz	217 Hz	1120 Hz at 20 dB	1.75 x 1.75 x 3.5	10	10K	FIL-0030
27.700 KHz	50 Hz	250 Hz at 50 dB	2.25 x 4 x 1.5	1	12K x 10K	FIL-0244
61.150 KHz	600 Hz	2300 Hz at 70 dB	1 x 2 x 3.5	4	1.8K-8.2K	FIL-0273
100.000 KHz	10 Hz	120 Hz at 40 dB	1.25 x 1 x 1.75	5	1500	FIL-0283
100.000 KHz	250 Hz	1 KHz at 60 dB	2 x 3.5 x .75	3	330	FIL-0099
100.000 KHz	2790 Hz USB	4790 Hz at 70 dB	2.5 x 3.5 x 2	3	330	FIL-0095
100.000 KHz	2790 Hz LSB	4790 Hz at 70 dB	2.5 x 3.5 x 2	3	330	FIL-0097
125.000 KHz	±10 Hz at 3 dB	3 Hz at 50 dB notch	2 x 6 x 2.5	3	1K	FIL-0131
250.000 KHz	400 Hz at 1 dB	30 Hz at 30 dB notch	2.9 x 2 x 2.5	2	12K	FIL-0008
250.000 KHz	2780 Hz USB	3500 Hz at 60 dB	1.875 x 2.75 x .65	4	500	FIL-0127
455.000 KHz	300 Hz at 6 dB	1700 Hz at 60 dB	.5 x 2.75 x .76	14	100K	FIL-0063
455.000 KHz	Dual 6 dB 100 Hz & 1000 Hz	1 KHz & 5 KHz Dual 60 dB	1.45 x 3.5 x 1	4 & 7	2.5K	FIL-0100
455.000 KHz	10 KHz at 6 dB	50 KHz at 60 dB	1 x 3.5 x 1	8	500-2K	FIL-0274
500.000 KHz	2 KHz at 6 dB	5 KHz at 40 dB	.6 x 4.66 x 1.5	7	50-500	FIL-0317
500.000 KHz	6 KHz at 6 dB	35 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0345
500.000 KHz	12 KHz at 6 dB	30 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0344
500.000 KHz	22 KHz at 6 dB	75 KHz at 60 dB	1 x 1 x 3.5	8	2K	FIL-0343
1.000 MHz	900 Hz at 6 dB	24 KHz at 50 dB	1 x 2.8 x 1.07	3	50K	FIL-0043
1.250 MHz	12 KHz at 6 dB	72 KHz at 60 dB	.8 x 1.25 x 3.5	10	500	FIL-0366
1.600 MHz	750 Hz at 6 dB	4 KHz at 60 dB	1 x 2.8 x 1.07	6	9K	FIL-0031
1.600 MHz	2800 Hz at 6 dB	15.2 KHz at 60 dB	1 x 2.8 x 1.07	6	9K	FIL-0005
1.750 MHz	2750 Hz USB	6 KHz at 60 dB	1 x 1.12 x 3.38	3	3.3K-500	FIL-0107
1.750 MHz	2750 Hz LSB	6 KHz at 60 dB	1 x 1.12 x 3.38	3	3.3K-500	FIL-0108
2.500 MHz	12 KHz	72 KHz at 60 dB	.8 x 1.25 x 3.5	10	500	FIL-0367
5.000 MHz	12 KHz	72 KHz at 60 dB	.8 x 2.5 x 1.25	10	500	FIL-0368
5.000 MHz	50 KHz	250 KHz at 50 dB	1 x 2.37 x 1.03	8	50	FIL-0377
5.750 MHz	3000 Hz at 3 dB	450 Hz at 60 dB notch	1 x 3.5 x 1	2	50	FIL-0230
6.290 MHz	500 Hz	20 KHz at 60 dB	.625 x 2⅛ x .750	6	470	FIL-0044
6.400 MHz	8000 Hz	20 KHz at 60 dB	.825 x 3 x .562	3	2.8K-150	FIL-0003
8.242 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0134
10.000 MHz	6300 Hz	63 KHz at 40 dB	1 x 1.77 x .88	6	50-500	FIL-0039
10.000 MHz	36 KHz	160 KHz at 60 dB	1 x 2.5 x 1	3	100	FIL-0035
10.125 MHz	40 KHz	80 KHz at 50 dB	.7 x 2.2 x .7	4	50	FIL-0375
10.700 MHz	70 KHz	140 KHz at 60 dB	1.31 x 2.35 x .782	8	50	FIL-0231
11.500 MHz	50 KHz	450 KHz at 60 dB	½ x 1.27 x .718	4	1K	FIL-0288
12.300 MHz	3200 Hz	52 KHz at 20 dB	.93 x 1.68 x .75	2	470	FIL-0113
13.418 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0295
15.542 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0296
16.533 MHz	7500 Hz	17.5 KHz at 60 dB	1.75 x 3.75 x 1.25	2	50	FIL-0314
21.400 MHz	20 KHz	40 KHz at 60 dB	1.2 x .6 x .4	3	700	FIL-0511
21.400 MHz	40 KHz	80 KHz at 60 dB	1.2 x .6 x .4	2	1400	FIL-0512
21.400 MHz	60 KHz	120 KHz at 60 dB	1.2 x .6 x .4	1	2100	FIL-0513
21.953 MHz	1600 Hz	20 KHz at 50 dB	1 x 1.5 x .875	5	2K	FIL-0028

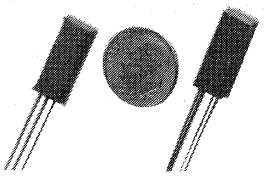
If you need Custom Designs at Standard Prices — you need the experience of TMC working for you. Our Computerized Techniques provide you with Optimum Designs and Rapid Response at Cost Savings.

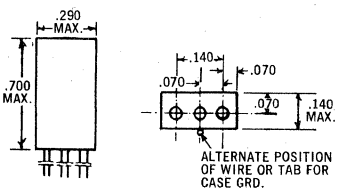
Complete sales and technical information available, contact Factory or Sales Rep. See Yellow section for local representative.

A Subsidiary of **THE TECHNICAL MATERIEL CORPORATION**

T-F Electronics

TUNING FORK AND CRYSTAL OSCILLATORS
TUNING FORK FILTERS





TFF-38 TUNING FORK FILTER

PRELIMINARY SPECIFICATIONS

Center Frequency Range:	10 KHz to 50 KHz*
Center Frequency Accuracy @ 26°C:	±0.05%
6 db Bandwidth:	0.2% Nominal
40 db Bandwidth:	2.0% Nominal
Maximum Insertion Loss:	−6 db
Temperature Range:	−5° to +55°C
Frequency Shift vs. Temp.:	±.1%
Nominal Drive Level:	1 VPK-PK (±20%)
Spurious Mode Refection:	−25 db
Size:	.140 x .290 x .700
Mounting:	Flat Case
Weight:	5 Grams
Finish:	Tin Plate

*5 KHz to 10 KHz can be supplied by extending the length.

NEW

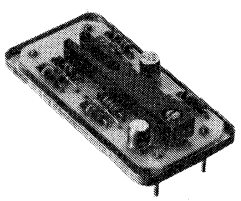
VOLTAGE CONTROL TUNING FORK OSCILLATORS

CMOS/MOS OUTPUTS

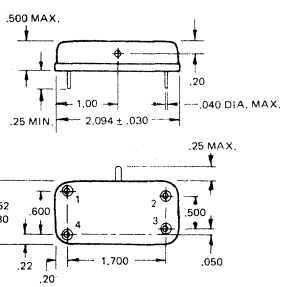
1 MHz TUNING FORK CONTROLLED OSCILLATORS

MECHANICAL FILTERS

LOW POWER TUNING FORK OSCILLATORS



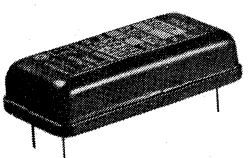
TFO-22



TUNING FORK OSCILLATORS

SPECIFICATIONS — TFO-22 SERIES

Output Frequency Range:	400 Hz to 50 KHz
Output Frequency Tolerance:	±.02% to ±0.005%
Output Signal:	Asymetrical square wave
Output Level:	Logic "0" 0 to +.5 volts maximum, Logic "I" +2.5 volts Pk minimum
Output Load:	Current sink 2.5 ma, current source 100 μa
Rise Time:	2 microseconds typical
Fall Time:	1 microsecond typical
Stabilization Time:	5 seconds typical, 10 seconds maximum
Input Voltage:	5 VDC ±5%
Input Current:	5 ma maximum
Finish:	Flat black epoxy paint
Weight:	1.75 ounces maximum
Connections:	4 straight pin PCB solder terminals
Mounting:	Low profile printed circuit board
Size:	1 x 2 x ½ inches
Options:	200 micro watt input power Single stud mounting — 50 millisecond stabilization time Sine wave output: — 1 volt Pk-Pk, 3% distortion Other can sizes available



TFO-22

TCXO-50
Temperature-Compensated
Crystal Oscillator
2 x 2 x 1″

CRYSTAL OSCILLATORS

SPECIFICATIONS — TFO-22 SERIES

Standard Frequencies:	10, 5, and 1 MHz, 100 and 10 KHz
Frequency Tolerance:	±5 x 10^{-6} — 5° to +55°C ±3 x 10^{-5} −20°C to +71°C
Output Voltage:	Logic 0 — 0 to 0.5 volts maximum Logic 1 — 2.5 volts minimum
Load:	
Current Sink	Logic 0 — 2.5 ma
Current Source	Logic 1 — 100 μa
Input Voltage:	5 volts dc, ±1%
Size:	1.052 x 2.094 x 0.5 inches
Weight:	1.75 ounces, maximum
Finish:	Hot tin dip/acrylic protective coating
Mounting:	Printed circuit board (4 solder pins)
Sealing:	Case is hermetically sealed
Standard Options:	±1 x 10^{-7}/day
1. Frequency stability	.2 volts rms into 50 ohm
2. Sine wave*	5% maximum harmonic distortion
3. 12 or 24 volt input*	±10% amplitude stability

TEMPERATURE-COMPENSATED CRYSTAL OSCILLATORS

ACO-57

Frequency Range:	100 KHz to 50 MHz
Accuracy:	±1 x 10^{-6}
Frequency vs. Temperature:	5 x 10^{-6}
Temperature Range:	−5°C to +55°C
Input:	5 Volts dc ±1%
Output:	1-4 volts Pk-Pk into 10 K ohms

TCXO-50

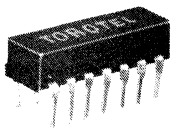
Frequency Range:	1 MHz to 10 MHz
Frequency Tolerance:	±1 x 10^{-6}
Temperature Range:	−5°C to +55°C
Frequency vs. Temperature:	±1 x 10^{-6}
Input:	20 volts dc ±10%
Output:	1-4 volts Pk-Pk into 10 K ohms
Stabilization:	<3 seconds

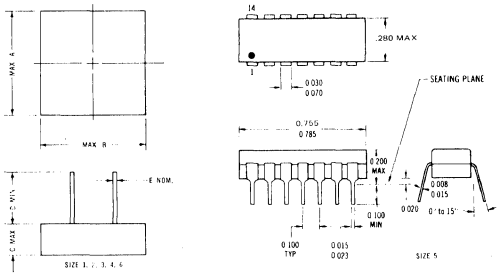
TOROTEL INC.

13402 SOUTH 71 HIGHWAY, GRANDVIEW, MO. 64030

PHONE: 816 SO 1-6314 TWX-910-777-7037

CRYSTAL CONTROLLED CLOCK OSCILLATORS





0.1 Hz to 25 MHz FIXED FREQUENCY CRYSTAL OSCILLATOR

	PACKAGE SIZE				
	A	B	C	D	E
1	1.505″	3.260″	0.45″	0.75″	0.040″
2	1.505″	2.510″	0.45″	0.75″	0.040″
3	1.505″	1.505″	0.45″	0.75″	0.040″
4	1.505″	1.505″	0.45″	0.75″	0.040″
5		TO116 - See Drawing			
6	1.005″	1.005″	0.45″	0.75″	0.040″

- Available in Plastic Package or Hermetic Seal
- Excellent Rise/Fall Time, Square Wave
- Compatible with T²L Logic
- Minimum Power Required, All Solid State
- Economically Priced for Industrial Applications

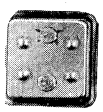
Type	Frequency Range	Temp. Range Degrees C	Tol. PPM	Package Size
T070E10E	0.1 Hz to 24 Hz	−20 to +70	200	1
T070G10E	0.1 Hz to 24 Hz	−20 to +70	300	1
T070F10E	0.1 Hz to 24 Hz	−20 to +70	500	1
T070E10E	25 Hz to 6.24 KHz	−20 to +70	200	2
T070G10E	25 Hz to 6.24 KHz	−20 to +70	300	2
T070F10E	25 Hz to 6.24 KHz	−20 to +70	500	2
T070E10E	6.25 KHz to 199 KHz	−20 to +70	200	3
T070G10E	6.25 KHz to 199 KHz	−20 to +70	300	3
T070F10E	6.25 KHz to 199 KHz	−20 to +70	500	3
T070D05E	200 KHz to 2.5 MHz	−20 to +70	100	4
T070E05E	200 KHz to 2.5 MHz	−20 to +70	200	4
T070F05E	200 KHz to 2.5 MHz	−20 to +70	500	4
T040C05P	1.000,000 MHz*	+10 to +40	50	5
T040D05P	1.000,000 MHz*	+10 to +40	100	5
T040E05P	1.000,000 MHz*	+10 to +40	200	5
T040F05P	1.000,000 MHz*	+10 to +40	500	5
T050D05P	1.000,000 MHz*	0 to +50	100	5
T050E05P	1.000,000 MHz*	0 to +50	200	5
T050F05P	1.000,000 MHz*	0 to +50	500	5
T070E05C	1.000,000 MHz*	−20 to +70	200	5
T070F05C	1.000,000 MHz*	−20 to +70	500	5
T090E05C	1.000,000 MHz*	−40 to +90	200	5
T090F05C	1.000,000 MHz*	−40 to +90	500	5
T105F05C	1.000,000 MHz*	−55 to +105	500	5
T070C05E	2.5 MHz to 25 MHz	−20 to +70	50	4
T070D05E	2.5 MHz to 25 MHz	−20 to +70	100	4
T105C05E	2.5 MHz to 25 MHz	−55 to +105	50	4
T105D05E	2.5 MHz to 25 MHz	−55 to +105	100	4
T040E05S	10 MHz to 20 MHz	+10 to +40	200	6

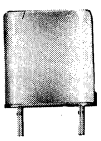
*Special order for other frequencies.

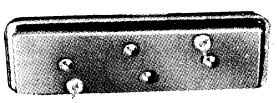
POWER REQUIREMENT:

Operating Voltage ..... 3.5 to 5.5 V DC
Nominal Power ..... 30 MW 100 KHz Up
Special Order for other operating voltage.
Logic Out: 1 = 2.4 V Minimum 0 = 0.4 V Maximum
Fan Out ..... 5 TTL Loads Min.
Duty Cycle ..... 40% to 60% at 1.4 Volts
Rise/Fall Time ..... 1 to 2 Volts
20 Nanoseconds or less ..... 2.5 MHz and Up
50 Nanoseconds or less ..... .1 MHz to 2.5 MHz

QUARTZ CRYSTALS







Frequencies from 15 KHz to 100 MHz manufactured to the highest tolerances and hermetically sealed with the latest methods.

Torotel's cold welding process provides crystals to the most severe Tolerances in the HC-38/U, HC-39/U and HC-41/U crystal holders. These holders are checked for helium leaks in 10^{-9} CC per second. Crystals packaged in this manner are especially suited for PC board mounting.

Resistance weld sealing is available **at no extra cost** in the HC-6/U, HC-18/U, HC-25/U and HC-33/U standard holders. This process uses an electrical weld to seal the crystal unit in a helium-nitrogen atmosphere. Solder balls and aging due to flux contamination are completely eliminated.

QPL-3098

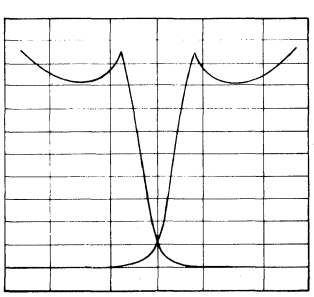
In house laboratory facilities can perform testing to MIL-C-3098F. Many standard types are QPL approved and custom designs are available on request.

CRYSTAL FILTERS

Crystal filters from 10 KHz to 30 MHz are computer designed for maximum performance. Custom designs are considered a challenge. Contact Torotel's engineering staff for assistance.

WE SPECIALIZE IN THESE TYPES OF PASSIVE NETWORKS:

BAND PASS
BAND REJECT
LOW PASS
HIGH PASS
IN THE FREQUENCY RANGES FROM DC TO 35 MHz
LINEAR PHASE
PHASE EQUALIZER
AMPLITUDE EQUALIZER
DELAY LINES



FOR APPLICATIONS INVOLVING:

DATA MODEMS
RF COMMUNICATIONS
AVIONICS
TELEGRAPH
INSTRUMENTATION TELEMETRY
FSK
SINGLE SIDEBAND

SEE OTHER TOROTEL PAGES Vol.3•538-3•541 & 3•1304, 3•1305

tyco filters

A BROADLINE MANUFACTURER OF FREQUENCY CONTROL PRODUCTS

CRYSTAL FILTERS
Monolithic and discrete "AT" cut crystal filters. Monolithics available in HC-12, HC-18 and sub-miniature HC-24.

DISCRIMINATORS
Custom capability plus many standards.

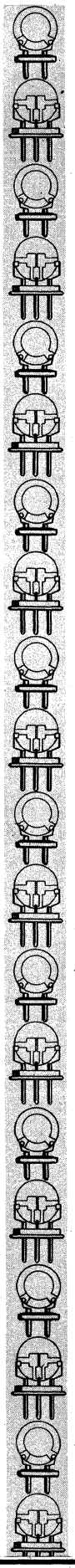
CRYSTAL OSCILLATORS
Crystal oscillators for a wide variety of applications. TTL/Sinusodal.

I.F. STRIPS
Containing two crystal filters, two amplifiers, limiter, and crystal discriminator.

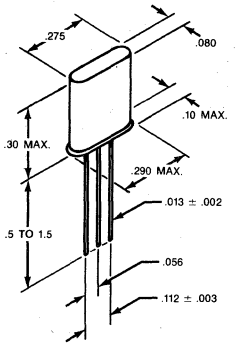
F-M FILTERS
Crystal and LC wide band filters for high fidelity applications.

DUAL AND TRIPLE MODE CRYSTAL FILTERS
Dual mode AM/LSB for amateur and marine application. Triple mode LSB/AM/USB for amateur applications. Not to be confused with two or three filters in one package.

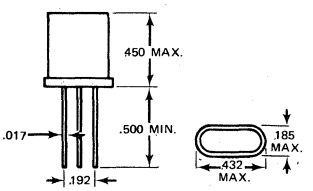
Tyco Filters Division, Inc. manufactures all components to military standards at commercial prices. Crystals are given 100% shock tests and X-rays at a .25% AQL.



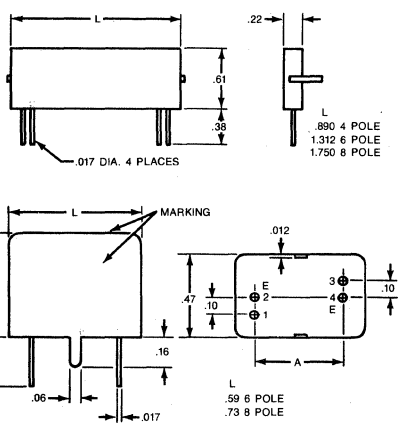
SUBMINIATURE 2 POLE MONOLITHIC PACKAGE

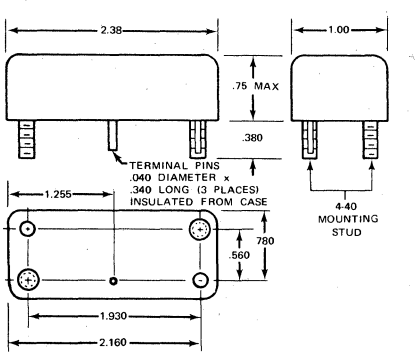


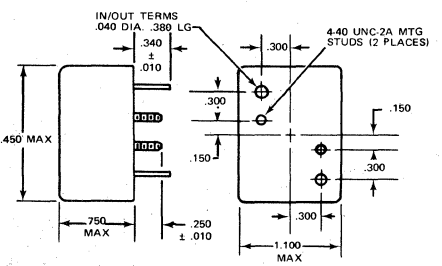
STANDARD 2 POLE MONOLITHIC PACKAGE



STANDARD FILTER PACKAGES







tyco FILTERS DIVISION INC.
3940 West Montecito Street
Phoenix, Az. 85019 • (602) 272-7945

Tyco Filters Division, Inc., formerly Sherold Filters & C-F Networks, is one of the major suppliers of crystal filters, discriminators and oscillators to both commercial and military markets.

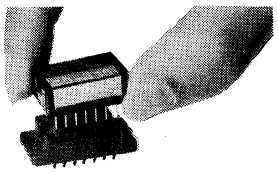
Clock Oscillators TTL, CMOS and ECL

Model:	CO-231	CO-235*	CO-238*	CO-239*	CO-233ME	CO-236
Output:	TTL	TTL	TTL	TTL	ECL	CMOS
Frequency:	1 Hz-100 MHz	20 KHz-30 MHz	3 MHz-100 MHz	4 MHz-100 MHz	5 MHz-200 MHz	.01 Hz-10 MHz
Input:	5 VDC	5 VDC	5 VDC	5 VDC	−5.2 VDC	5-15 VDC
Size:	1½" x 1½" x ½"	1½" x 1½" x ½"	0.5" x 0.8" x 0.35"	1.4" x 0.8" x .225"	1½" x 1½" x ⅝"	1½" x 1½" x ½"
Accuracy:	CO-231: ±.001% CO-231T: ±.0001%	CO-235: ±.001% CO-235T: ±.0001%	CO-238A: ± .005% CO-238B: ± .001%	CO-239A: ±.005% CO-239B: ±.001%	CO-233ME: ±.001% CO-233MET: ±.0001%	CO-236: ±.001% CO-236T: ±.0001%

Stability:

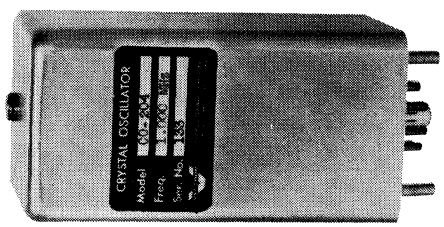
Standard:	0°C to +70°C:	±.0025%	
−1 Option:	−55°C to +85°C:	±.005%	(−40°C to +85°C for CO-236-1)
−2 Option:	−55°C to +125°C:	±.005%	
−3 Option:	0°C to +50°C:	±.0003%	(not available for CO-236 below 2 MHz)
−4 Option:	0°C to +50°C:	±.0001%	(only for CO-231 in 3-20 MHz range)
−6 Option:	0°C to +50°C:	±.001%	
−8 Option:	0°C to +70°C:	±.01%	(includes initial accuracy)

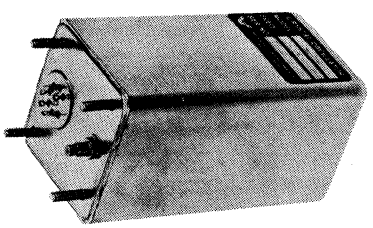
*DIP Compatible



High Stability Crystal Oscillators OVEN CONTROLLED

Model:	CO-204	CO-201	CO-217	CO-214	CO-211	CO-244V	CO-246-1	CO-229	CO-226
Aging Rate:	1x10⁻⁹/day	1x10⁻⁸/day	1x10⁻⁹/day	1x10⁻⁸/day	1x10⁻⁷/day	1x10⁻⁹/day	1x10⁻¹⁰/day	1x10⁻⁸/day	1x10⁻⁷/day
Temperature:	0°C to +50°C: ±5 x 10⁻⁹ −20°C to +70°C: ±1 x 10⁻⁸ −55°C to +85°C: optional		Standard: 0°C to +50°C: ±5x10⁻⁸ −1 Option: 0°C to +50°C: ±1x10⁻⁸ −20°C to +70°C: ±3x10⁻⁸			0°C to +50°C: ±1x10⁻⁹ −55°C to +75°C: Optional	0°C to +50°C: ±5x10⁻¹⁰ −55°C to +60°C: optional	0°C to +50°C: ±1x10⁻⁷ −55°C to +85°C: optional	
Frequency:	1, 5 or 10 MHz standard (broad range of frequencies available)		1, 5 or 10 MHz standard (broad range of frequencies available)			1, 5 or 10 MHz std. (broad range of frequencies available)	1 MHz or 5 MHz Std. (other freq. available)	Any frequency in 25-400 MHz range	
Output:	1 vrms/50 ohms (TTL output optional)		1 vrms/500 ohms (TTL or 50 ohm output optional)			1 vrms/500 ohms (TTL or 50 ohm opt.)	1 vrms/50 ohms	0.5 vrms/50 ohms (+7 dbm) (+13 dbm or ECL optional)	
Input:	24 VDC standard (5 VDC to 32 VDC optional)		24 VDC standard (5 VDC to 32 VDC optional)			24 VDC Standard (5-32 VDC opt.)	24 VDC Standard (15-32 VDC Optional)	24 VDC Standard (15-32 VDC optional)	
Size:	2" x 2" x 4"		2" x 2" x 3"			2¼" x 2¼" x 4¼"	3" x 3" x 5"	2" x 2" x 3" (or 4")	

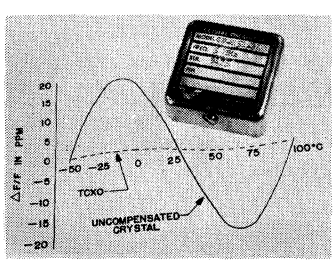




TCXOs TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

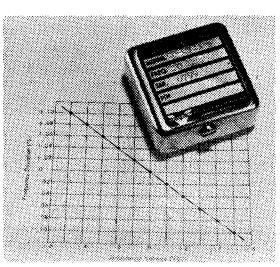
Model:	CO-251	CO-252	CO-252-3	CO-252-4
Temperature:	0/+50°C	−20/+70°C	0/+50°C	−55/+85°C
Standard:	±1 x 10⁻⁶	±1 x 10⁻⁶	±2 x 10⁻⁷	±5 x 10⁻⁶
Option A:	N/A	±5 x 10⁻⁷	±1 x 10⁻⁷	±1 x 10⁻⁶

Frequency: 1, 2, 3, 4, 5 or 10 MHz Standard (Units available from 60 Hz thru 150 MHz)
Aging: Better than 1 x 10⁻⁸/day and 1 x 10⁻⁶/year
Output: Sinewave, TTL or CMOS
Input: 5-30 VDC with 3-15 ma current drain
Size: 2" x 2" x ¾" (other configurations optional)



VCXOs VOLTAGE CONTROLLED CRYSTAL OSCILLATORS

Model:	CO-271V	CO-275V	CO-272V	CO-273V
Frequency:	2-20 MHz	20-100 MHz	2-100 MHz	0.5-4 MHz
	(Higher and lower frequencies optionally available)			
Deviation:	±.1%	±.1%	±.1%	±.5%
Linearity:	±1%	±1%	±1%	±1%
Stability:	−A: ± .01%	−A: ± .01%	±.0001%	±.025%
(0-50°C)	−B: ± .001%	−B: ± .001%		
Oven Control:	No oven	No oven	Proportional	No oven
Size:	2" x 2" x ¾"	2" x 3" x ¾"	2" x 2" x 4"	2" x 3" x ¾"



VECTRON LABORATORIES, INC.
121 Water Street • Norwalk, CT. 06854 • 203/853-4433

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ANODIZED MACHINED ALUMINUM ALCOKNOBS

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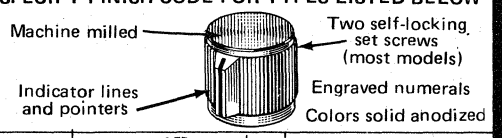
1–99, Net 100–249, Less 10% 250–499, Less 14% 500–999, Less 20%

SPECIFY FINISH CODE FOR TYPES LISTED BELOW



A B KN-500-1/4 .75 KN-500-1/8 .75	A B KN-700-1/4 .80	A B KN-900-1/4 .95	A B KN-1250-1/4 1.15	A B KN-1751-1/4 2.05	A B KN-1751S-1/4 2.40
AB BA KN-500-1/4 .95 KN-500-1/8 .95	AB BA KN-700-1/4 1.05	AB BA KN-900-1/4 1.20	AB BA KN-1250-1/4 1.40	AB BA KN-1751-1/4 2.35	AB BA KN-1751S-1/4 2.70
BA KN-501-1/4 .90 KN-501-1/8 .90	BA KN-701-1/4 .95 KN-701-1/8 .95	A B KPN-500-1/4 1.90 KPN-500-1/8 1.90	A B KPN-900-1/4 2.45	A B KN-5700 1.70	A B KN-7900 1.90
BA KNS-501-1/4 1.10 KNS-501-1/8 1.10	BA KNS-701-1/4 1.25 KNS-701-1/8 1.25	A B KPN-700-1/4 2.05	AB BA KPN-700-1/4 2.30	AB BA KPN-900-1/4 2.65	A B KB-500-1/4 .85 KB-500-1/8 .85
A B KS-500-1/4 .85 KS-500-1/8 .85	A B KS-700-1/4 .95	A B KS-900-1/4 1.10	A B KSP-700-1/4 .90	A B KSP-900-1/4 1.05	A B KC-500-1/8 .90 KC-500-10-1/8 1.05
A B G K-500-1/4 .65 K-500-1/8 .65	A B G K-700-1/4 .70	A B G K-900-1/4 .80	A B G K-1250-1/4 1.05	A B G K-1251-1/4 1.00	A B K-1251S-1/4 1.65
A B G KD-500-1/4 .75 KD-500-1/8 .75	A B G KD-700-1/4 .80	A B G KD-900-1/4 .95	A B G KD-1250-1/4 1.15	A B K-5700 1.50	A B K-7900 1.65
A G KHF-500-1/4 .65	A G KHF-700-1/4 .70	A G KHF-900-1/4 .80	A G KHF-1250-1/4 1.05	A B KBS-500-1/4 1.05 KBS-500-1/8 1.05	A B KBS-500-10-1/4 1.30 KBS-500-10-1/8 1.30

A — Natural Aluminum; Black Indicator
B — Black; White Indicator
G — Gold; Red Indicator
AB — Natural Body & Black Top; Black Indicator
BA — Black Body & Natural Top; White Indicator
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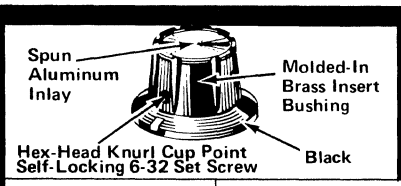
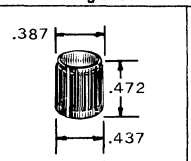


CONTROL KNOBS

PLASTIC ALCOKNOBS WITH ALUMINUM INLAYS

DISCOUNT SCHEDULE

1–99, NET 100–249, LESS 10% 250–499, LESS 14% 500–999, LESS 20%



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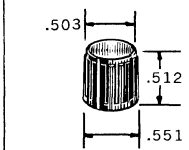
PKG-40B-1/8 .45



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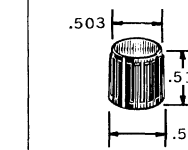

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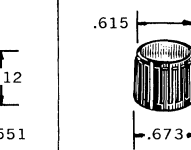

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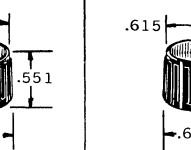

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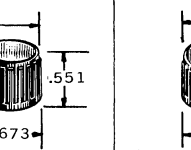

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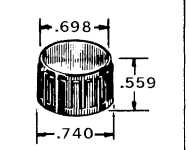

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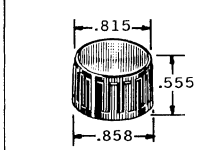

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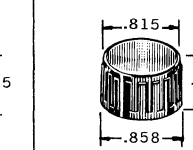

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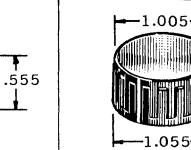

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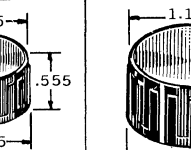

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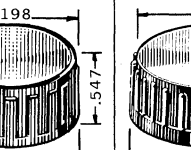

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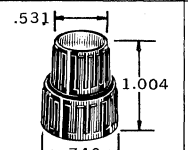

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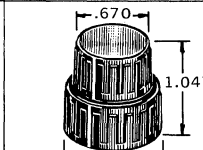

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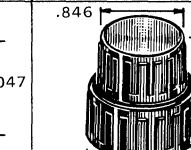

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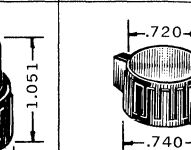

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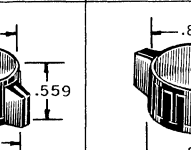

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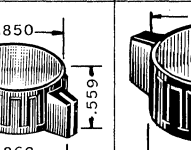

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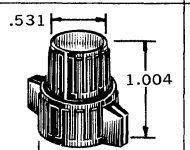

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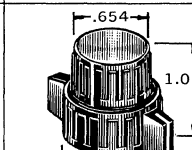

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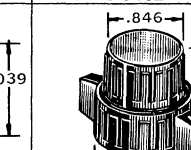

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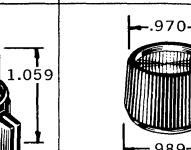

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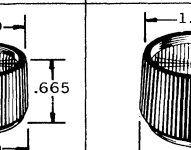

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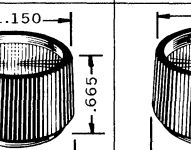

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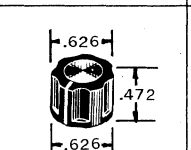

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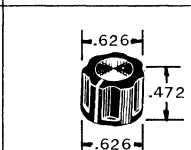

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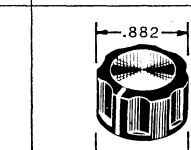

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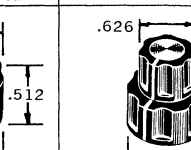

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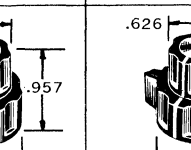

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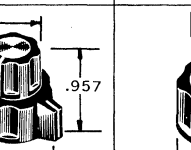

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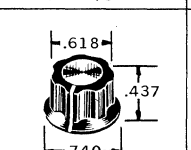

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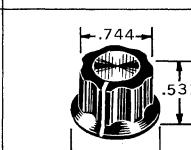

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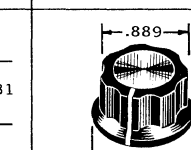

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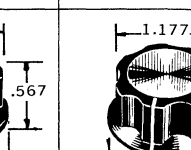

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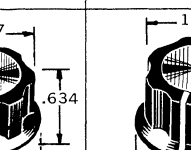

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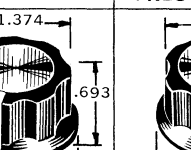

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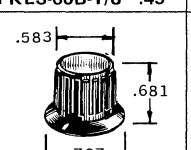

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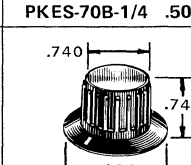

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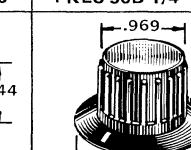

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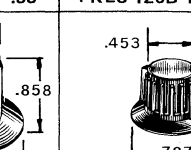
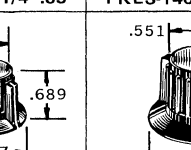


PKAP-50B-1/4 .45
PKAP-50B-1/8 .45



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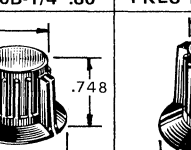
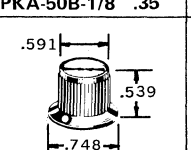
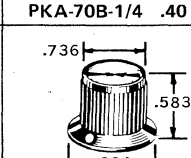


PKAP-90B-1/4 .70



PK-50B-1/4 .25
PK-50B-1/8 .25



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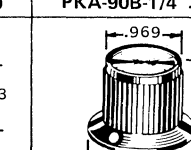
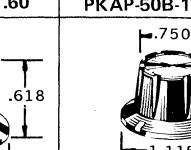
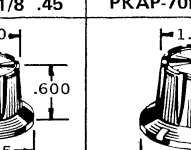


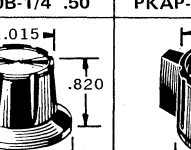
PK-90B-1/4 .35



PKB-70B-1/4 .40



PKB-90B-1/4 .50



PKP-194B-1/4 .65

—10 = Skirted, with numerals
—R = Red, —B = Black
—1/8 = 1/8" shaft —1/4 = 1/4" shaft
Concentrics: 1/4" shaft bottom, 1/8" shaft top.

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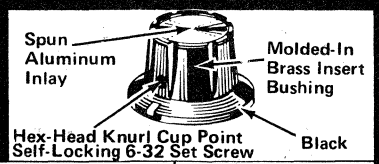
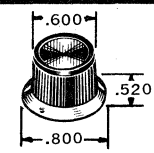
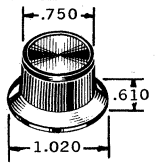




PKD-60B-1/4 .50
PKD-60B-1/8 .50



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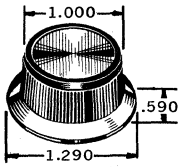

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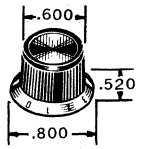
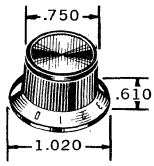


PKD-60B-10-1/4 .55
PKD-60B-10-1/8 .55



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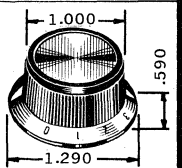

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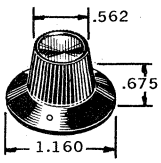

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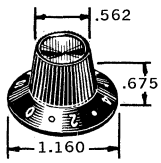

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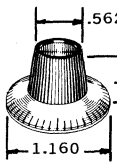
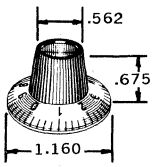


PKS-1106B-1/4 .50



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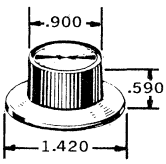
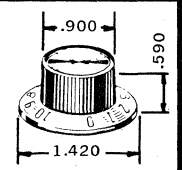
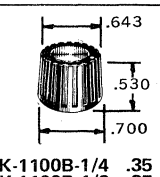


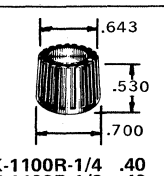
PKS-90B-1/4 .55



PKS-90B-10-1/4 .60



PK-1100B-1/4 .35
PK-1100B-1/8 .35



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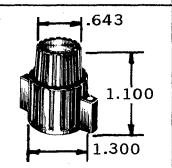
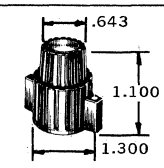
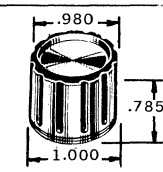
PK-1100R-1/8 .40



PKC-1111B .95



PKC-1111BR 1.00



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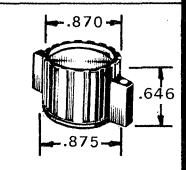
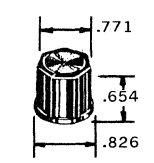
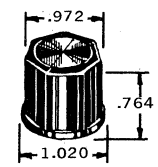


PKP-1109B-1/4 .55



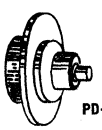
PFM-80B-1/4 .50



PFM-100B-1/4 .60

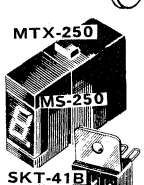
— 10 = Skirted, with numerals
— R = Red, — B = Black
— 1/8 = 1/8" shaft, — 1/4 = 1/4" shaft
Concentrics have 1/4" shaft bottom and 1/8" shaft top.

PLANETARY DRIVE



Model PD-10 for Vernier knobs, others improved efficiency, better torque characteristics and true reliability. Backlash and play are virtually eliminated, allowing tighter control of your instruments. The Planetary Drive is available only in 10:1 reduction ratio and has a torque exceeding 30 oz. ins. with self-contained limitations.

Model	Volts	Amps	MSCP	(Pkg.)	One-99	100-249	250-499	500-999
PD-10-1	10:1 Reduction, 3/8" Long				4.95	4.46	4.20	3.96
PD-10-2	10:1 Reduction, 7/8" Long				4.95	4.46	4.20	3.96



INCANDESCENT READOUT INDICATORS

MS-250 — 0-9. Socket, plastic housing. Lamps: 2.5V @ 20ma per seg. Current drain: 40ma (min), Consumption: 160ma (max). 0.4W (max). Mating socket supplied.

MS-5030E — These 5V plug-in display units have 0.79 h characters, plus dec. pt. in molded phenolic housing. Large, well styled characters, wide angle display, low voltage and low current operation (30ma per seg). Case size: 1.30 x .870 x .795.

INCANDESCENT MOSAIC READOUT INDICATORS

MS-6A & MS-14A — single plane 0-9 & some alphabet. Decimal points used as colon. Figures: .800 h. Body size: .834 w x 1.750 h x 2.104 d. Lamp life: 20,000hrs. Plug-in at rear of case. Supplied less socket, order separately.

MSM-5A — miniature readout is same as above, except smaller. Lamps: 5V @ 60ma. Figure: .475 h. Body: .475 w x .985 h x 1.562 d. Lamp life: 50,000hrs. Plug-in thru standard 10-term. PC connector. Supplied less socket, order separately.

MSM-5AL — as above, but has 10" flat cable connection.

MSM-5S — mates with above MSM series, but has symbol indicators for +,—, & figure "one". Plug-in.

BCD-TO-7 SEGMENT DECODER DRIVERS

MSDD-731 — with active low output to display numeric character 0-9. Supply voltage: 7V; Input: 5.0V. Plastic/epoxy package w/Dual-in-Line (DIP) configurations.

PANEL MOUNTING ACCESSORIES

MS-4BA & MS-4BB — use up to 5 modular digits. Has top & bottom aluminum extrusion.

LOGIC POWER SUPPLY

5V @ 1 amp regulated section and 200 VDC @ 50ma Input 115 VAC.

Model	Volt	Description	One-24	25-99	100-499
MS-250AR	2.5	Num. red w/socket	8.25	7.01	6.19
MS-250AC	2.5	Num. clear w/socket	8.25	7.01	6.19
MS-250SR	2.5	Symbol red w/socket	8.25	7.01	6.19
MS-250SC	2.5	Symbol clear w/socket	8.25	7.01	6.19
MS-5030ER	5	Num. red w/o socket	6.25	5.31	4.69
MS-5030EC	5	Num. clear w/o socket	6.25	5.31	4.69
SKT-41B		Socket for MS-5030	.48	.41	.36
MS-6A	6.3	Mosaic	10.95	9.31	8.21
MS-14A	14	Mosaic	10.95	9.31	8.21
MSM-5AL	3-5	Num. 0-9 & 1 Dec.	9.95	8.46	7.46
MSM-5A	3-5	Num. 0-9 & 1 Dec.	8.25	7.01	6.19
MSM-5S	3-5	Symbol +,—,1	8.25	7.01	6.19
MS-SK-R		Right Angle socket for MS	1.55	1.32	1.16
MS-SKT		Socket for MS	1.15	.98	.86
MSM-SK		Socket for MSM	1.15	.98	.86
MS-MTX		Dec.-7, 49 Diode Matrix	12.45	10.58	9.34
MS-FLV		Violet Filter for MS	.40	.34	.30
MS-FLR		Red Filter for MS	.40	.34	.30
MS-FLG		Green Filter for MS	.40	.34	.30
MSDD-731		BCD-7 Dec-Drv	4.15	3.53	3.11
MSDD-702		80mA/seg w/Dec pt	6.50	5.53	4.88
MSDD-703		80mA/seg w/rip blank	6.50	5.53	4.88
DDM-702		Plug-in 80mA/seg w/Dec.	18.50	15.73	13.88
DDM-703		Plug-in 80mA/seg w/ripple	18.50	15.73	13.88
MTX-4000/41000		Dec.-7 plug-in	12.85	10.92	9.64
MTX-250		Dec.-7 plug-in	12.85	10.92	9.64
MS-4BA		Bezel Only, Nat(pr.)	1.50	1.28	1.13
MS-4BB		Bezel Only, Blk(pr.)	1.50	1.28	1.13
PS-51-117		Logic Power Supply	39.95	33.96	29.96

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ALCOLITE®

BRITE GLO NEON LAMPS

(T-1⅜). MNE-4A/-4LA/-4SLA have straight electrodes. MNE-4B has the electrodes bent on the ends. MNE-4SL has metal base to increase light output. 100K resistor required for 115V.

(T-1⅛). Ignition voltage 75 VAC or 95 VDC. Current should be limited to 800 μA. 150K resistor recommended for 115V.

Longer than conventional NE-2. Breakdown: 90 VDC; maintained V: 65 VDC; design current: 1.3 mA.

(T-1). NE-1H. High intensity neon with lens end magnification. Ignition voltage 60 VAC or 67 VDC and a ballast resistor of 35K is recommended at 115 VAC. NE-1-HL is same only with insulated leads.

Series BIM-A — truncated cones, single lens style; height of lens is ¼". Incorporates NE2H high intensity lamp. Acrylic housing, tin-plated solder terminals. For 11/32" dia. panel mounting hole. Retainer included. Specify Color: Red, Amber, Clear.

Miniature T-1¼ neon. Wire leads. 100K resistor recommended. Approx. ½" size. Specify Color: Red, Amber, Clear. SM-1.

T-1 #680: 5 VDC 60 mA, 100,000-hrs. For ¼" hole, 10" leads.

T-1⅜ neon lamp in black phenolic case, for ¼" hole, 10" leads. 100K resistor required. See MNE-4 story for lamp description.

Miniature, transistorized neon lite operates from 5 VDC source. Mounts in ⅜" hole. Size 2.086". Specify: Red, Amber, Clear.

NEON LAMP ASSEMBLIES

Series BNE Neon Assemblies, Compact Lens..— protrudes slightly above the panel. Operating voltage: 75 VDC without resistor; for 115 VAC operations use external resistors (150K for standard intensity, 33K for high intensity) not supplied. Temperature range: —10°C to 70°C. Mounts with single 5/16-32 nut. BNE-4R comes with built-in resistor for 115 VAC.

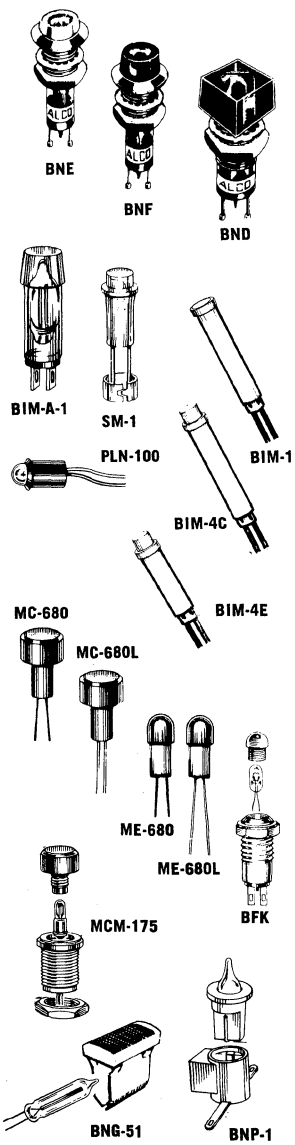
Series BNF Neon Assemblies, Long Lens — Similar to the BNE Series except that the lens system extends a greater distance beyond the panel for a brighter illumination.

Series BND Neon Assemblies, Square Lens — Combines an entirely new look in a space-saving pilot assembly. The BND is available with or without built-in series resistor. Specify Color: Red, Amber, Clear, White.

LAMP HOLDERS

Relampable miniature holders have ⅜" dia. lens and small size. **MCM-100** has 0.7" length, mounts with 5/16-32 nut. **MCM-175** has 1" length, mounts with ⅜-32 nut. Specify Lens Colors: Red, Green, Amber, Blue, White.

Simplified, low-cost, snap-type lamp holders for miniature lamps, such as NE-2, etc. 5 different size holders are available, each adaptable to particular panel thickness. Less lamps. Specify Color: Red, Amber, or Clear.



NEON LAMP ASSEMBLIES

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
BND-2	Neon Lite Assembly, Standard Intensity	(25)	.84	.57	.50	.42
BND-2R	Neon Lite Assembly, With Resistor	(25)	.89	.61	.53	.45
BND-3	Hi Intensity Neon Lite	(25)	.89	.61	.53	.45
BND-3R	Hi Intensity Neon Lite With Resistor	(25)	.99	.67	.59	.50
BNE-2	Standard Intensity Neon Lite	(25)	.84	.57	.50	.42
BNE-3	Hi-Intensity Neon Lite	(25)	.89	.61	.53	.45
BNE-4R	Hi Intensity w/Internal Resistor	(25)	.99	.67	.59	.50
BNF-2	Standard Intensity Neon Lite	(25)	.84	.57	.50	.42
BNF-3	Hi Intensity Neon Lite	(25)	.89	.61	.53	.45
BNF-4R	Hi Intensity w/Internal Resistor	(25)	99	.67	.59	.50
Specify Color: Red, Amber, White or Clear						
SM-1	Without Resistor	(25)	.89	.61	.53	.45
BIM-1*	White Shoulder	(25)	.59	.40	.35	.30
BIM-1-B*	Black Shoulder	(25)	.59	.40	.35	.30
BIM-4-C*	Chrome Bezel	(25)	.69	.47	.41	.35
BIM-4-E*	Chrome Bezel	(25)	.69	.47	.41	.35
BIM-A-1	Without Resistor	(25)	.69	.47	.41	.35
BIM-A-4	With Resistor	(25)	.79	.54	.47	.40
BNM-2R**	Standard With Resistor	(25)	1.29	.88	.77	.65
PLN-100A	Neon Pilot, Clear *U.L. Listed	(25)	.99	.67	.59	.50
Specify Color: Red, Amber, Clear	**Translucent White					

INCANDESCENT LAMP ASSEMBLIES

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
MC-680†	With Pin Contacts	(25)	1.29	.88	.77	.65
MC-680LT†	With 6" Leads	(25)	1.29	.88	.77	.65
ME-680*	With Pin Contacts	(25)	1.19	.81	.71	.60
ME-680LT*	With 6" Leads	(25)	1.19	.81	.71	.60
† Specify Color: Red, Green, Amber, Blue, White * Specify Color: Red, Green, Yellow, Blue, White						
PL-105	5V Lamp Assembly, Clear	(25)	.89	.61	.53	.45
BFK-5	Pilot Assembly with 5V Lamp	(25)	1.49	1.01	.89	.75
Specify Color: Red, Green, Blue, Yellow, White						

LAMP HOLDERS

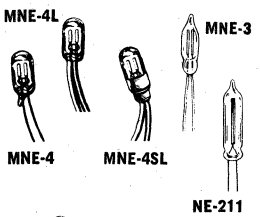
Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
MCM-100	Pilot, Takes T-1 Submidget Flange Lamp	(25)	1.09	.74	.65	.55
MCM-175	Pilot, Takes T-1¾ Midget Flange Lamp	(25)	1.39	.95	.83	.70
BNP-1‡	White Nylon Holder for NE-2	(25)	.18	.12	.11	.09
BNG-51‡	Holder for Neon Lamp	(100)	.20	.14	.12	.10
Specify Color: Red, Amber, Clear. Sold in Minimum Quantities of 100.						

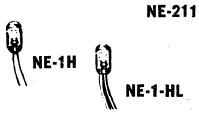
PLEASE SPECIFY COLOR OF LENS WHEN ORDERING PILOT LIGHTS

ALCO® ELECTRONIC PRODUCTS, INC.
1551 OSGOOD ST., NO. ANDOVER, MASS. 01845
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)
TEL: (617) 685–4371
TWX: 710 342–0552

Prices and specifications are subject to change without notice.

ALCOLITE®





BRITE GLO NEON LAMPS

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
MNE-4A	Short Bare Leads	(25)	.59	.40	.35	.30
MNE-4LA	10″ Insulated Leads	(25)	.69	.47	.41	.35
MNE-4SLA	10″ Insulated Leads, Metal Base	(25)	.74	.50	.44	.37
MNE-3	Short Bare Leads	(25)	.69	.47	.41	.35
MNE-3H	Short Bare Leads, Hi Intensity	(25)	.79	.54	.47	.40
NE-211	11 mm Glow,Bare Leads	(25)	.49	.33	.29	.25
NE-214	11 mm Glow,Bare Leads	(25)	.64	.44	.38	.32
NE-1H	Short Bare Leads	(25)	.69	.47	.41	.35
NE-1-HL	10″ Insulated Leads	(25)	.79	.54	.47	.40
	‡ Hardware					

INCANDESCENT LAMP ASSEMBLIES

Ultraminiature series has cylindrical appearance and fits in 3/16″ hole. Has 5V 60 mA rating, 100,000-hr. life. Contains #683 T-1 lamp. Mounting ring supplied. ME-680L & MC-680L have solder tin dipped, hi-temp leads. 24 AWG wire. Lens unscrews, T-1 lamp is exposed. Specify: Red, Green, Blue, Yellow, White. #680 lamp 5V @ 60 mA, supplied.

INCANDESCENT T-3/4, T-7/8, T-1 AND T-1¾ LAMPS

Model	Volts	Amps	MSCP	(Pkg.)	One-9	10-99	100-499	500-999
T-7/8 Wire Terminals								
RM2-5V20	5.0	.020	.020	(10)	1.09	.71	.55	.47
RM2-5V30	5.0	.030	.030	(10)	.99	.64	.50	.43
RM2-5V60	5.0	.035	.035	(10)	.93	.60	.47	.40
T-1 Wire Terminals								
680AS15	5.0	.060▲	.032†	(10)	1.25	.81	.63	.54
680AS25	5.0	.060	.032	(10)	.83	.54	.42	.36
683-AS15	5.0	.060	.053†	(10)	1.25	.81	.63	.54
683-AS25	5.0	.060	.053	(10)	.83	.54	.42	.36
713AS15	5.0	.075	.088†	(10)	1.25	.81	.63	.54
713AS25	5.0	.075	.088	(10)	.83	.54	.42	.36
715AS15	5.0	.115	.147†	(10)	1.25	.81	.63	.54
715AS25	5.0	.115	.147	(10)	.83	.54	.42	.36
RM3-5V20	5.0	.020	.020	(10)	.99	.64	.50	.43
RM3-5V30	5.0	.030	.030	(10)	.89	.58	.45	.38
T-1 Sub-Midget Flange								
685	5.0	.060	.050	(10)	1.44	.94	.72	.62
718	5.0	.115	.147	(10)	1.38	.90	.69	.59
856	28.0	.024	.150	(10)	3.06	1.99	1.53	1.32
1112	14.0	.065	.150	(10)	2.16	1.40	1.08	.93
T-1¾ Wire Terminals								
2181	6.3	.200	.40	(10)	.65	.42	.33	.28
2182	14.0	.080	.30	(10)	.69	.45	.35	.30
T-1¾ Midget Flange Base								
327	28.0	.040	.34	(10)	.79	.51	.40	.34
330	14.0	.080	.50	(10)	.83	.54	.42	.36
381	6.3	.200	.40	(10)	.86	.56	.43	.37
382	14.0	.080	.30	(10)	.86	.56	.43	.37
387	28.0	.040	.30	(10)	.79	.51	.40	.34
815	5.0	.115	.147	(10)	.86	.56	.43	.37
T-1¾ Midget Grooved Base								
379	6.3	.200	.40	(10)	.86	.56	.43	.37
386	14.0	.080	.30	(10)	.90	.59	.45	.39
388	28.0	.040	.30	(10)	.95	.62	.48	.41
To be used with MSPN Switches on Page XX								
T-1¾ Midget Screw Base								
362	14.0	.080	.30	(10)	.99	.64	.50	.43
378	6.3	.200	.40	(10)	.95	.62	.48	.41
399	28.0	.040	.30	(10)	1.05	.68	.53	.45
To be used with MSLN Switches on Page XX								
† ±15%								

MODEL 201 LOGIC CHECKER AND MODEL 300 LOGIC PROBE

Model 201 Logic Checker is a self-contained solid state electronic instrument used to test DTL or TTL integrated circuits. Operates from power of unit under test. Model 300 Logic Probe traces logic levels and pulse activity through integrated circuits. Operates on 5V power from unit under test.

Model	Description	Price
201	Logic Checker	99.95
300	Logic Probe	19.95

MACHINED ALUMINUM AZIMUTH INDICATOR WITH GRADUATIONS

			Pkg.	1-99	100-249	250-499	500-999
AZ-360	2″	Black (numerals every 20°)	(1)	3.35	3.02	2.85	2.68
AZ-360A	2″	Black (numerals every 90°)	(1)	2.75	2.48	2.34	2.20

KNOB ACCESSORIES

KR-1	1/4″ to 1/8″ Reducer	(25)	.15	.14	.13	.12
KR-2	1/4″ to 3/16″ Reducer	(25)	.15	.14	.13	.12

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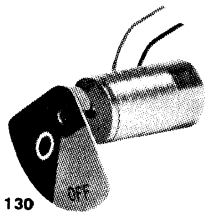
ELECTROMAGNETIC INDICATORS

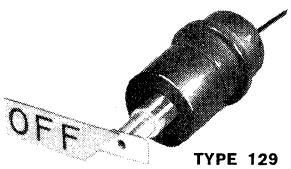
ALLARD INSTRUMENT CORP.

Designed for compact instrument and control panels, Allard miniature electromagnetic indicators provide positive visual signaling, are not subject to burnout, assure high readability in strong incident light. One-piece balanced rotor for dependable performance under shock and vibration. Models for momentary or latching operation, from DC or rectified AC. All models can be supplied to meet particular requirements for operating voltage, type of display and mounting, to commercial or MIL specifications.



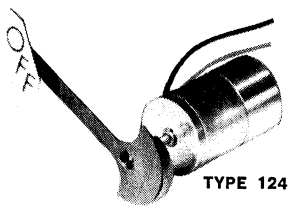
TYPE 130

Tiny indicator, totally enclosed structure. Rotation up to 60°. CW or CCW. For use with plug-on flags. Operates in any position. Case size: 7/16" O.D. x 25/32" L.



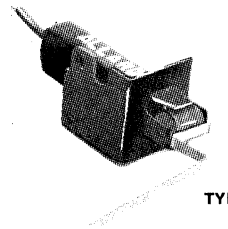
TYPE 129

Short, powerful semaphore indicator for CW or CCW rotation using demountable flag arms. Rotational anges to 60°. Works in any position. 7/16" diam. x 3/4" long.



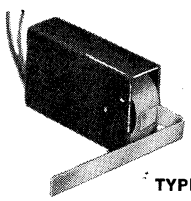
TYPE 124

Miniaturized semaphore indicator with rotation up to 60°. Available with CW or CCW rotation. For use with plug-on flags. Operates in any position. Case size: 3/8" O.D. x .575" long.



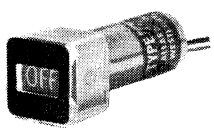
TYPE 219

Relatively inexpensive version of our highly successful instrument and panel mount indicator. Can display legends on the drum face or rotate a flag arm CW or CCW. 2 or 3 position momentary or 2 position latching operation. Indicator drum is .300" wide x .300" diam. Total length is 1 5/8".



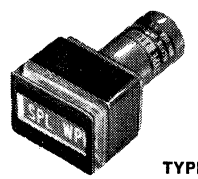
TYPE 109

2 or 3 position slim indicator for narrow locations. Can supply power to rotate a flag arm up to 60° or can display a legend directly on rotor face. CW or CCW for two position operation. .270" x .562" x 1".



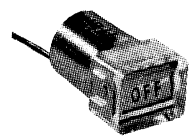
TYPE 108

Small indicator for 2- or 3-position momentary or 2-position latching (memory) indication. Prism-cut plastic lens in head can focus external light on indicator face. Colors or legends as required. 1 1/8" long, 3/8" dia., 7/16" square head.



TYPE 110

Extended face indicator, permits display of complete words- or multiple symbols. For 2- or 3-position momentary, or 2-position latching indication. Plastic capped for dust and moisture protection. Length 1 3/4", head 1" by 3/4".



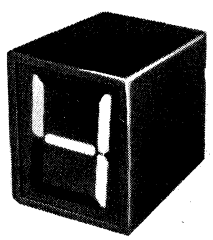
TYPE 120

Tiny broad faced indicator available with 2- or 3-position momentary or 2-position latching indication. Shows colors or legends. Head is 5/16" wide by 7/16" high. Body 1/2" dia. Overall length 15/16".

Types	130	129	124	219	109	108	110	120
D.C. VOLTAGES	To 28	To 40	To 40	To 40	To 40	To 90	To 50	To 40
OPERATING POWER (WATTS)	0.8	0.9	1.0	0.9	1.0	1.0	0.5	0.5
NO. OF CONNECTIONS	2	2	2	2, 3, 4	2, 3, 4	2, 3	2, 3, 4	2, 3
WEIGHT (GRAMS)	10	10.5	5	15	9.	10.6	35	9.5

ELECTROMECHANICAL READOUTS

All units illustrated are made under one or more of the following patents:
Re 24943/3,096,594 3,273,270/3,553,619



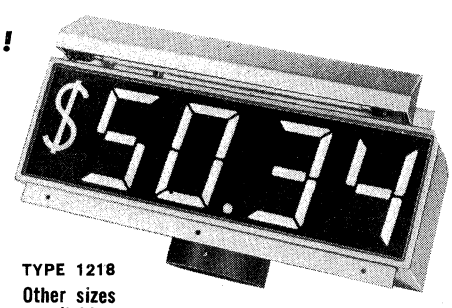
TYPE 202

A wide variety of other sizes available in single and multi-unit packages.

Compact digital indicating modules for instrument, data presentation and other display systems. Seven electromagnetic indicating segments can be operated in any desired combination by low power DC signals. Momentary or latching types. Windings available from 1 to 30 V, 1 13/16" h. x 1 7/16" w. x 2 1/4" d. Digit size 1 1/2" h. x 1" w. Other digit sizes up to 4" and custom units, with as many lines as necessary, also available. Operating time less than 0.03 sec. Units also supplied with packaged encoders and decoders.

High Visibility!
Inherent Memory!

Complete readout display operating as remote repeater of cash register readings Contains readouts, encoding matrices, pulsing and cycling circuitry and its own power supply. Use of latching (memory) type readouts makes average power consumption negligible. Packaged for all-weather, outdoor use. Uses 4 Type 218 readouts, 4" high.



TYPE 1218
Other sizes available

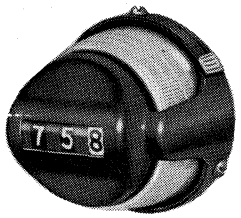
For literature or quotations on electromagnetic instruments and controls, call or write -

ALLARD INSTRUMENT CORP.

770 MAIN STREET, WESTBURY, L. I., N. Y. 11590 • (516) 334-8742

MICRODIAL® COUNTING DIALS

BUNKER RAMO AMPHENOL



1300 Series, Digital

Gives you fast, accurate indication of shaft position up to 1,000 turns. All models (3-digit 10-turn, 4-digit, 100-turn, and 5-digit 1,000-turn) mount directly on shaft to be controlled, eliminating backlash. Speed: up to 6,000 counts per minute.

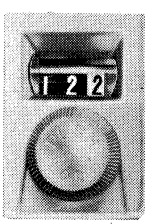
Large, contrasting numerals readable even from angular view because convex windows reduce glare, reflections. Rugged, dust-sealed construction includes Cycolac[1] counter wheels, Nylatron[2] GS gear assemblies, knurled aluminum control knobs. Brake optional. Special readouts are also optional. All models conform to military requirements.

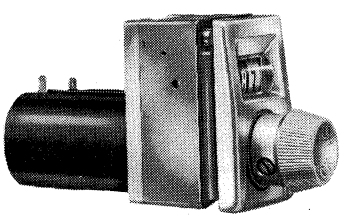
[1]Reg. TM Borg-Warner Corp.
[2]Reg. TM Borg-Warner Corp.

1330 Series, Digital

You get straight-on or angular readout with this illuminated turns-counting Microdial. One-piece lens/window magnifies numerals 1.5x. In exactly 10 turns, unit counts from 000 through 999. Fingertip brake locks settings in place.

This Microdial is sealed against dust yet its snap-on cap makes lamp replacement easy. Standard finishes for color coding: dark or light gray, red, white, and black; other colors and special read outs available on request.





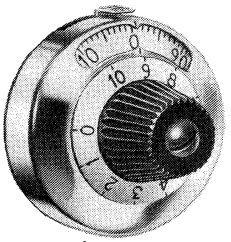
3100 Series, Digital

Remarkably accurate (1000:1 indexing accuracy) miniature 3100 Series dial almost makes a standard circular dial look gigantic by comparison. This Microdial measures only $1\frac{1}{8}$ x $1\frac{21}{32}$ inches and protrudes only $\frac{25}{32}$" from a panel.

Digits (with illumination optional) are magnified by a convex lens in recessed window. Three-digit, ten-turn dial rotates continuously clockwise or counter clockwise with push-pull fingertip brake to lock settings. This 3100 miniature Microdial will mount on panels from $\frac{1}{16}$" through $\frac{3}{16}$" thick.

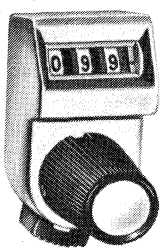
Standard color: natural brushed aluminum finish.

Amphenol's Dial-Pot assembly saves you time and money... eliminates costly mounting and phasing. If you now buy pots and dials separately, but for the same application, Amphenol can prephase and pre-assemble the 3100 dial to any potentiometer at no extra cost. You simply mount the assembly from rear of panel and wire into your circuit.



1320 Series, Concentric

The 1320 series is a $1\frac{3}{4}$ inch diameter 10 turn concentric scale dial with extra large numerals and a wide variety of color combinations including gloss and dull black, satin chrome, and bright chrome. Incorporating Amphenol's exclusive continuous inner dial movement, the 1320 is offered with or without brake. This dial is a rugged, long lasting, highly accurate unit which will meet your most demanding requirements.



DFD Series, Digital

- **250 PPM Reading Accuracy.**
- **High-Density Packaging — Up to 72 Per Sq. Foot!**

The DFD is a precision mechanism that provides a direct manual drive for a panel-mounted ten-turn potentiometer and an associated 3-digit readout that registers the drive-shaft rotation in turns, to three significant figures, a vernier wheel providing four graduations intermediate between adjacent digits on the least significant digit counter wheel permits interpolating to 250 parts per million, or less — fully compatible with the resolution and linearity of the average ten-turn precision potentiometer.

The entire assembly is less than one inch wide and less than two inches high, making it feasible to mount up to 72 controls per square foot of panel space, yet the digital display is comfortably readable at all times. It is not hidden by the operator's hand during adjustment and is equipped with a magnifying window that significantly enlarges the numerals and vernier scale for easy viewing from all positions.

Special Options

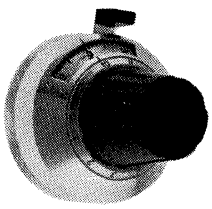
Amphenol, with the broadest and most versatile concentric scale and digital dial lines in the industry, offers you more than standard units. An example is the 1300 and 1330 series digitals which can be modified to give you such special features as index lines, internal illumination and special readouts. Contact your Amphenol area representative for full details on these and other optional features available to solve your design problems.

Microdial® — Trademark Reg. U.S. Patent Office.

MICRODIAL® COUNTING DIALS

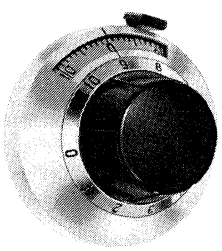
BUNKER RAMO AMPHENOL

Specify AMPHENOL Concentric and Digital Dials for precise potentiometer control



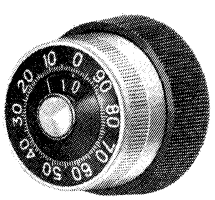
1370 Series, Concentric

Only ⅞" diameter (1" with finger brake), this 10-turn Microdial® projects 2$^{9}/_{32}$" from panel. Don't let the small size of this dial fool you. It has the same silent gear action of the conventional size Amphenol dials. It indicates angular position of potentiometers and multiturn devices of 10 turns and less with 1000:1 indexing accuracy. Inner dial counts turns, outer dial counts hundredths. Locks rigidly onto shaft to eliminate backlash. Epicyclical internal gearing assures readout accuracy. Finger-tip lever offers positive brake action without disturbing critical settings.



1350 Series, Concentric

The 1350, 1$^{13}/_{16}$" diameter, indicates angular position of potentiometers and multiturn devices of ten turns and less with 1000:1 indexing accuracy. Inner dial counts turns, outer dial counts off hundredths. Locks rigidly onto shaft to prevent backlash. Internal gearing is epicyclical type so you always know exact reading. Fingertip brake holds shaft position until reset.

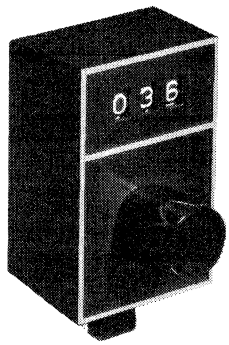


3000 Series, Concentric

Only 1-inch diameter (1$^{5}/_{32}$" with finger brake), this 10-turn Microdial projects 1$^{5}/_{16}$" from your panel. Without brake, array of these units can be mounted on 1¼" centers. And the digits are as large and as easy to read as some dials twice the size.

Clear plastic dial face is sealed and angled to prevent reflections. You can color-key dial functions by choosing from 5 standard brake knob colors and different combinations of numeral and background colors.

Don't let the small size of this Microdial fool you. It has the same silent gear action of the conventional size Amphenol Microdials.

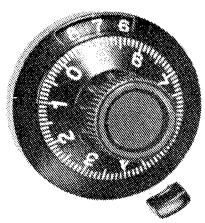


1380 Series

FEATURES . . .

- **Precision digital dial designed for precision potentiometers up to ten turns — yet exceptionally low cost.**
- **Zinc die cast housing and rear cover for demanding applications.**
- **Indexing accuracy is 1 part in 1,000.**
- **Modern styling and small size.**
- **Easy mounting . . . A single set screw mounts dial to potentiometer shaft.**

Amphenol's new 1380 Series miniature digital dial is available in a black finish model 1381 or a fine black-grey hammer finish model 1385. The 1380 accepts a ¼" shaft diameter and modification for a ⅛" shaft diameter is available as a special option. Fingertip brake assures maintenance of critical dial settings. And the 1380 offers you ultra-modern styling to compliment any panel layout.



DFA Series, Concentric

- **1 Part in 1000 Reading Accuracy.**
- **Up to 99 Dials Per Square Foot of Panel Space!**
- **Satin Chrome on Black Finish.**

The DFA is an excellent answer to the need for a precision setting and indicating device for use with multi-turn potentiometers, particularly in control-console and computer applications, where the multiplicity of control elements is a significant factor in the total investment, and panel space is often at a premium.

The dial control knob couples directly to the potentiometer shaft, hence there is no backlash in the control of the actual resistance setting. A single numeral in the window above the knob indicates the number of completed turns of the shaft, and the graduated dial integral with the knob indicates in tenths and hundredths the percent of partial turn of the shaft enabling an accuracy in setting of one part per 1000.

Two standard models are available in this control series: The Model DFA-N with satin chrome finish and Model DFA-NB with white numbers on black finish. They feature constant torque that allows easy adjustment, yet maintain settings under conditions of extreme vibration. Both models include a flip-lock lever that applies 25 inch-ounces of torque against accidental displacement, in the locked position, yet allows high-speed rotation and setting when unlocked. The units are only 1.06 inches wide, with a body height of 1.25 inches (1.63 inches including lock lever) enabling grouping of miniature ten-turn potentiometers in control banks of up to 99 elements per square foot of panel space.

CHICAGO MINIATURE LAMP WORKS

Subminiature Incandescent Lamps

SELECTING A MINIATURE OR SUBMINIATURE INCANDESCENT LAMP.

Your lamp and lighting requirements should receive careful consideration in order to take full advantage of the wide range of miniature and subminiature lamps available from Chicago Miniature. Most of the lamps listed are Industry Standard lamps. Non-standard lamps are identified by a CM7-, or a CM8-, preceding the part number. We recommend the use of Industry Standard lamps whenever possible. If a standard lamp cannot be found in the following listings contact your local Chicago Miniature representative or Chicago Miniature direct.

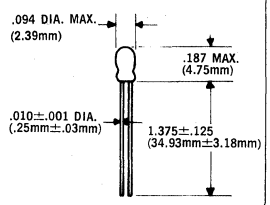
Chicago Miniature has over 4,000 lamps plus the capability of engineering and manufacturing to provide special lamps to meet your specific needs.

DEFINITIONS

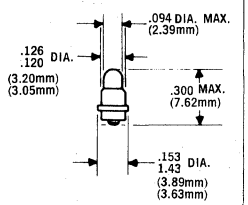
MEAN SPHERICAL CANDLEPOWER (MSCP): A measure of total luminous light output traceable to the National Bureau of Standards.

LUMENS: A measure of light output traceable to the National Bureau of Standards and relatable to MSCP by factor of 4π
(Example: MSCP X 4π = Lumens).

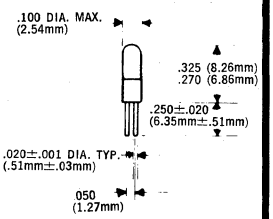
LIFE (HOURS): The rated average life of a lamp in hours. Rated life is determined by testing a group of lamps on constant AC voltage under laboratory conditions at room temperature. DC aging vibration and high ambient temperature (220°F and over) can each affect actual service life.



Wire Terminal



Micro Midget Flanged Base



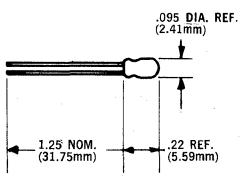
Bi-Pin Base

Wire Terminal	Micro Midget Flanged Base	Bi-Pin Base	DESIGN Volts	DESIGN Amps (±10%)	M.S.C.P.	Life (Hours)	Filament Shape
CM-8712	CM-7120	CM-7110	1.15	.090	.003 NOM.	5,000	C-2R
CM-7100	CM-3810	CM-7810	1.5	.015±20%	.002 NOM.	10,000	C-2R
CM-7101	CM-3811	CM-7811	1.5	.015±20%	.01 NOM.	5,000	C-2R
CM-8534	CM-7121	CM-7111	2.5	.110	.04 NOM.	10,000	C-2R
CM-30	.....	.....	4.5	.021	.017 NOM.	5,000	C-2R
CM-8537	CM-8538	CM-7538	5.0	.015±20%	.02 NOM.	1,000	C-2R
CM-2	CM-7122	CM-7112	5.0	.021	.034	10,000	C-2R
CM-6803	CM-8587	CM-7113	5.0	.060	.03	100,000	C-2R
CM-6833	CM-8913	CM-7114	5.0	.060	.05	100,000	C-2R
CM-6153	CM-6183	CM-7115	5.0	.060	.15	3,000	C-2R
CM-7133	CM-8828	CM-7116	5.0	.075	.09	25,000	C-2R
CM-8666	CM-8383	CM-7117	5.0	.080	.15	15,000	C-2R
CM-7153	CM-8270	CM-7118	5.0	.115	.15	40,000	C-2R
CM-7102	CM-7123	CM-7119	5.0	.115	.20	5,000	C-2R

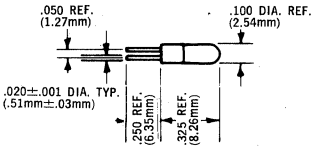
T—3/4 Subminiature Incandescent Lamps

All Chicago Miniature T-3/4 Lamps are aged prior to selection for current (±10%) unless otherwise stated, and candlepower (MSCP). To specify a specific MSCP tolerance add AS (aged and selected) and ±25% or ±15% whichever is applicable. (Example: CM7153AS15%).
Other selection tolerances are available on request.

APPLICABLE MILITARY LAMP DRAWINGS
MS 90452(AS) (6803AS15, 6833AS15, 7133AS15, 7153AS15)



Wire Terminal

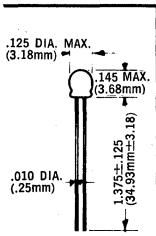


Bi-Pin Base

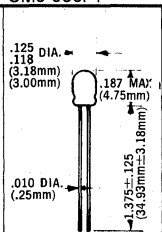
Wire Terminal	Bi-Pin Base	DESIGN Volts	DESIGN Amps	M.S.C.P. (Approx.)	Life (Hours)	Filament Shape
CM8-3982	.....	5.0	.02 NOM.	.015 - .040	10,000	C-2R
CM8-984	CM7-984	5.0	.06 NOM.	.02 - .10	50,000	C-2R
CM8-981	CM7-981	5.0	.06 NOM.	.10 - .20	5,000	C-2R
CM8-988	CM7-988	5.0	.08 NOM.	.10 - .20	3,000	C-2R
CM8-986	CM7-986	5.0	.11 NOM.	.05 - .15	25,000	C-2R
CM8-986F1	CM7-986F1	5.0	.11 NOM.	.10 - .20	15,000	C-2R

T—3/4 ECONO Lamp

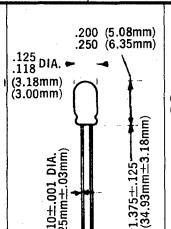
All Chicago Miniature T-3/4 Econo Lamps are aged prior to sample inspection for current and MSCP conformance to applicable specifications. These lamps are manufactured to the same high quality standard as regular T-3/4 Lamps.



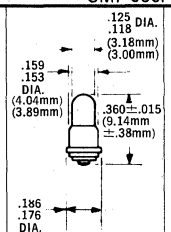
Short Wire Terminal .145 MAX.



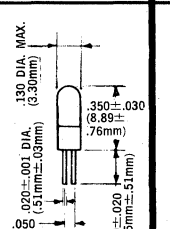
Intermediate Wire Terminal .187 MAX.



Standard Wire Terminal .250 MAX.



Sub-Midget Flanged Base



Bi-Pin Base

Short Wire Terminal .145 MAX.	Intermediate Wire Terminal .187 MAX.	Standard Wire Terminal .250 MAX.	Sub-Midget Flanged Base	Bi-Pin Base	DESIGN Volts	DESIGN Amps (±10%)	M.S.C.P.	Life (Hours)	Filament Shape
.....	.....	CM-8798	CM-7244	CM-7252	1.25	.012±20%	.004 NOM.	1,000	C-6
.....	.....	CM-8910	CM-7245	CM-7253	1.35	.220	.02 NOM.	25,000	C-2R
.....	.....	CM-7203	CM-8102	CM-7255	1.5	.075	.03	16,000	C-2R
.....	.....	CM-8601	CM-7246	CM-7256	2.5	.015±20%	.001 NOM.	10,000	C-2R
.....	.....	CM-8732	CM-7247	CM-7732	2.5	.100	.10	10,000	C-2R
.....	.....	CM-8711	CM-7248	CM-7257	2.5	.320	.21 NOM.	5,000	C-2R
.....	.....	CM-8846	CM-7249	CM-7258	3.0	.008±20%	.001 NOM.	16,000	C-2R
.....	.....	CM-2128	CM-679	CM-7259	3.0	.0125±20%	.001 NOM.	16,000	C-2R
.....	.....	CM-7205	CM-7229	CM-3229	3.0	.015±20%	.02 NOM.	5,000	C-2R

T—1 Subminiature Incandescent Lamps

All Chicago Miniature T-1 Lamps are aged prior to selection for current (±10%) unless otherwise stated, and candlepower (MSCP). To specify a specific MSCP tolerance add AS (aged and selected) and ±25% or ±15% whichever is applicable. (Example: CM715AS15%).

APPLICABLE MILITARY LAMP DRAWINGS
MS 3338 (6839AS25)
MS 24367 (680, 683, 713, 715)
MS 24515 (682, 685, 714, 718)
MS 90451(AS) (6802AS15, 6832AS15, 7132AS15, 7152AS15)

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

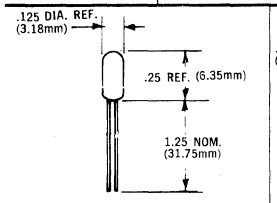
ALL CHICAGO MINIATURE LAMPS MEET OR EXCEED APPLICABLE ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE) INDUSTRY STANDARD REQUIREMENTS
CHICAGO MINIATURE LAMPS LEDS AND LITED DEVICES ARE AVAILABLE THROUGH YOUR LOCAL AUTHORIZED CM STOCKING DISTRIBUTOR OR FACTORY FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

CHICAGO MINIATURE LAMP WORKS

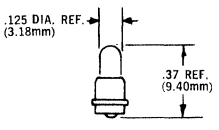
SUBMINIATURE INCANDESCENT LAMPS

T—1 (Cont'd)

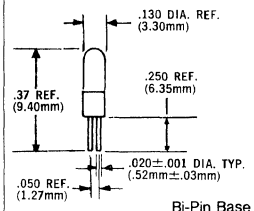
					DESIGN Volts	DESIGN Amps (±10%)	M.S.C.P.	Life (Hours)	Filament Shape
.....	.....	CM-7207	CM-7231	CM-7260	3.0	.060	.03	100,000	C-2R
.....	.....	CM-7208	CM-7232	CM-7261	3.0	.120	.15	16,000	C-2R
.....	.....	CM-8602	CM-8605	CM-7262	5.0	.017±20%	.005 NOM.	10,000	C-2R
CM-2022	CM-3022	CM-6022	CM-8022	CM-7022	5.0	.021	.034 NOM.	10,000	C-2R
.....	.....	CM-7210	CM-7234	CM-7263	5.0	.030	.03	75,000	C-2R
.....	.....	CM-8729	CM-7250	CM-7264	5.0	.045	.04	10,000	C-2R
CM-6802	CM-6801	CM-680	CM-682	CM-7680	5.0	.060	.03	100,000	C-2R
CM-6832	CM-6831	CM-683	CM-685	CM-7683	5.0	.060	.05	100,000	C-2R
CM-6152	CM-6151	CM-6150	CM-6180	CM-7265	5.0	.060	.15	5,000	C-2R
CM-7132	CM-7131	CM-713	CM-714	CM-7714	5.0	.075	.09	25,000	C-2R
CM-6212	CM-6211	CM-7211	CM-7235	CM-7266	5.0	.080	.16	3,000	C-2R
CM-7152	CM-7151	CM-715	CM-718	CM-7715	5.0	.115	.15	40,000	C-2R
CM-7212	CM-3211	CM-7213	CM-7236	CM-7267	5.0	.115	.20	5,000	C-2R
CM-8175	CM-8179	CM-7216	CM-7239	CM-7268	5.0	.125	.22	5,000	C-2R
.....	.....	CM-8096	CM-7251	CM-7269	5.0	.145	.16	10,000	C-2R
.....	.....	CM-7218	CM-7240	CM-8095	10.0	.027	.10	10,000	C-2F
.....	.....	CM-7219	CM-32	CM-8097	12.0	.060	.15	16,000	C-2F
.....	.....	CM-8111	CM-8112	CM-8098	14.0	.065	.15	16,000	C-2F
.....	.....	CM-7220	CM-7241	CM-8099	18.0	.026	.15	16,000	C-2F
.....	.....	CM-6838	CM-6839	CM-7839	28.0	.024	.15	16,000	CC-2F



Wire Terminal



Sub-Midget Flanged Base

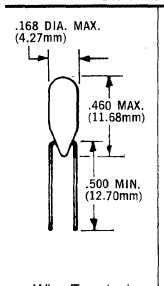


Bi-Pin Base

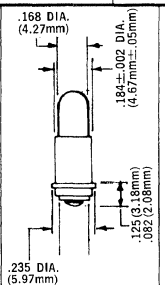
T—1 ECONO Lamp

All Chicago Miniature T-1 Econo Lamps are aged prior to sample inspection for current and MSCP conformance to applicable specifications. These lamps are manufactured to the same high quality standards as regular T-1 Lamps.

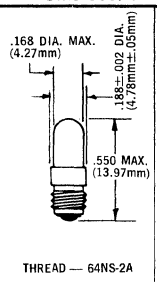
			DESIGN Volts	DESIGN Amps	M.S.C.P. (Approx.)	Life (Hours)	Filament Shape
CM8-880	CM8-882	CM7-880	5.0	.06 NOM.	.02 - .05	50,000	C-2R
CM8-883	CM8-884	CM7-883	5.0	.06 NOM.	.05 - .09	50,000	C-2R
CM8-889	CM8-886	CM7-889	5.0	.06 NOM.	.10 - .20	5,000	C-2R
CM8-885	CM8-888	CM7-885	5.0	.11 NOM.	.05 - .15	25,000	C-2R
CM8-885F1	CM8-888F1	CM7-885F1	5.0	.11 NOM.	.15 - .25	15,000	C-2R



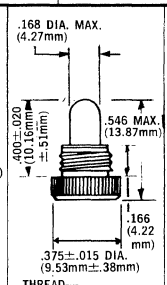
Wire Terminal



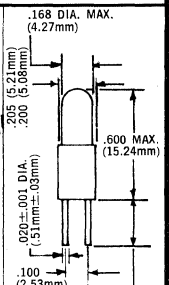
Special Midget Flanged Base



Special Screw Base



Knurled Screw Base



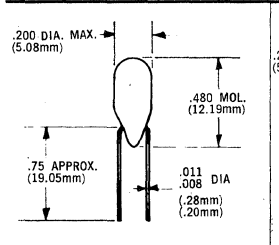
Bi-Pin Base

T—1-1/4 Subminiature Incandescent Lamps

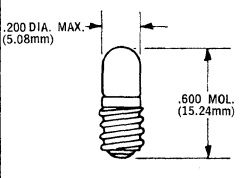
All Chicago Miniature T-1 1/4 Lamps are inspected for current and light up. To specify a specific tolerance add AS (aged and selected) and ±25% or ±15%, whichever is applicable. (Example: CM2114AS25%).
Other selection tolerances are available on request.

APPLICABLE MILITARY LAMP DRAWINGS
MS 25236 (323AS25, 8623AS25, 8639AS25)
MS 28135 (8627A525)
MS 51608 (325, 329, 673, 8605, 8641, 8644, 8662)

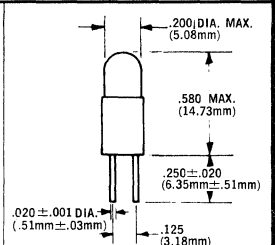
					DESIGN Volts	DESIGN Amps	M.S.C.P. (Approx.)	Life (Hours)	Filament Shape
CM-2135	CM-7302	CM-7303	CM-7301	CM-7306	1.3	.03	.006 NOM.	100	S-2
CM-8631	CM-8636	CM-8641	CM-8647	CM-7636	1.35	.06	.006 NOM.	500	SC-2R
CM-8655	CM-8656	CM-329	CM-326	CM-7307	2.5	.40	.55	30	C-2R
CM-324	CM-8637	CM-325	CM-323	CM-7637	3.0	.19	.25	350	C-2R
CM-8816	CM-7305	CM-673	CM-7304	CM-7308	4.5	.285	1.05	100	C-2R
CM-580	CM-3582	CM-3580	CM-3581	CM-7580	5.0	.06	.03	100,000	C-2R
CM-583	CM-3585	CM-3583	CM-3584	CM-7583	5.0	.06	.05	100,000	C-2R
CM-515	CM-3518	CM-3515	CM-3516	CM-7515	5.0	.115	.15	40,000	C-2R
CM-8661	CM-8660	CM-8662	CM-8657	CM-7660	6.0	.04	.03	1,000	C-2V
CM-2114	CM-8541	CM-371	CM-8543	CM-7309	6.0	.06	.13	3,000	C-2R
CM-634	CM-8628	CM-8645	CM-8639	CM-7628	6.0	.20	.63	1,000	C-2R
CM-8610	CM-8551	CM-8552	CM-8553	CM-7310	6.3	.20	.55	5,000	C-2R
CM-8608	CM-8609	CM-8606	CM-8607	CM-7311	10.0	.014	.004 NOM.	10,000	C-2F
CM-8640	CM-8646	CM-8644	CM-8654	CM-7646	14.0	.08	.50	1,000	C-2F
CM-8627	CM-8632	CM-8635	CM-8623	CM-7632	28.0	.04	.32	1,000	C-2F



Wire Terminal



Midget Screw Base



Bi-Pin Base

T—1-1/2 Subminiature Incandescent Lamps

All Chicago Miniature T-1 1/2 Lamps are inspected for current and light up. To specify a specific MSCP tolerance add AS (aged and selected) and ±25% or ± 15%, whichever is applicable (Example: CM8-192AS25%).
Other selection tolerances are available on request.

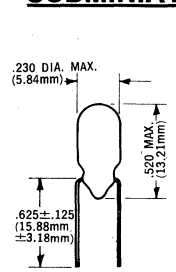
			DESIGN Volts	DESIGN Amps	M.S.C.P. (Approx.)	Life (Hours)	Filament Shape
CM8-190	CM8-189	CM7-3922	2.5	.20	.10	500	C-2R
CM8-192	CM8-191	CM7-3923	6.0	.20	.75	350	C-2R
CM8-194	CM8-193	CM7-3924	28.0	.04	.34	1,000	C-2F

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

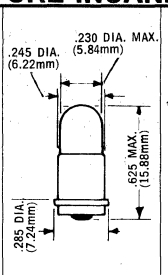
ALL CHICAGO MINIATURE LAMPS MEET OR EXCEED APPLICABLE ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE) INDUSTRY STANDARD REQUIREMENTS
CHICAGO MINIATURE LAMPS LEDS AND LITED DEVICES ARE AVAILABLE THROUGH YOUR LOCAL AUTHORIZED CM STOCKING DISTRIBUTOR OR FACTORY
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

CHICAGO MINIATURE LAMP WORKS

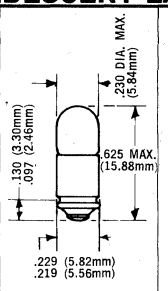
SUBMINIATURE INCANDESCENT LAMPS



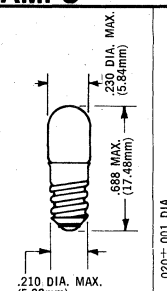
Wire Terminal



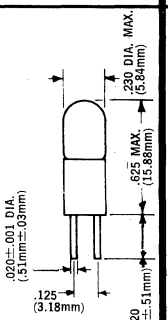
Midget Flanged Base



Midget Grooved Base



Midget Screw Base



Bi-Pin Base

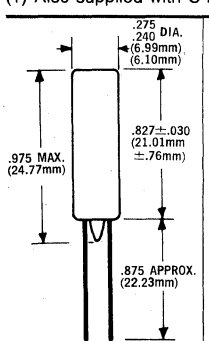
T—1-3/4 Subminiature Incandescent Lamps

All Chicago Miniature T-1 3/4 Lamps are inspected for current and light up. To specify a specific MSCP tolerance add AS (aged and selected) and ±25% or ± 15%, whichever is applicable. (Example: CM380AS25%). Other selection tolerances are available on request.

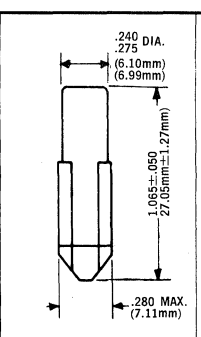
APPLICABLE MILITARY LAMP DRAWINGS
MS 15612 (335, 342, 1767, 1768, 1769)
MS 18209 (387AS25)
MS 25237 (327, 328, 330, 338, 368)

Wire Terminal	Midget Flanged Base	Midget Grooved Base	Midget Screw Base	Bi-Pin Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
CM-1728	CM-331	CM-698	.....	CM-7931	1.35	.06	.01 NOM.	500	C-2R
CM-1783	CM-368	CM-8699	CM-1769	CM-7968	2.5	.20	.22	500	C-2R
CM-2169	CM-268	CM-266	.....	CM-7868	2.5	.35	.21	10,000	C-2R
CM-8663	CM-343	CM-8703	.....	CM-7357	2.5	.40	.55	30	C-2R
CM-1738	CM-338	CM-8704	.....	CM-7838	2.7	.06	.04	6,000	C-2R
CM-2158	CM-375	CM-390	.....	CM-7375	3.0	.015±20%	.003 - .006 NOM.	10,000	C-6
CM-2156	CM-7329	CM-7343	.....	CM-7358	3.0	.03	.02 NOM.	1,800	C-6
CM8-8847	CM8-8848	CM8-8849	.....	CM7-7847	3.0	.35	.30	10,000	C-2R
CM-2171	CM-7331	CM-7345	.....	CM-7359	4.5	.120	.05	25,000	C-2V
CM-3950	CM-8950	CM-6950	.....	CM-7950	5.0	.017±20%	.018 NOM.	8,000	C-2R
CM-8805	CM-7332	CM-7346	.....	CM-7360	5.0	.06	.03	100,000	C-2R
CM-2200	CM-7333	CM-7347	.....	CM-7361	5.0	.06	.05	100,000	C-2R
CM-3151	CM-3150	CM-3152	.....	CM-3149	5.0	.06	.15	5,000	C-2R
CM-2203	CM-7335	CM-7348	.....	CM-7362	5.0	.115	.15	40,000	C-2R
CM-8784	CM-7334	CM-7350	.....	CM-7363	5.0	.19	.45	1,000	C-2R
CM-1730	CM-345	CM-8705	CM-342	CM-7945	6.0	.04	.03	10,000	C-2V
CM-8664	CM-7336	CM-8706	.....	CM-7364	6.0	.20	.10	50,000	C-2F
CM-1784	CM-328	CM-337	CM-1768	CM-7328	6.0	.20	.60	1,000	C-2R
CM-2180	CM-380	CM-7351	.....	CM-7380	6.3	.04	.02 NOM.	50,000	C-2V
CM-1739	CM-377	CM-8708	CM-1775	CM-7377	6.3	.075	.22	500	C-2R
CM-8350	CM-350	CM-7352	.....	CM-7368	6.3	.15	.45	3,000	C-2R
CM-2181 (1)	CM-381 (1)	CM-379 (1)	CM-378 (1)	CM-7381 (1)	6.3	.20	.40	50,000	C-2F
CM-2112	CM-349	CM-398	.....	CM-7349	6.3	.20	.55	3,000	C-2R
CM-1869	CM-344	CM-709	.....	CM-7344	10.0	.014	.002 NOM.	10,000	C-2F
CM-2107	CM-367	CM-397	.....	CM-7367	10.0	.04	.08	5,000	C-2F
CM-8946	CM-7338	CM-7353	.....	CM-7369	11.0	.022	.03	10,000	C-2F
CM-2174	CM-394	CM-7354	.....	CM-7371	12.0	.04	.12	10,000	C-2F
CM-2182	CM-382	CM-386	CM-8362	CM-7382	14.0	.08	.30	50,000	C-2F
CM-1705	CM-330	CM-336	CM-373	CM-7330	14.0	.08	.50	750	C-2F
CM-2162	CM-8918	CM-393	.....	CM-7373	14.0	.100 NOM.	.50	10,000	C-2F
CM-2102	CM-370	CM-346	.....	CM-7370	18.0	.04+10% - 20%	.15	10,000	C-2F
CM-8425	CM-459	CM-457	.....	CM-7459	22.0	.04	.30	2,000	C-2F
CM-2176	CM-8176	CM-8177	.....	CM-7001	24.0	.05	.50	1,000	C-2F
CM-2185	CM-385	CM-7355	.....	CM-7374	28.0	.04	.20	50,000	C-2F
CM-2187	CM-387	CM-388	CM-399	CM-7387	28.0	.04	.30	25,000	C-2F
CM-1764	CM-327	CM-334	CM-335	CM-7327	28.0	.04	.34	7,000	C-2F
CM-1764LSV	CM-376	CM-334LSV	CM-335LSV	CM-7876	28.0	.06	.34	25,000	C-2F
CM-8361	CM-7341	CM-7356	.....	CM-7376	28.0	.065	.65	5,000	C-2F
CM8-6748	CM8-6848	.....	.....	CM7-7748	48.0	.025	.20	5,000	CC-2F

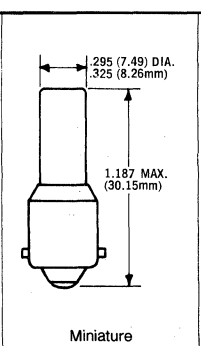
(1) Also supplied with C-2R filament



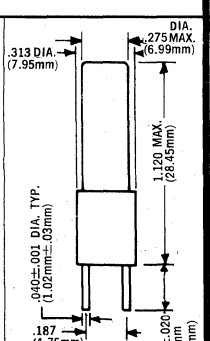
Wire Terminal



Slide Base



Miniature Bayonet Base



Bi-Pin Base

T-2 Subminiature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

Slide Base	Miniature Bayonet Base	Bi-Pin Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Average End-Foot Candles	Life (Hours)	Filament Shape
6 PSB	6 MB	6 BP	6.0	.140	.12	800	20,000	C-2F
12 PSB	12 MB	12 BP	12.0	.170	.48	2400	12,000	C-2F
24 PSB	24 MB	24 BP	24.0	.073	.85	2200	10,000	C-2F
28 PSB	28 MB	28 BP	28.0	.040	.17	1900	5,000	C-2F
48 PSB	48 MB	48 BP	48.0	.053	.52	1500	10,000	C-7A
60 PSB	60 MB	60 BP	60.0	.050	.67	2400	7,500	C-7A
120 PSB	120 MB/CM8-967	120 BP	120.0	.025	.36	1600	10,000	CC-7A

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

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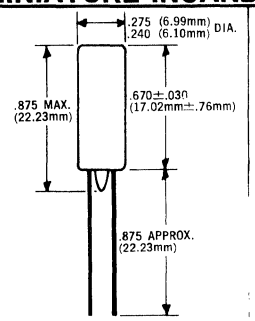
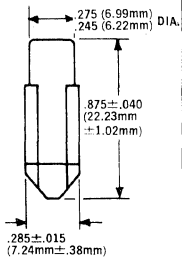
CHICAGO MINIATURE LAMP WORKS

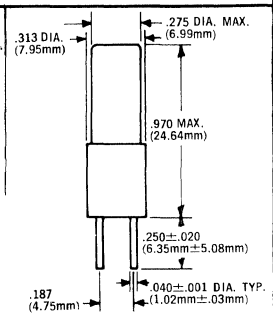
MINIATURE INCANDESCENT LAMPS



Wire Terminal



Slide Base

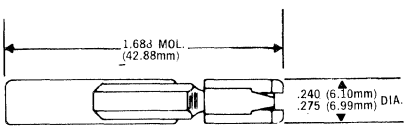


Bi-Pin Base

T—2 Subminiature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

Wire Terminal	Slide Base	Bi-Pin Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Average End-Foot Candles	Life (Hours)	Filament Shape
4 ES	4 ESB	4 EBP	4.0	.040	.03	200	10,000	C-6
5 ES	5 ESB	5 EBP	5.0	.040	.04	225	8,000	C-6
6 ES	6 ESB	6 EBP	6.0	.040	.03	250	15,000	C-2F
10 AS	10 ASB	10 ABP	10.0	.010	red glow	red glow	50,000	C-2F
10 CS	10 CSB	10 CBP	10.0	.017	.01	100	20,000	C-2V
10 ES	10 ESB	10 EBP	10.0	.040	.07	450	15,000	C-2V
12 ES	12 ESB	12 EBP	12.0	.040	.09	650	15,000	C-2V
16 CS	16 CSB	16 CBP	16.0	.017	.02	150	15,000	C-2V
16 ES	16 ESB	16 EBP	16.0	.040	.17	900	7,500	C-2F
18 ES	18 ESB	18 EBP	18.0	.040	.14	1,000	10,000	C-2F
24 CS	24 CSB	24 CBP	24.0	.017	.02	200	15,000	C-2F
24 ES	24 ESB	24 EBP	24.0	.040	.12	1,100	8,000	C-2F
28 ES	28 ESB	28 EBP	28.0	.040	.25	1,285	6,000	C-2F
48 ES	48 ESB	48 EBP	48.0	.040	.44	2,000	5,000	CC-2F

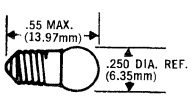


T—2 Telephone Slide Base

T—2 Subminiature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

DESIGN Volts	DESIGN Amps	Average End-Foot Candles	Life (Hours)	Filament Shape
4A	4.0	.190	450	5,000	C-2
6A	6.0	.140	510	15,000	C-2V
6B	6.0	.290	270	15,000	C-2
6C	6.0	.040	180	4,000	C-2
8A	8.0	.090	600	1,000	C-2
10A	10.0	.110	600	10,000	C-2V
10B	10.0	.250	900	1,000	C-2V
12A	12.0	.100	1200	12,000	C-2V
12B	12.0	.035	650	2,000	C-6
12C	12.0	.170	1500	5,000	C-2V
16A	16.0	.100	720	5,000	C-2V
16B	16.0	.290	840	1,000	C-7A
18A	18.0	.040	800	1,000	C-2F
18B	18.0	.100	600	1,000	C-2V
20C	20.0	.034	—	1,000	C-2V
24A	24.0	.030	600	1,000	C-2V
24B	24.0	.040	1000	4,000	C-2F
24C	24.0	.072	1400	6,000	C-2V
24D	24.0	.100	1500	8,000	C-7A
24E	24.0	.035	600	8,000	C-2F
24F	24.0	.090	1120	7,000	C-2F
24X	24.0	.035	600	8,000	C-2F
30A	30.0	.072	2000	3,000	C-7A
30B	30.0	.100	3000	4,000	C-7A
35A	35.0	.040	1000	7,500	C-2F
35B	35.0	.072	700	5,000	C-7A
35C	35.0	.100	750*	5,000	C-7A
40B	40.0	.040	—	1,000	C-7A
44A	44.0	.072	1250*	1,000	C-7A
48A	48.0	.072	2000*	5,000	C-7A
48B	48.0	.100	2200*	5,000	C-7A
48C	48.0	.035	475*	10,000	C-7A
48D	48.0	.021	100*	20,000	C-7A
48H	48.0	.045	1000*	5,000	C-7A
55B	55.0	.100	1800*	5,000	C-7A
55C	55.0	.052	1400*	5,000	C-7A
60A	60.0	.050	1600*	5,000	C-7A



G-2 Midget Screw

G—2 Subminiature Incandescent Lamps

Industry Standard (ANSI) tolerances apply

DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
CM8-162	7.0	.063	.085	3,000	C-2V
CM8-163	14.0	.065	.066	3,000	C-2F

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

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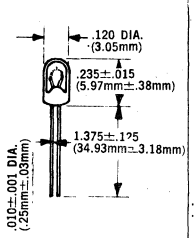
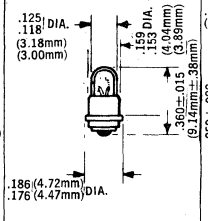
CHICAGO MINIATURE LAMP WORKS

Helium Retardant Lamps



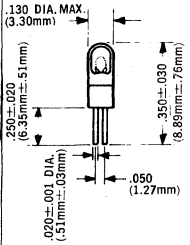
T—1 Wire Terminal

CM-6806
CM-6807
CM-6808
CM-6809



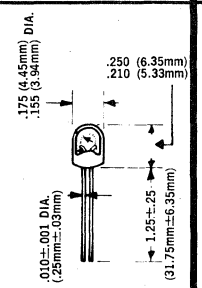
T—1 Sub-Midget Flanged Base

CM-930
CM-931
CM-933
CM-932



T—1 Bi-Pin Base

CM7-7270
CM7-7271
CM7-7272
CM7-7274



T—1-1/4 Wire Terminal

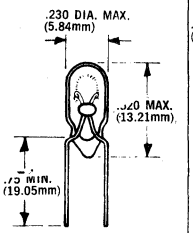
CM-1189
CM-1190
CM-1191
CM-8515

T—1 & T—1-1/4 Helium Retardant Lamps

These lamps are intended for use in Helium filled aircraft instruments where optimum resistance to Helium permiation and associated lamp darkening is required. To specify a specific MSCP tolerance add AS (aged and selected) and ± 25% or ±15%, whichever is applicable. (Example: 6809AS15%).
(All Chicago Miniature T-1 and T-1¼ Helium Retardant Lamps are aged prior to current (±10%) and candlepower (MSCP).).
All Chicago Miniature T-1 1/4 Helium Retardant Lamps are inspected for current and light up.
Other selection tolerances are available on request.

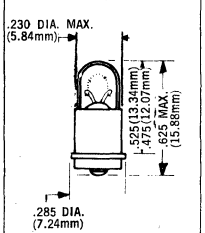
APPLICABLE MILITARY LAMP DRAWINGS
T—1: MS 27571 (6806AS15, 6807AS15, 6808AS15, 6809AS15)
T—1-1/4:MS 27570 (1189AS15, 1190AS15, 1191AS15, 8515AS15)

DESIGN		M.S.C.P.	Life	Filament
Volts	Amps (±10%)		(Hours)	Shape
5.0	.060	.03	60,000	C-2R
5.0	.060	.05	40,000	C-2R
5.0	.075	.09	16,000	C-2R
5.0	.115	.15	16,000	C-2R



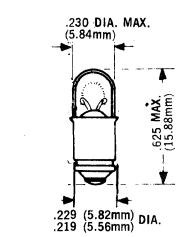
Wire Terminal

CM8-1428



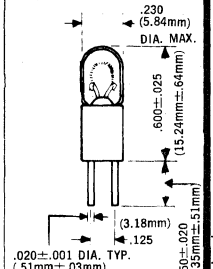
Midget Flanged Base

CM-339



Midget Grooved Base

CM-341



Bi-Pin Base

CM7-7366

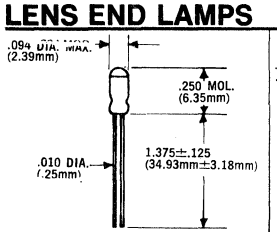
T—1-3/4 Helium Retardant Lamps

These lamps are intended for use in Helium filled aircraft instruments where optimum resistance to Helium permiation and associated lamp darkening is required. All Chicago Miniature T-1 3/4 Helium Retardant Lamps are aged prior to selection for current (±10%) and candlepower (MSCP.) To specify a specific MSCP tolerance add AS (aged and selected) and ±25% or ±15%, whichever is applicable. (Example: CM339AS15%).
Other selection tolerances are available on request.

APPLICABLE MILITARY LAMP DRAWINGS
MS 27569 (339AS15, 341AS15)

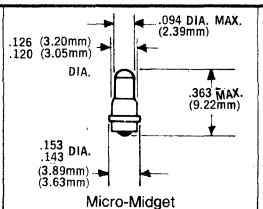
DESIGN		M.S.C.P.	Life	Filament
Volts	Amps (±10%)		(Hours)	Shape
5.0	.200	.34	15,000	C-2R

LENS END LAMPS



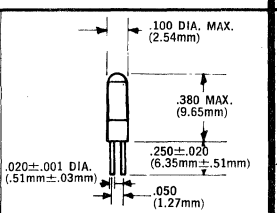
Wire Terminal

CM-1212
CM-1425



Micro-Midget Flanged Base

CM-3910
CM-3909



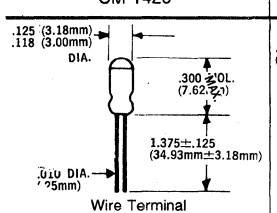
Bi-Pin Base

CM-7910
CM-7909

TL—3/4 Lens-end Lamps

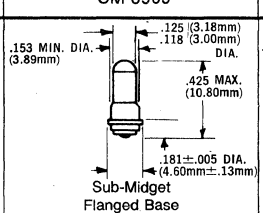
Almost any Chicago Miniature lamp can be ordered with a lens, and if required, controlled to a specific spot characteristic.
All Chicago Miniature TL-3/4 Lens-end Lamps are aged prior to current (±10%) selection.
Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.

DESIGN		Life	Filament Shape
Volts	Amps	(Hours)	
5.0	.060	100,000	C-2R
5.0	.115	40,000	C-2R



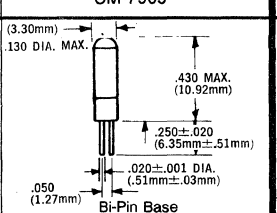
Wire Terminal

CM-1284
CM-1283
CM-1413
CM-1415



Sub-Midget Flanged Base

CM8-1285
CM-3905
CM-3906
CM8-1418



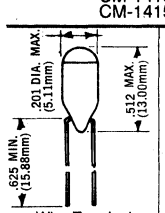
Bi-Pin Base

CM-7908
CM-7905
CM-7906
CM-7907

TL—1 Lens-end Lamps

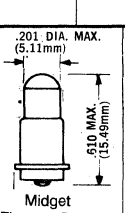
All Chicago Miniature TL-1 Lens-end Lamps are aged prior to current (±10%) selection.
Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.

DESIGN		Life	Filament Shape
Volts	Amps	(Hours)	
1.5	.075	16,000	C-2R
5.0	.060	100,000	C-2R
5.0	.075	16,000	C-2R
5.0	.115	40,000	C-2R



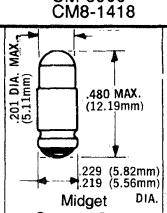
Wire Terminal

CM8-454
CM8-468
CM8-363



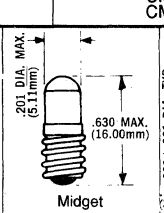
Midget Flanged Base

CM8-455
CM8-469
CM8-904



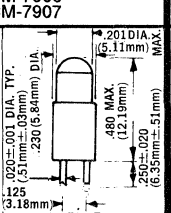
Midget Grooved Base

CM8-3920
CM8-3921
CM8-3919



Midget Screw Base

CM8-358
CM8-359
CM8-364



Bi-Pin Base

CM-3920
CM-3921
CM-3919

TL—1-1/2 Lens-end Lamps

Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.

DESIGN		Life	Filament Shape
Volts	Amps	(Hours)	
2.5	.200	500	C-2R
6.0	.200	500	C-2R
28.0	.040	1,000	C-2F

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

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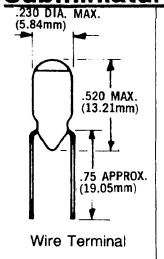
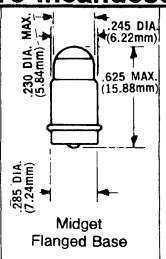
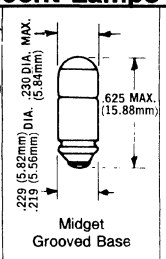
Subminiature Incandescent Lamps



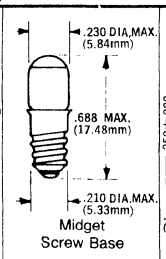
Wire Terminal



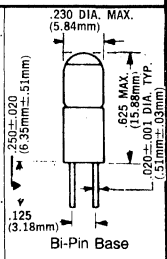
Midget Flanged Base



Midget Grooved Base



Midget Screw Base

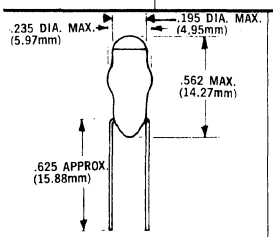


Bi-Pin Base

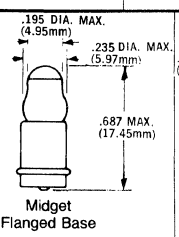
Wire Terminal	Midget Flanged Base	Midget Grooved Base	Midget Screw Base	Bi-Pin Base	Volts	Amps	Life (Hours)	Filament Shape	Spot Characteristics
CM8-374	CM8-3374	CM8-373	CM-8299	CM-761	2.5	.350	10,000	C-2R	C
CM8-8426	CM8-443	CM-3901	CM8-3426	CM-7426	5.0	.220	10,000	C-2R	C
CM-8281	CM-3903	CM-3904	CM-3902	CM-7903	14.0	.080	1,000	C-2F	**

TL—1-3/4 Lens-end Lamps

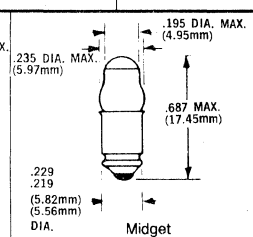
Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.



Wire Terminal



Midget Flanged Base

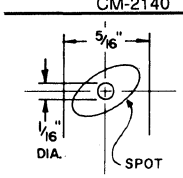


Midget Grooved Base

Wire Terminal	Midget Flanged Base	Midget Grooved Base	Volts	Amps	Life (Hours)	Filament Shape	Spot Characteristics
.....	CM-252	CM-253	2.5	.350	10,000	C-2R	A
.....	.....	CM-253X					B
.....	.....	CM-261					C
CM-2136	.....	.....					D
CM-2124	.....	CM8-3946					**
CM-2140	.....	.....					**

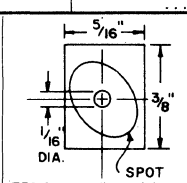
GTL—1-3/4 Lens-end Lamps

Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.



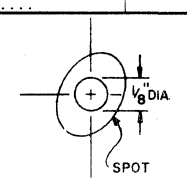
750 footcandles minimum over a 1/16" dia. circle centered on axis of lamp.

A



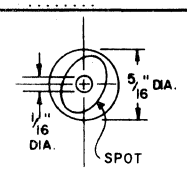
750 footcandles minimum over a 1/16" dia. circle centered on axis of lamp.

B



750 footcandles minimum over a 1/8" dia. circle centerd on axis of lamp.

C



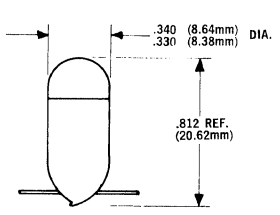
750 footcandles minimum over a 1/16" dia. circle centered on axis of lamp.

D

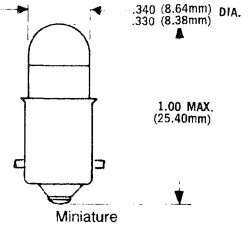
SPOT CHARACTERISTICS

Spots produced by lens-end lamps vary in shape from elliptical to round. Lamps supplied with specific spot characteristics are defined in the following manner and noted above:

1. With the lamp .375" from tip to surface, the spot shape is defined within the limits shown. The filament positioned in the vertical plane and the solder spot (grooved base) should be within 25° from the vertical axis. The spot must completely cover the specified diameter circle.
2. Within the specified diameter circle a minimum of 750 foot candles must be maintained when operating at 2.5 volts and at a distance of .375".



Wire Terminal



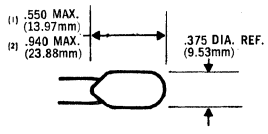
Miniature Bayonet Base

Wire Terminal	Miniature Bayonet Base	Volts	Amps	Life (Hours)	Filament Shape
CM8-306	CM8-503	6.3	.350	250	C-2R

TL—2-3/4 Lens-end Lamps

Most Chicago Miniature Lamps can be ordered with a condensing lens to your specific spot specification requirements.

MINIATURE INCANDESCENT LAMPS



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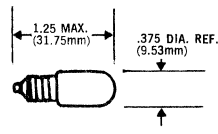

Miniature Screw Base

Wire Terminal	Miniature Screw Base	Volts	Amps	M.S.C.P.	Life (Hours)	Filament Shape
(1) CM8-755	.....	10.0	.45 NOM.	6.0 NOM.	50	C-2R
(2) CM8-240	.....	10.0	1.02	7.60 NOM.	10	C-2V
.....	CM-1474	14.0	.17	1.7	250	C-2V
.....	CM-1476	18.0	.17	2.2	250	C-2V
.....	CM-1477	24.0	.17	3.3	250	C-2V
.....	CM-1796	30.0	.17		250	C-2V

T—3 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

** LENS END LAMPS OF THIS TYPE HAVE NO SPOT CHARACTERISTICS.

- Chicago Miniature Lamps have tinned leads for ease of soldering
- Chicago Miniature Lamps are manufactured to MIL-L-6363D
- Chicago Miniature Bi-Pin Lamps have gold plated nickel pins
- All dimensions are in inches, metric size in parentheses

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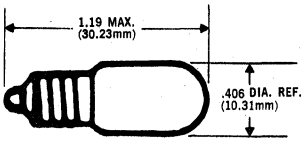
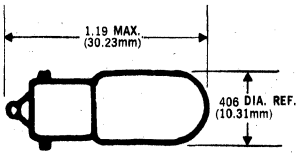
MINIATURE INCANDESCENT LAMPS



Miniature Screw Base



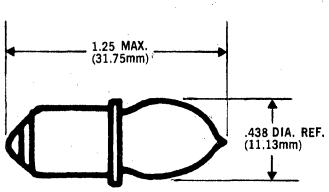
Miniature Bayonet Base

T—3-1/4 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

Miniature Screw Base	Miniature Bayonet Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
CM-1800	.....	1.35	.06	.009	500	S-2
.....	CM-1809	2.0	.06	.02	1,000	C-6
CM-48	CM-49	2.0	.06	.04	1,000	S-2
CM-41	CM-43	2.5	.50	.50	3,000	C-2R
.....	CM-1490	3.2	.16	.20	3,000	C-2R
CM-42	CM-45	3.2	.35	.50	3,000	C-2R
.....	CM-1804	4.0	.06	.07	1,000	S-2
.....	CM-1850	5.0	.09	.25	1,500	C-2R
CM8-30	.....	6.0	.45	1.40	1,000	C-6
.....	CM-316	6.0	.70	3.4	500	C-2R
.....	CM-1830*	6.3	.15	—	3,000	C-2R
.....	CM-755	6.3	.15	.33	50,000	C-2R
.....	CM-1847	6.3	.15	.38	20,000	C-2R
CM-40	CM-47	6.3	.15	.52	3,000	C-2R
CM-46	CM-1866	6.3	.25	.65	20,000	C-2R
.....	CM-44	6.3	.25	.9	3,000	C-2R
.....	CM-240	6.3	.36	.67	5,000	C-2R
.....	CM-239	6.3	.36	.67	5,000	C-2R
.....	CM-1810	6.3	.40	1.5	3,000	C-2R
.....	CM-1811	6.5	.40	1.7	1,000	C-2R
.....	CM-1888	7.0	.50	2.0	3,000	C-2R
.....	CM-1816	13.0	.33	3.0	1,000	C-2V
.....	CM-756	14.0	.08	.31	50,000	C-2F
.....	CM-1488	14.0	.15	1.5	200	C-2V
CM-1487	CM-1815	14.0	.20	1.4	3,000	C-2V
.....	CM-1891	14.0	.24	2.0	500	C-2F
.....	CM-1889	14.0	.27	2.0	1,500	C-2F
.....	CM-1893	14.0	.33	2.0	3,000	C-2F
.....	CM-1813	14.4	.10	.86	1,000	C-2V
.....	CM-1892	14.4	.12	.75	1,000	C-2F
.....	CM-1881	15.5	.24	2.2	500	C-2F
.....	CM-1826	18.0	.15	1.8	250	C-2V
.....	CM-1818	24.0	.17	3.3	250	C-2V
.....	CM-1819	28.0	.04	.34	1,000	C-2F
.....	CM-1829	28.0	.07	1.0	1,000	C-2F
.....	CM-1820	28.0	.10	1.6	1,000	C-2F
.....	CM-1864	28.0	.17	3.0	1,500	C-2F
CM-1821	CM-313	28.0	.17	3.5	500	C-2F
.....	CM-1822	36.0	.10	2.5	1,000	C-2V
CM-1832	CM-1828	37.5	.05	.65	3,000	C-2F
CM-1823	.....	48.0	.10	3.3	1,000	C-2V
.....	CM-1835	55.0	.05	1.1	5,000	C-5

* TOP OF LAMP PAINTED BLACK



Single Contact Miniature Flange Base
(Flashlite Prefocus)

B—3-1/2 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
PR-4	2.33	.27	.40	10	C-2R
PR-5	2.35	.35	.45	35	C-2R
PR-2	2.38	.50	.80	15	C-2R
PR-6	2.47	.30	.45	30	C-2R
PR-9	2.70	.15	.25	45	C-2R
PR-3	3.57	.50	1.50	15	C-2R
PR-7	3.70	.30	.90	30	C-2R
PR-13	4.75	.50	2.20	15	C-2R
PR-15	4.82	.50	1.90	30	C-2R
PR-12	5.95	.50	3.10	15	C-2R
PR-18	7.20	.55	5.50	5	C-2R
PR-20	8.63	.50	4.50	15	C-2R
PR-16	12.50	.25	2.70	50	C-2R

• Chicago Miniature Lamps are manufactured to MIL-L-6363D

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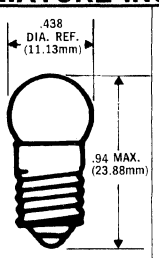
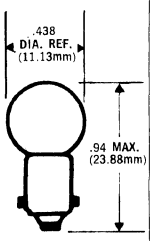
CHICAGO MINIATURE LAMP WORKS

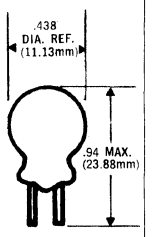
MINIATURE INCANDESCENT LAMPS



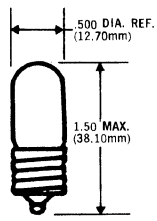
G—3-1/2
Miniature
Screw Base



G—3-1/2
Miniature
Bayonet Base



G—3-1/2
Miniature
2-Pin Base

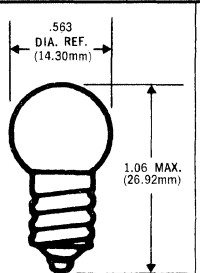


T—4
Candelabra
Screw Base

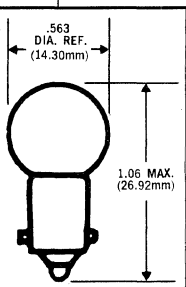
G—3-1/2 Miniature Screw Base	G—3-1/2 Miniature Bayonet Base	G—3-1/2 Miniature 2-Pin Base	T—4 Candelabra Screw Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
CM-123	.....	.....	.....	1.25	.30	.10	10	S-2
CM-131	.....	.....	.....	1.3	.10	.03	50	S-2
CM-359	.....	.....	.....	1.35	.06	.02	50	S-2
CM-352	.....	.....	.....	2.0	.06	.03	2,000	S-2
.....	.....	CM-10	.....	2.5	.50	.50	3,000	C-6
CM-233	.....	.....	.....	2.33	.27	.42	10	C-2R
CM-245	.....	.....	.....	2.46	.50	.90	15	C-2R
CM-14	CM-354	.....	.....	2.47	.30	.50	15	C-2R
CM-365	.....	.....	.....	3.69	.50	1.6	15	C-2R
CM-13	.....	.....	.....	3.7	.30	.98	15	C-2R
CM-1438	.....	.....	.....	3.8	.43	1.6	1	C-2R
CM-403	.....	.....	.....	4.0	.30	1.0	30	C-2R
.....	.....	CM-12	.....	6.3	.15	.35	L	C-6
.....	CM-130	.....	.....	6.3	.15	.38	3,000	C-2R
.....	CM-137	.....	.....	6.3	.25	—	L	C-2R
.....	CM-219	.....	.....	6.3	.25	.50	L	C-2V
CM-50	CM-51	.....	.....	7.5	.22	1.0	1,000	C-2R
CM-1446	.....	.....	.....	12.0	.20	1.7	250	C-2V
.....	.....	.....	CM-1479	14.0	.17	1.7	250	C-2V
CM-1449	CM-363	.....	.....	14.0	.20	2.0	250	C-2V
CM-52	.....	.....	.....	14.4	.10	.75	1,000	C-2V
.....	.....	CM-19	.....	14.4	.10	.9	1,000	C-2R
.....	CM-53	.....	.....	14.4	.12	1.0	1,000	C-2V
.....	CM-53X	.....	.....	14.4	.12	1.0	L	C-2V
CM-1447	CM-1445	.....	.....	18.0	.15	1.5	250	C-2V
.....	.....	.....	CM-1480	18.0	.17	2.2	250	C-2V
CM-1448	.....	.....	.....	24.0	.035	.23	3,000	C-2V
.....	.....	.....	CM-1841	24.0	.17	3.3	250	C-2V
.....	CM-356	.....	.....	28.0	.17	3.5	500	C-2V

G—3-1/2 & T—4 Miniature Incandescent Lamps

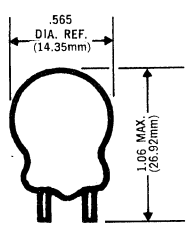
Industry Standard (ANSI) tolerances apply.



Miniature
Screw Base



Miniature
Bayonet Base



Miniature
2-Pin Base

Miniature Screw Base	Miniature Bayonet Base	Miniature 2-Pin Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
CM-136	CM-423	.....	1.25	.60	.20	75	S-2
CM-27	.....	.....	4.9	.30	1.4	30	C-2R
CM-407*	CM-408*	.....	4.9	.30	1.2	50	C-2R
CM-425	.....	.....	5.0	.50	2.3	15	C-2R
CM-502	CM-503	.....	5.1	.15	.60	100	C-2R
CM-1483	.....	.....	6.0	.04	.10	500	C-6
CM-1482	.....	.....	6.0	.45	2.2	100	C-2R
.....	CM-455	.....	6.5	.50	1.9	500	C-2R
CM-31	.....	.....	6.15	.30	2.0	15	C-2R
CM-605	.....	.....	6.15	.50	3.4	15	C-2R
.....	.....	CM-15	7.0	.40	2.0	500	C-6
.....	CM-55	.....	7.0	.41	2.0	500	C-2R
CM-426	.....	.....	8.0	.25	1.6	250	C-2R
CM-428	.....	.....	12.5	.25	2.4	250	C-2V
.....	CM-57	.....	14.0	.24	2.0	500	C-2V
.....	CM-57X	.....	14.0	.24	2.0	500	C-2F
.....	CM-431	.....	14.0	.25	2.7	250	C-2V
CM-258*	CM-257	.....	14.0	.27	1.6	500	C-2R
.....	CM-1895	.....	14.0	.27	2.0	1,500	C-2F
CM-432	CM-433	.....	18.0	.25	3.5	250	C-2V

*FLASHER LAMPS

G—4-1/2 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

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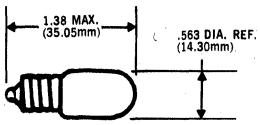
CHICAGO MINIATURE LAMP WORKS

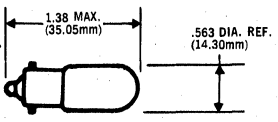
MINIATURE INCANDESCENT LAMPS

T—4-1/2 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.



Miniature Screw Base



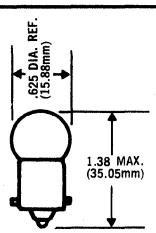
S.C. Miniature Bayonet Base

DESIGN		M.S.C.P.	Life	Filament
Volts	Amps		(Hours)	Shape
6.3	.80	3.6	3,000	C-2R
9.8	.50	6.0	15	C-2R
28.0	.30	6.0	500	C-2F

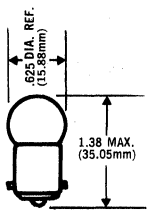
Miniature Screw Base	S.C. Miniature Bayonet Base
CM-965	CM-1855 CM-1495

G—5 & T—5 Miniature Incandescent Lamps

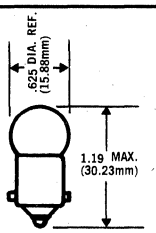
Industry Standard (ANSI) tolerances apply.



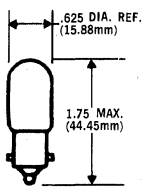
G-5
S.C. Bayonet
Base



G-5
D.C. Bayonet
Base



G-5
Miniature Bayonet
Base

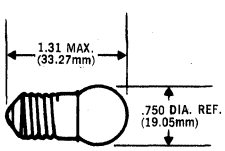


T-5
S.C. Bayonet
Base

DESIGN		M.S.C.P.	Life	Filament	G-5 S.C. Bayonet Base	G-5 D.C. Bayonet Base	G-5 Miniature Bayonet Base	T-5 S.C. Bayonet Base
Volts	Amps		(Hours)	Shape				
3.7	2.75	11.0	100	C-6				CM-1874
6.5	1.54	12.5	125	C-6				CM-1884
6.5	2.75	25.0	125	C-6				CM-1489
13.0	.37	3.0	1,000	C-2V		CM-78		
18.0	.25	3.0	250	C-2V			CM-1456	
20.0	.25	4.2	250	C-2V			CM-1458	
22.0	.25	3.8	250	C-2F			CM-1464	
28.0	.17	3.0	500	C-2F	CM-301	CM-302		

G—5-1/2 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.



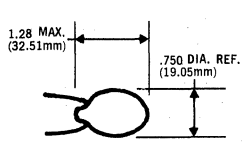
Miniature Screw Base

DESIGN		M.S.C.P.	Life	Filament
Volts	Amps		(Hours)	Shape
2.5	.80	1.3	150	C-2R
2.5	.80	1.3	150	S-2

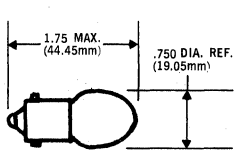
Miniature Screw Base
CM-35 CM-248

B—6 Miniature Incandescent Lamps

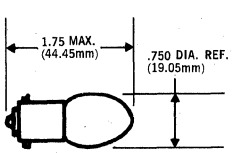
Industry Standard (ANSI) tolerances apply.



Wire Terminal



Single Contact
Bayonet Base



Double Contact
Bayonet Base

DESIGN		M.S.C.P.	Life	Filament	Wire Terminal	Single Contact Bayonet Base	Double Contact Bayonet Base
Volts	Amps		(Hours)	Shape			
6.5	1.78	15.0	100	C-6	CM8-808	CM-209	CM-210
6.5	1.88	8.9	875	C-2R			CM8-707
12.8	.94	15.0	100	C-6		CM-1003	CM-1004
28.0	.52	15.0	300	2/C-2R		CM-1309	

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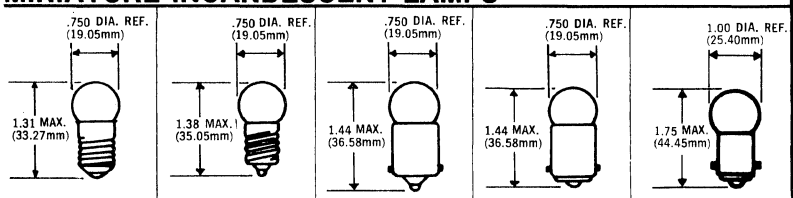
CHICAGO MINIATURE LAMP WORKS

MINIATURE INCANDESCENT LAMPS

G—6 & G—8 Miniature Incandescent Lamps

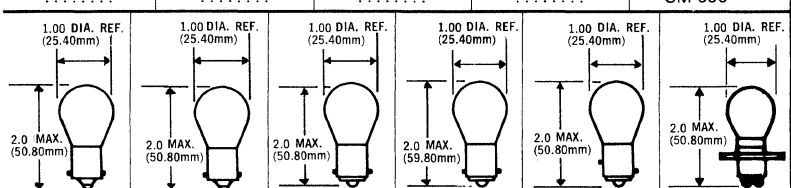
Industry Standard (ANSI) tolerances apply.



G—6 Miniature Screw Base	G—6 Candelabra Screw Base	G—6 S.C. Bayonet Base	G—6 D.C. Bayonet Base	G—8 D.C. Bayonet Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
.....	.....	.....	.....	CM-1491	2.4	.80	1.3	75	S-2
.....	.....	CM-61	.....	.....	3.45	.84	2.0	250	C-2R
.....	CM-81K	CM-81	.....	.....	6.5	1.02	6.0	500	C-2R
.....	.....	.....	CM-82	.....	6.5	1.05	6.0	500	C-2R
.....	CM-63K	CM-63	CM-64	.....	7.0	.63	3.0	1,000	C-2R
.....	CM-1471	.....	.....	.....	12.0	.26	2.3	250	C-2V
.....	CM-89K	.....	.....	.....	13.0	.53	6.0	750	C-2R
.....	.....	CM-89	CM-90	.....	13.0	.58	6.0	750	C-2R
CM-67M	CM-67K	.....	.....	.....	13.5	.41	4.0	1,500	C-2R
.....	.....	CM-1155	.....	.....	13.5	.59	4.0	5,000	2/C-2R
.....	.....	CM-67	CM-68	.....	13.5	.59	4.0	5,000	C-2R
.....	.....	CM-1247	.....	.....	14.0	.48	3.0	1,000	2/C-2R
.....	.....	CM-631	.....	.....	14.0	.63	6.0	1,000	2/C-2R
CM-71M	CM-71K	CM-71	CM-72	.....	22.0	.18	3.0	200	C-2V
.....	CM-530	.....	.....	.....	24.0	.17	3.3	250	C-2V
.....	CM-509K	.....	.....	.....	24.0	.18	2.8	1,000	C-2F
.....	.....	CM-509	.....	.....	24.0	.18	2.8	1,000	C-2V
.....	.....	CM-1251	CM-1252	.....	28.0	.23	3.0	2,000	2/C-2V
.....	.....	CM-303	CM-304	.....	28.0	.30	6.0	500	C-2F
.....	.....	CM-623	.....	.....	28.0	.37	6.0	1,000	2/C-2V
.....	CM-1224K	.....	.....	.....	32.0	.16	4.0	200	C-2F
.....	.....	.....	.....	CM-1226	32.0	.21	6.0	150	C-2V
.....	.....	CM-1223	CM-1224	.....	34.0	.16	3.8	275	C-2F
.....	.....	.....	.....	CM-536	45.0	.20	5.2	1,500	C-2F

S—8 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.



S.C. Bayonet Base	S.C. Bayonet Base (Double Filament)	D.C. Bayonet Base	D.C. Bayonet Base (Double Filament)	D.C. Index Base (Double Filament)	D.C. Prefocus Base	DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
.....	.....	CM-1492	.....	.....	.....	2.5	1.5	3.2	15	S-2
CM-1651	.....	.....	.....	.....	.....	5.0	.60	3.0	20	C-2R
CM-1611	.....	.....	.....	.....	.....	5.4	1.86	10.0	1,000	C-6
CM-1129	.....	.....	.....	.....	.....	6.4	2.63	21.0	200	C-6
.....	.....	CM-1130	.....	.....	.....	6.4	2.6	21.0	200	C-6
.....	.....	CM-1618	.....	.....	.....	6.4	2.8	21.0	200	C-2V
.....	.....	CM-6	.....	.....	.....	76.4	3.07	23.0	500	C-2V
.....	.....	CM-1493	.....	.....	.....	6.5	2.8	23.0	100	C-6
.....	.....	.....	.....	.....	CM-1630	6.5	2.75	23.0	100	C-6
CM-1619	.....	.....	.....	.....	.....	6.7	1.90	15.0	500	C-6
CM-87	.....	.....	.....	.....	.....	6.8	1.91	15.0	300	C-2R
.....	.....	CM-88	.....	.....	.....	6.8	1.9	15.0	300	C-6
.....	.....	CM-88L	.....	.....	.....	6.8	2.0	15.0	750	C-2R
.....	.....	.....	CM-1158	CM-1154	.....	6.4	2.63	21.0	200	C-6
.....	.....	.....	CM-1158	CM-1154	.....	7.0	.75	3.0	1,000	C-6
.....	.....	CM-1648	.....	.....	.....	8.0	2.0	21.0	1,500	C-2R
.....	.....	CM-8	.....	.....	.....	8.0	2.2	20.0	500	C-2R
.....	.....	CM-94	.....	.....	.....	12.8	1.0	15.0	500	C-2R
CM-1141	.....	CM-1142	.....	.....	.....	12.8	1.44	21.0	500	C-6
CM-1073	.....	CM-1076	.....	.....	.....	12.8	1.80	32.0	200	C-6
CM-1156	.....	.....	.....	.....	.....	12.8	2.10	32.0	600	C-6
CM-93	.....	.....	.....	.....	.....	12.8	1.04	15.0	500	C-2R
.....	.....	.....	.....	CM-1157	.....	12.8	2.10	32.0	1,200	C-6
.....	.....	.....	.....	CM-1157	.....	14.0	.59	4.0	5,000	C-6
.....	.....	.....	CM-1005	.....	.....	12.8	1.26	21.0	300	C-2R
.....	.....	.....	CM-1176	CM-1016	.....	12.8	1.34	21.0	200	C-6
.....	.....	.....	CM-1176	CM-1016	.....	14.0	.59	6.0	1,000	C-6
.....	.....	.....	.....	CM-1034	.....	12.8	1.80	32.0	200	C-6
.....	.....	.....	.....	CM-1034	.....	14.0	.51	4.0	5,000	C-6
.....	.....	CM-1696	.....	.....	.....	28.0	.42	10.0	500	C-2V
.....	.....	CM-306	.....	.....	.....	28.0	.51	15.0	300	C-2V
CM8-305	.....	.....	.....	.....	.....	28.0	.56	15.0	480	C-2V

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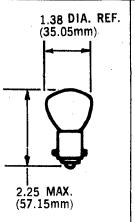
CHICAGO MINIATURE LAMP WORKS

MINIATURE INCANDESCENT LAMPS

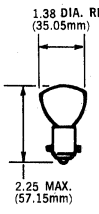
S—8 (Cont'd)

DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
28.0	.61	15.0	1,000	2/C-2R
28.0	.61	15.0	1,000	2/C-2V
28.0	.66	21.0	300	C-2V
28.0	.67	21.0	300	C-2V
28.0	.70	21.0	400	C-2V
28.0	.68	21.0	300	CC-6
28.0	.90	32.0	300	C-2V
28.0	1.02	32.0	500	2/C-6
34.0	.45	15.0	275	C-2V
40.0			1,000	C-13
44.0	.17	6.0	200	C-7A

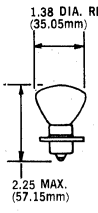
CM-1691, CM-307, CM-1203, CM-315, CM-1683, CM-109, CM-1692, CM-308, CM-1204, CM-1666, CM-1228, CM-1676, CM-110



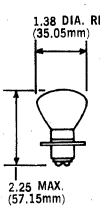
D.C. Bayonet Base



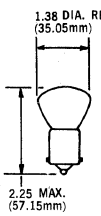
D.C. Bayonet Base (Double Filament)



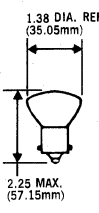
S.C. Prefocus Base



D.C. Prefocus Base



S.C. Bayonet Base



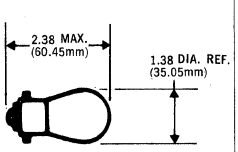
S.C. Bayonet Base (Double Filament)

RP—11 Miniature Incandescent Lamps

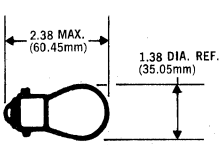
Industry Standard (ANSI) tolerances apply.

DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
4.5	1.25	5.7	75	C-6
5.5	6.25	50.0	100	C-2V
5.5	6.18	50.0	100	C-2V
6.2	3.87	32.0	125	C-2V
5.9	6.53	50.0	200	C-2V
6.2	4.23	32.0	200	C-2V
6.0	5.5	28.0	2,000	C-2V
6.2	4.23	32.0	200	C-2V
6.2	4.23	32.0	200	C-2V
6.2	3.87	32.0	125	C-2V
6.2	3.87	32.0	125	C-2V
5.9	6.36	50.0	200	C-6
5.9	6.53	50.0	200	C-2V
6.0	2.35	19.0	75	C-6
6.1	4.10	32.0	125	C-6
6.2	3.91	32.0	200	C-2R
12.5	3.00	50.0	300	C-2V
6.2	4.13	32.0	200	C-2V
12.5	1.92	32.0	300	C-2R
12.5	1.92	32.0	300	C-2R
12.5	2.23	32.0	300	C-2V
12.5	2.10	32.0	300	C-2R
12.5	2.00	32.0	400	C-2R
12.5	3.0	50.0	300	C-2V
12.5	3.00	50.0	300	C-2R
12.8	35W		300	C-6
12.8	1.85	32.0	200	C-6
12.8	2.18	32.0	300	C-2V
12.8	1.85	32.0	200	C-6
12.8	35W		80@14.0V	C-6
14.0	.51	4.0	200	C-6
12.8	2.08	32.0	300	C-2V
12.8	2.08	32.0	300	C-2V
25.6	.34	40.0	500	2/C-2R
26.0	2.70	105.0	25	2/CC-6
32.0	.74	32.0	100	C-2V
32.0	.53	21.0	100	C-2V
32.0	1.15	50.0	100	C-5
44.0	.47	21.0	150	C-13

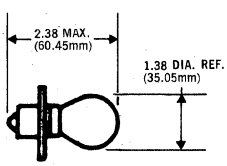
CM-1184, CM-1188, CM-1188, CM-1000, CM-1000, CM-1501, CM-1503, CM-1025, CM-1209, CM-1134, CM-1507, CM-1323, CM-1124, CM-1124, CM-2530, CM-2530, CM-2330, CM-2330, CM-2336, CM-2336, CM-1144, CM-1196, CM-1044, CM-1044, CM-1026, CM-1026, CM-1074, CM-1074, CM-1011, CM-1327, CM-1271, CM-1054, CM-1230, CM-1056, CM-1150, CM-1183, CM8-60, CM-1133, CM-1143, CM-1195, CM-1047



S.C. Bayonet Base



D.C. Bayonet Base



S.C. Prefocus Base

S—11 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

DESIGN Volts	DESIGN Amps	M.S.C.P.	Life (Hours)	Filament Shape
6.1	4.1	32.0	125	C-6
6.2	4.5	32.0	400	C-6
28.0	.90	32.0	300	C-2V
28.0	.92	32.0	300	C-2V
28.0	1.29	50.0	300	C-2V
90.0			200	C-5

CM-309, CM-311, CM-1724, CM-310, CM-1744, CM-1763

• Chicago Miniature Lamps are manufactured to MIL-L-6363D

ALL CHICAGO MINIATURE LAMPS MEET OR EXCEED APPLICABLE ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE) INDUSTRY STANDARD REQUIREMENTS
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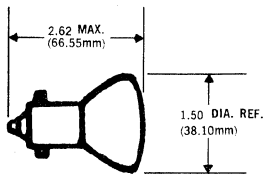
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

•All dimensions are in inches, metric size in parentheses

CHICAGO MINIATURE LAMP WORKS

MINIATURE INCANDESCENT LAMPS



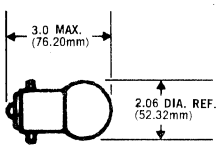
S.C. Bayonet Base

R—12 Miniature Incandescent Lamps

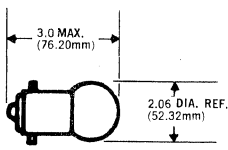
Industry Standard (ANSI) tolerances apply.

	DESIGN		M.S.C.P.	Life	Filament
	Volts	Amps		(Hours)	Shape
CM-1383*	13.0		20.0 Watts	300	C-8
CM-1385*	28.0		20.0 Watts	300	CC-8

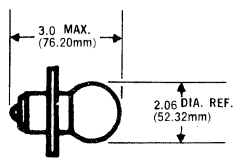
* BASE HALF OF BULB REFLECTORIZED



D.C. Bayonet Base



D.C. Bayonet Base (Double Filament)



D.C. Prefocus Base

G—16-1/2 Miniature Incandescent Lamps

Industry Standard (ANSI) tolerances apply.

			DESIGN		M.S.C.P.	Life	Filament
			Volts	Amps		(Hours)	Shape
CM-1238		CM-1240	32.0	3.5	225.0	50	CC-6
	CM-958		5.5	2.0	14.0	50	YC-8Z
							Major
	CM-958		6.0	.82	5.0	100	C-12
							Minor

STANDARD VOLTAGE LAMPS

Lamp Number	Bulb Size and Type	Volts	Watts	Base	Filament Shape	Life (Hours)	M.O.L.	M.O.D.
3S6/5	S-6	120 - 125	3.0	Candelabra	C-7A	3,000	1 7/8	.750
6S6/30V	S-6	30	6.0	Candelabra	C-2V	1,500	1 7/8	.750
6S6/115-125V	S-6	115 - 125	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/White	S-6	115 - 125	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/Red	S-6	115 - 125	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/130V	S-6	130	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/135V	S-6	135	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/145V	S-6	145	6.0	Candelabra	C-7A	1,500	1 7/8	.750
6S6/155V	S-6	155	6.0	Candelabra	C-7A	1,500	1 13/16	.750
6S6DC/120V	S-6	120	6.0	D. C. Bayonet	C-7A	1,500	1 13/16	.750
6S6DC/130V	S-6	130	6.0	D. C. Bayonet	C-7A	1,500	1 13/16	.750
6S6/7	S-6	120	6.0	Intermediate	C-7A	1,500	1 13/16	.750
6T4 1/2	T-4 1/2	115 - 125	6.0	Candelabra	C-7A	1,500	1 7/8	.563
7C7	C-7	115 - 125	7.0	Candelabra	C-7A	3,000	2 1/8	.875
10C7	C-7	115 - 125	10.0	Candelabra	C-7A	5,000	2 1/8	.875
10C7DC	C-7	115 - 125	10.0	D. C. Bayonet	C-7A	3,000	2 1/8	.875
10S6C (230V)	S-6	230	10.0	Candelabra	C-13	1,500	1 7/8	.750
10S6C (250V)	S-6	250	10.0	Candelabra	C-13	1,500	1 7/8	.750
10S6DC (250V)	S-6	250	10.0	D. C. Bayonet	C-13	1,500	1 13/16	.750
10S14 (130V)	S-14	130	13.0	Medium	C-9	1,500	3 1/2	1.625
15T6 (115 - 125V)	T-6	115 - 125	15.0	Candelabra	C-13	2,000	3 1/16	.750
15T7C	T-7	115 - 125	15.0	Candelabra	C-13	1,000	2 1/4	.875
15T7DC/IF	T-7	115 - 125	15.0	D. C. Bayonet	C-13	600	2 1/4	.875
25T8C	T-8	115 - 125	25.0	Intermediate	C-13	600	2 5/8	1.00
25T8DC	T-8	115 - 125	25.0	D. C. Bayonet	C-13	600	2 5/8	1.00
25T8DC/IF	T-8	115 - 125	25.0	D. C. Bayonet	C-13	600	2 5/8	1.00
25T8N	T-8	115 - 125	25.0	Intermediate	C-13	600	2 5/8	1.00

• Chicago Miniature Lamps are manufactured to MIL-L-6363D

ALL CHICAGO MINIATURE LAMPS MEET OR EXCEED APPLICABLE ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE) INDUSTRY STANDARD REQUIREMENTS
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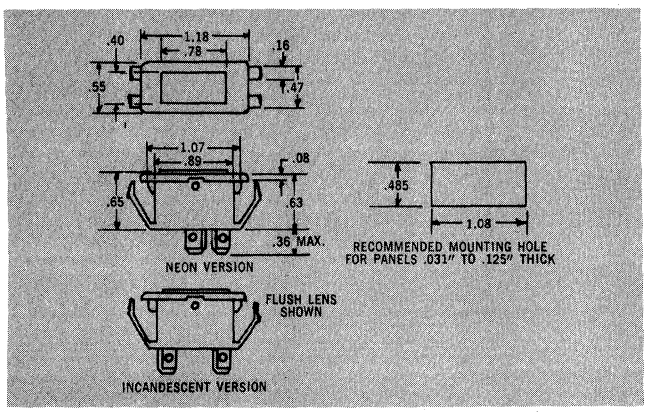
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

•All dimensions are in inches, metric size in parentheses

panel indicator lights

Matches 26 and 27 series rocker & paddle switches — Snaps In - Holds Fast

Available with protruding lenses, transparent lenses, and two separate panel lights in one "double case."
Hot Stamping available.



How to order:

15-XXX-1X9

TERMINAL CODE
LENS CODE
LAMP CODE
CASE CODE

TERMINAL CODE
0 — ¼" wide slip-on
1 — Screw terminals
2 — Solder
6 — 9/64" wide slip-on

LENS COLOR CODE
0 — Milky White
2 — Red
4 — Yellow
5 — Green
8 — Clear

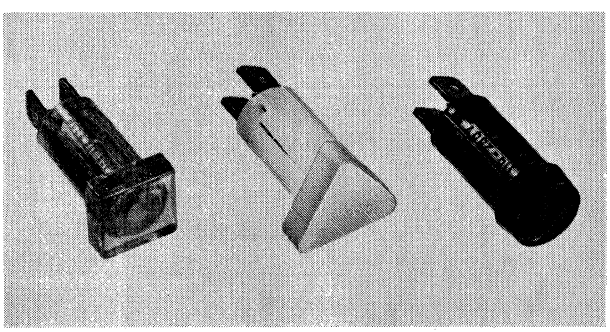
CASE COLOR CODE
0 — White
1 — Chrome Bezel
2 — Red
3 — Gold Bezel
4 — Ivory
5 — Legiht Green
6 — Light Blue
8 — Gray
9 — Black

LAMP CODE
0 — 120V Neon, high intensity, 5,000 hour life
1 — 240V Neon, medium intensity
2 — 4-6.3V Incandescent, 600,000 - 3,000 hours life
3 — 18-28V Incandescent, 1,760,000 - 10,000 hours life
4 — 9-14V Incandescent, 180,000 - 1,000 hours life
5 — 120V Neon, medium intensity, 25,000 hours life

series 15

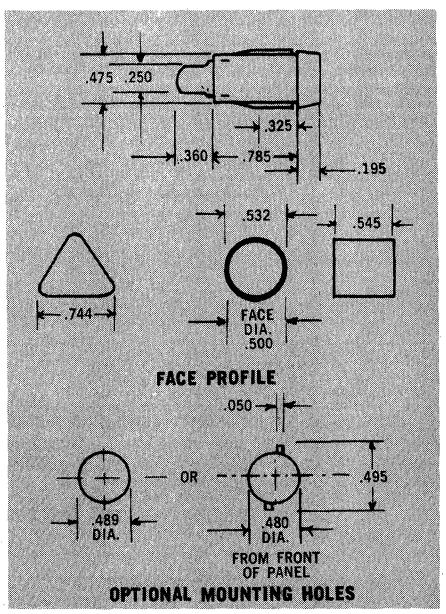
- U.L. listed versions available
- ¼" wide slip on terminals
- Available with square, triangular or round lenses.
- Colors: red, clear, amber, green and white
- Chrome bezels available for round-faced versions.

Also available: Versions with wire leads, solder terminals, and with two separate neon lamps.
Also other lamp ratings, 240V neon versions, and hot-stamping.



Ordering information

LENS FACE	LENS COLOR	120V NEON BRIGHT C2A (NE2H) 22K Resistor 5K Hour Life	120V NEON MEDIUM C2A (NE2H) 33K Resistor 25K Hour Life	4-6.3V INCANDESCENT 150-200ma, 600K-3K Hour Life	9-14V INCANDESCENT 69-88ma, 1800K-10K Hour Life	18-28V INCANDESCENT 30-40ma, 180K-1K Hour Life
ROUND*	RED	15-192-109	15-192-159	15-192-129	15-192-149	15-192-139
ROUND*	CLEAR	15-198-109	15-198-159	15-198-129	15-198-149	15-198-139
ROUND*	GREEN			15-195-129	15-195-149	15-195-139
ROUND*	AMBER	15-194-109	15-194-159	15-194-129	15-194-149	15-194-139
ROUND*	WHITE	15-190-109	15-190-159	15-190-129	15-190-149	15-190-139
ROUND†	RED	15-000-001	15-000-002	15-000-200	15-000-205	15-000-210
ROUND†	CLEAR	15-000-003	15-000-004	15-000-201	15-000-206	15-000-211
ROUND†	GREEN			15-000-202	15-000-207	15-000-212
ROUND†	AMBER	15-000-007	15-000-008	15-000-203	15-000-208	15-000-213
ROUND†	WHITE	15-000-009	15-000-010	15-000-204	15-000-209	15-000-214
SQUARE	RED	15-000-091	15-000-092	15-000-230	15-000-235	15-000-240
SQUARE	CLEAR	15-000-093	15-000-094	15-000-231	15-000-236	15-000-241
SQUARE	GREEN			15-000-232	15-000-237	15-000-242
SQUARE	AMBER	15-000-097	15-000-098	15-000-233	15-000-238	15-000-243
SQUARE	WHITE	15-000-099	15-000-100	15-000-234	15-000-239	15-000-244
TRIANG.	RED	15-000-081	15-000-082	15-000-214	15-000-220	15-000-225
TRIANG.	CLEAR	15-000-083	15-000-084	15-000-216	15-000-221	15-000-226
TRIANG.	GREEN	—	—	15-000-217	15-000-222	15-000-227
TRIANG.	AMBER	15-000-087	15-000-088	15-000-218	15-000-223	15-000-228
TRIANG.	WHITE	15-000-089	15-000-090	15-000-219	15-000-224	15-000-229



*** Concave faced — for jewel-like effect**
† Flat faced

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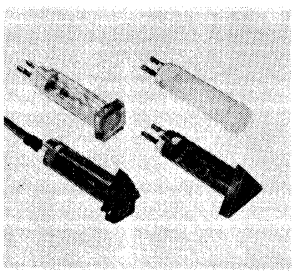
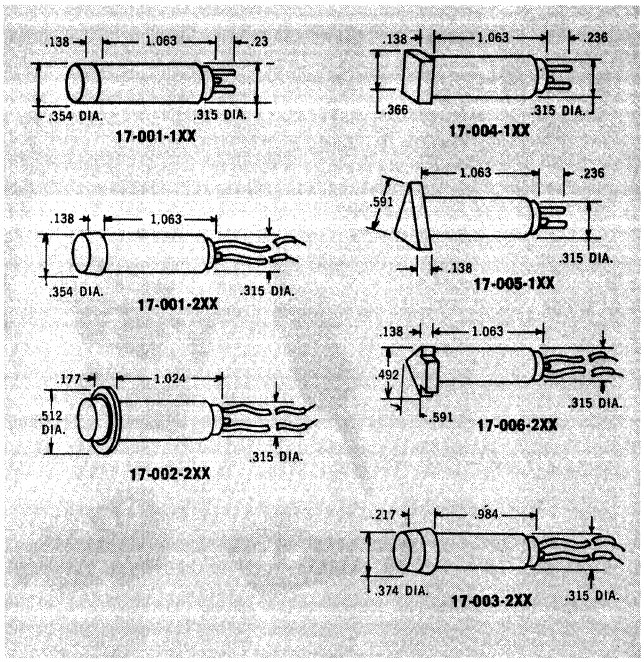
panel indicator lights

series 17

- Long life
- High Brilliance
- Temperature range to 100°C
- Mounts in .319-.323" Dia. Hole





How to order:

17-00X-XXX

LENS STYLE CODE / TERMINAL CODE — VOLTAGE CODE / COLOR CODE

LENS STYLE CODE
1 — Round lens
2 — Round lens + chrome flange
3 — Round lens + chrome flange
4 — Square lens
5 — Triangular lens
6 — Arrow lens

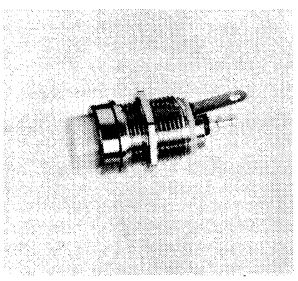
TERMINAL CODE
1 — Solder
2 — Wire (6" long)
3 — Pins for socket insertion

COLOR CODE
0 — White
2 — Red
4 — Amber
5 — Green (not w/neon)
8 — Clear

VOLTAGE CODE
0 — 110 V neon
1 — 220 V neon
2 — 4-6 V incandescent
3 — 18-28 V incandescent
4 — 8-12 V incandescent
6 — 380 V neon
7 — 110 V fluorescent*
8 — 220 V fluorescent*
9 — 380 V fluorescent*

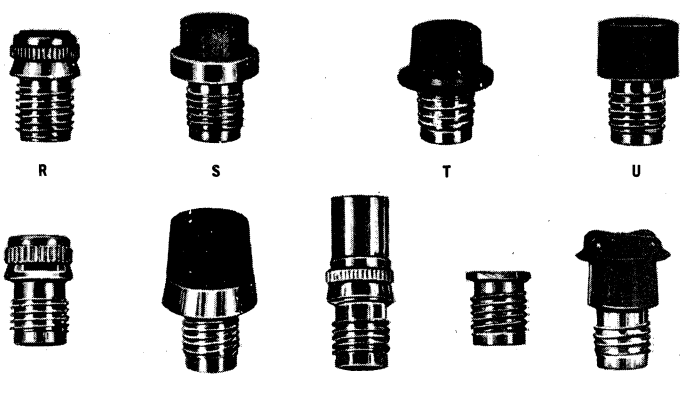
* For green or clear lenses only

series 33-89 midget-relampable



- For lamp-replacement from front of panel
- For T-1¾ Midget Flange-Based lamps.
- Hot stamping available
- Each has two sets of threads — one for lamp and one lens replacing and one for panel mounting.
- Replacement lenses available

LENS STYLES



How to order:

33-89X-XXX

BODY CODE / LENS STYLE CODE — LAMP CODE / LENS COLOR CODE

LENS STYLE CODE
0 — Model R (Special)
1 — **Model S (Standard)** Chrome ring
2 — **Model T (Standard)** Plain lens
3 — Model U (Special) has Black side shroud
4 — Model V (Special) for fan-shaped panel illumination
5 — **Model W (Standard)** Chrome ring
6 — Model X (Special) no lens
7 — Model Y (Special) no lens
8 — Model Z (Special) for behind-panel lighting of translucent panels
9 — Model P (Special) has extended black side shroud

BODY CODE
1 — Standard 2-terminal body (for 7/16" dia. panel hole)
2 — Same as body no. 1 except has two neoprene washers added for watertight applications
3 — Special 1-terminal grounded body (3/8" dia. panel hole)

LENS COLOR CODE
0 — White
2 — Red
4 — Yellow (Amber in style 5)
5 — Green
6 — Blue
8 — Clear (in style 5 only)
9 — No Lens (in styles 6 and 7)

LAMP CODE
2 — 4-6V
3 — 18-28V
4 — 9-14V
9 — No lamp (standard — for those who wish to assemble their own lamp)

NOTE: Unless heat sink is used, do not solder to relampable lampholders with lamp inside.

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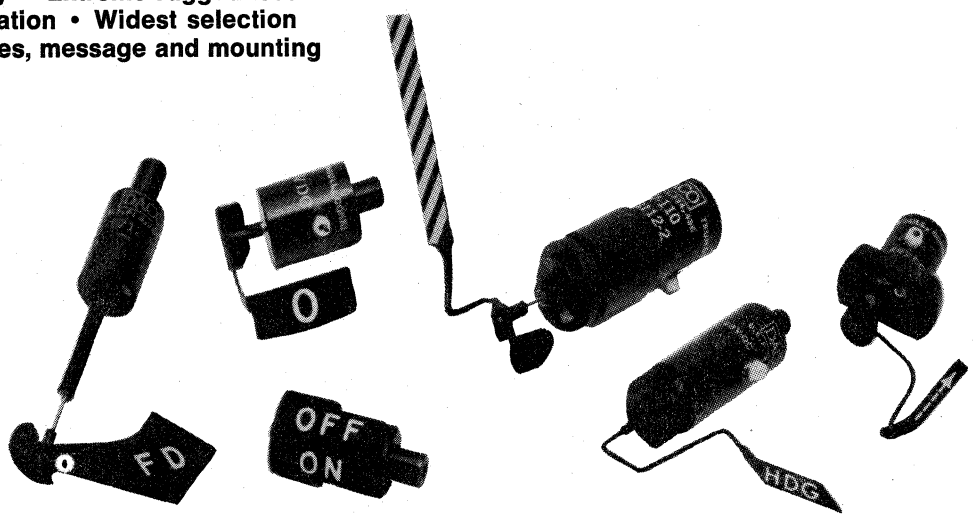
DACO Miniature Fail-Safe Indicators for aerospace and ground support instrumentation.

DACO Miniature Flag Indicators

High reliability • Extreme ruggedness
Positive indication • Widest selection
of models, sizes, message and mounting



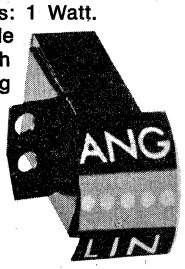
DACO Solenoid-Actuated Fail-Safe Indicators offer a combination of advantages that has made them the standard with leading international instrument manufacturers. The indicators are widely used in commercial and military aircraft, plus a number of space projects. In addition to their many applications in general system annunciation, they are used for sunshutters, video light sensors and photocell interrupters in spacecraft optical systems; digit maskers, request-action indicators and special system condition indicators.

Model Size No.	D-LE 5			D-LE 6	
Diameter	.38			.44	
Lengths Available	.38	.45	.57	.57	.82
Power Input Range	DC — 0.5 to 1 watt @ 25°C AC — 0.7 to 1.3 watts @ 25°C			DC — 0.4 to 1.3 watts @ 25°C AC — 1.2 to 1.8 watts @ 25°C	
Operating Voltage	DC operation: up to 45 volts AC operation: 26 and 115 volts 400Hz				
Rotation	up to 60° CW or CCW Standard Tolerance +2.5°				

For additional details, including variations of standard designs, mounting arrangements, shaft extensions, flag configurations, complete specifications, dimension drawings and ordering information, contact DACO.

DACO Flat Pack Indicator

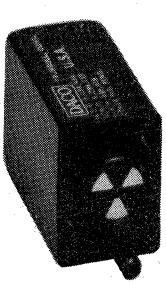
2-position or 3-position. Operating Voltage: 5VDC - 28VDC. Power Requirements: 1 Watt.
Size: .27 wide
.50 high
.85 long



DACO Front Face Indicators

2-position or 3-position (dual coil) indicator. Can be supplied to operate on all nominal DC voltages. Power requirements: 1 watt maximum. Available in 2 sizes: .46 x .46 Face, .44 Body Dia., 1.0 long
.38 x .38 Face, .38 Body Dia., .82 Long.

DACO Miniature Latching Indicators



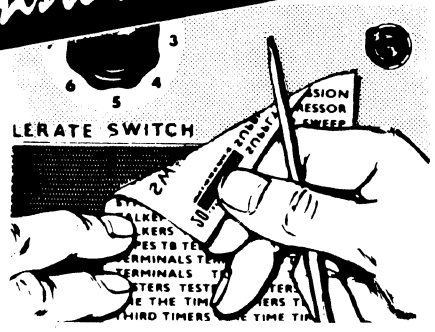
Highly reliable, extremely rugged, and positive indicating, these 2-position electromechanical latching indicators are widely used for visual indication of transitory circuit conditions, registering and holding "over-temperature" and "G-level" indications, monitoring firing circuits and many other applications. Designed for pulsed operations, indicator will operate continuously up to 45 VDC. Input power is 0.75 watt at 25°C. Available with external switch, actuated by the reset button, for a secondary circuit.

DACO Instrument Company
30 Stran Road, Milford, Connecticut 06460 (USA)
Telephone: (203) 874-2515 TWX: 710-462-1049 Cable: DACOINST-MILFORD, CONN.

DACO™

LETRASET

instant lettering®



THE REVOLUTIONARY METHOD FOR MARKING ELECTRONIC EQUIPMENT

JUST RUB and it's PRINTED!

Sharp • Clean • Fast • Not a Decal • No Water • No Tapes

INSTANT LETTERING® marking kits bring you all the necessary elements for completely marking electronic equipment, prototypes, drawings, etc. in this fast new easy-to-use form. There's even a new drafting symbol kit for better more readable schematics.

Words, letters, numerals, switch patterns, arcs, drafting symbols, etc. are printed on a special transparent carrier film. Rubbing over one of these elements with a ballpoint pen releases it from the carrier film and adheres it to your working surface.

INSTANT LETTERING® words and symbols transfer to almost any surface including glass, plastic, even painted and bare metals. Now you can quickly mark all panels, even especially calibrated two-color nomenclatures, pilot light jewels, sub-assemblies, circuit boards, etc. Reproduction quality **INSTANT LETTERING®** transfers are clean and sharp, leave no background haze or film, make prototypes look like finished production equipment and give all equipment and drawings a professional look.

instant lettering

DRY TRANSFER MARKING KITS

TITLES for ELECTRONIC EQUIPMENT

NEW, REVISED; Now 20% more titles in a new easy-to-read typeface. Researched to give up to 95% of all electronic marking. For labeling, marking, titling all electronic control panels, drawings, prototypes, etc.

No. 9581—Complete Set (black) **$5.95**
No. 9591—Complete Set (white) **$5.95**
REFILL SETS—12 sheets per set
No. 9601—Alphabets (black) **$3.00**
No. 9611—Alphabets (white) **$3.00**
No. 9621—Numerals (black) **$3.00**
No. 9631—Numerals (white) **$3.00**

TERMINAL & CHASSIS MARKING KIT

All the necessary letters, letter combinations and numerals for marking chassis, printed circuit and terminal boards, rotating components, etc.

No. 966—Black **$5.95**
No. 967—White **$5.95**

DATAMARK KITS

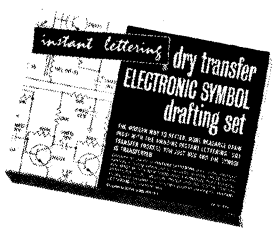
Low cost dry transfer marking kits designed to provide useful preset words, symbols and alphabets for specific uses.

K58B—Audio, TV & Hi-Fi (black) **$1.50**
K58W—Audio, TV & Hi-Fi (white) **$1.50**
K59B—Amateur Radio & CB (black) **$1.50**
K59W—Amateur Radio & CB (white) **$1.50**
K60B—Experimenter, Home & Intercom (black) **$1.50**
K60W—Experimenter, Home & Intercom (white) **$1.50**
K61B—Test & Industrial Equipment (black) **$1.50**
K61W—Test & Industrial Equipment (white) **$1.50**
K62—Marks & Switch Patterns **$1.50**
K63—Alphabets & Numerals (⅛") **$1.50**
K64—Alphabets & Numerals (¼") **$1.50**
K65—Alphabets & Numerals (½") **$1.50**

METER & DIAL MARKING KIT

Arcs, dial patterns, lines, wedges, graduation lines, switch symbols alphabets and numerals in black, white and red for marking standard and special rotary tap switches, potentiometers and prototype and specially calibrated meter dials. Colors provide contrast on scales and switches, simplifying usage of complex instruments.

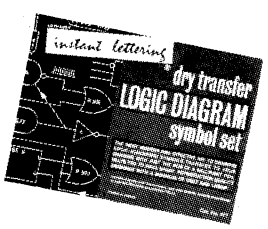
No. 968—Complete Set **$5.95**
REFILL SHEETS—set of four identical sheets
No. 968R—(specify sheet number) **$2.00**



ELECTRONIC SYMBOL DRAFTING SET

The quick way to more readable schematics. Contains 40 sheets of electronic symbols plus letters and numerals. Symbols designed to conform with MIL-STD-15-1A. Sheets have heat resistant adhesive for perfect reproduction in any blue- or white-printer. Also included is a complete guide to drawing with dry transfer symbols.

No. 970—Complete Set **$19.15**
REFILL SHEETS—set of four identical sheets
No. 970R—(specify sheet number) **$2.00**



LOGIC DIAGRAM SYMBOL SET

NEW! The most modern and effective aid to drawing logic diagrams. Symbols transfer to your drawing in seconds. All you need do is add the connecting leads. Heat resistant adhesive allows perfect reproduction even in diazo and other high speed printers. Symbols conform fully to MIL-STD-806B and ASA-Y32.14.

No. 971—Complete Set **$4.20**
REFILL SHEETS—set of four identical sheets
No. 971R—(specify sheet number) **$2.00**

NEW JOTDRAFT SETS

Over 120 sets of logic, schematic, component and printed circuit symbols. Each has a clear, tough plastic overcoat that transfers with the symbol. Tough! Scratch Resistant! Use with pencil, tape and ink. Suited for mylar, standard tracing vellums. All kits $6.50 each.

DATAKOAT — Clear protective coating specifically designed to protect "Instant Lettering" transfers from abrasion and weathering. Datakoat is water-clear and dries quickly.
Protective Coating Kit — contains a 1 oz. bottle of Datakoat with applicator brush in cap and a 1 oz. bottle of thinner.

No. 04176 ..... **$1.00**

Spray Coatings — the handy aerosol can form of Datakoat (16 oz. cans).

No. 04177 — Glossy **$2.95**
No. 04178 — Matte **$2.95**

STANDARD SHEETS — Full 10" x 15" sheets of alphabets and numerals are available in over 80 different type faces in sizes ranging from 8 pt. to 288 pt. Also available are arrows, math symbols, line and dot rules, etc. All are available in black, many also come in white and all feature heat resistant adhesive. Free sample and complete type chart available upon request.

SPECIAL SHEETS — Sheets made to your own specifications can include logos, drawings, symbols, preset words — anything that you use repeatedly. Hundreds of lettering and marking problems that were impossible or too expensive become practical with "Instant Lettering". Tell us your problem and let us suggest a "dry transfer" solution.

LETRATAPES — Here's a revolutionary advance in the application of dry transfer component references. The special dispenser does half the job for you. The range of tapes comprises 122 different items including letters of the alphabet, numerals, 0-9, common component designations, frequently used preset words, etc. Letratapes provide an ideal method for a wide range of repetitive marking or coding jobs. Write for complete details.

SPECIAL LETRATAPES — Tapes can be made to fit your own specific needs. Items like company trade marks, technical symbols, frequently used words and phrases —whatever you need—prepared as dry transfers on rolls of tape for fast, easy application. Complete details available upon request.

THE DATAK CORPORATION

PANEL INDICATOR LIGHTS

LED's, Self-Driven & Standard Incandescents, Neons

LOW COST • IMMEDIATE AVAILABILITY

Data Display Products offers a broad line of low cost subminiature panel indicator lights that are built for rugged long life performance.

All lights feature:

- Low profile or standard mounting models
- Gold plated, wrap terminals
- Fast, simple installation

STANDARD INCANDESCENTS AND NEONS

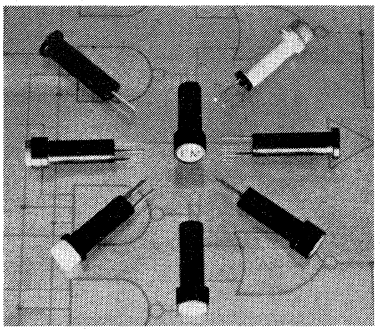
- Up to 30 year life rating

LED'S

- High brightness (1500 ft. - L @ 20mA)

SELF-DRIVEN INCANDESCENTS

- Exclusive FAN-IN Series features built-in lamp drivers and keep alive bias
- Life ratings equivalent to LED's because of long life lamps and built-in lamp bias for pre-heating lamps filament
- Operate from standard TTL or ECL (with ext. pull-down resistor for ECL)
- Positive or negative logic input available
- Input represents as low as $^1/_5$ of a standard TTL load (0.3mA)
- Optional built-in lamp test
- Have performed to MIL-E-5400, Class I environmental specifications



STANDARD INCANDESCENTS AND NEONS

ELECTRICAL DATA/PRICING

INCANDESCENT					QUANTITY/PRICE		
Lamp Type	Volts	mA	MSCP	Years	1-99	100-999	1000-4999
DD03	3	15	.005	10	$1.27	$1.08	$0.92
DD05	5	20	.04	2	1.27	1.08	0.92
DD07	5	30	.04	10	1.19	1.02	0.88
DD10*	5	33	.002	18	0.98	0.87	0.75
DD20	5	60	.05	10	0.98	0.87	0.75
DD30	5	115	.13	5	1.27	1.08	0.92
DD36	6	20	.04	2	1.69	1.48	1.34
DD37	6	30	.04	12	1.69	1.48	1.34
DD39†	6	43	.035	30	0.98	0.87	0.75
DD41	6	60	.05	12	1.39	1.24	1.05
DD43	6	115	.13	6	1.69	1.48	1.34
DD49	10	20	.04	2	1.69	1.48	1.34
DD50	10	35	.05	25	1.48	1.32	1.12
DD52†	10	55	.12	4	1.39	1.24	1.05
DD57	12	20	.04	2	1.69	1.48	1.34
DD60	12	36	.09	14	1.48	1.32	1.12
DD62†	12	60	.21	5	1.37	1.22	1.04
DD64	15	20	.04	2	1.69	1.48	1.34
DD65	15	36	.09	15	1.69	1.48	1.34
DD67†	15	60	.21	4	1.58	1.37	1.22
DD70†	18	40	.15	30	1.27	1.08	0.95
DD72†	20	45	.16	25	1.27	1.08	0.95
DD75	24	22	.08	15	1.78	1.56	1.43
DD76†	24	36	.21	5	1.27	1.08	0.95
DD77†	25	38	.25	5	1.27	1.08	0.95
DD79	28	24	.09	9	1.89	1.66	1.52
DD80†	28	33	.12	10	1.27	1.08	0.95
DD86†	36	33	.12	10	1.68	1.49	1.38
DD92*	48	25	.22	5	1.48	1.31	1.19

NEON					QUANTITY/PRICE		
Lamp Type	VAC	Watts	Rser.	Hours	1-99	100-999	1000-4999
N2‡	110	1/15	100K	10,000	$0.89	$0.76	$0.68
N3‡	110	1/15	Built-in	10,000	0.98	0.87	0.75
N6*	110	1/7	47K	25,000	0.79	0.69	0.58
N7*	110	1/7	Built-in	25,000	0.89	0.76	0.65

* Available only in 60 Series
† Available only in 40 & 60 Series
‡ Available only in 40 Series

All prices and specifications are subject to change without notice • Minimum order — $15.00 • Terms: 1% 10 days, net 30 days • FOB - Los Angeles, Calif. • Availability: stock to 3 weeks.

SELF-DRIVEN INCANDESCENTS

(With built-in lamp driver & keep alive bias)

ELECTRICAL DATA

CIRCUIT TYPE FOR INDICATING LOGICAL '1'	A05	A07	A1	A3	A36	A50	A6	A65	A8
CIRCUIT TYPE FOR INDICATING LOGICAL '0'	D05	D07	D1	D3	D36	D50	D6	D65	D8
V_{cc} (VDC)*	5				6	10	12	15	28
I_{cc} (MA)* ON	20	30	60	115	20	34	36	36	22
OFF	8	12	24	45	8	12	12	12	8
V_{in} (VDC)* ON	All Circuit A = 2.4 min. All Circuit D = 1.0 max.								
OFF	All Circuit A = 0.6 max. All Circuit D = Non-sink cond., or V_{cc} −.8V min.								
I_{in} (MA)* ON	0.4	0.4	0.8	1.6	0.4	0.6	0.6	0.6	0.4
OFF	-0.01								
BRIGHTNESS (MSCP)*	.035		.05	.13	.035	.05	.09	.09	.09
AVERAGE LIFE (YEARS)*	2	18	18	8	5	25	14	15	9

*(Parenthesis) Indicates Units

PRICING (ea.)

	CIRCUIT TYPE	1-99	100-999	1,000-4,999
F40 Series	A07, D07, A1, D1	$2.97	$2.58	$2.28
	A05, D05, A3, D3	3.12	2.68	2.33
	A6, D6	3.67	3.18	2.78
	A36, D36	3.80	3.31	2.89
	A50, D50, A65, D65	4.07	3.63	3.19
	A8, D8	4.53	4.14	3.84
F60 Series	A07, D07, A1, D1	2.56	2.17	1.87
	A05, D05, A3, D3	2.71	2.27	1.92
	A6, D6	3.46	2.97	2.57
	A36, D36	3.60	3.15	2.76
	A50, D50, A65, D65	3.87	3.48	3.06
	A8, D8	4.12	3.73	3.43
For lamp test option add		0.30	0.25	0.20

Note: For dark colors (blue and green) units with higher brightness are recommended.
Patent pending.

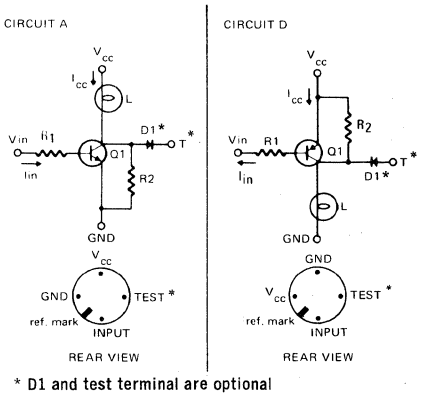
LED'S

ELECTRICAL DATA

LED Assembly	Volts	mA	ft-L
SL 3	3	18	1200
SL 3H	3	34	2400
SL 5L	5	10	550
SL 5	5	18	1200
SL 5H	5	34	2400
SL 6	6	18	1200
SL 6H	6	34	2400
SL 10	10	18	1200
SL 12	12	18	1200
SL 15	15	18	1200
SL 18	18	15	950
SL 20	20	13	700
SL 24	24	10	550
SL 25	25	10	550
SL 28	28	9	500

PRICING

1-99	100-999	1,000-4,999
1.70	$1.40	$1.10



* D1 and test terminal are optional

HOW TO ORDER (See Mechanical Data — Next Page)

SELF-DRIVEN & STANDARD INCANDESCENTS, NEONS

Model No. (see Mech. Data)

For FAN-IN Series Only: C

Cartridge Type Keyed for use only with panel-mount sockets (Bulletin 7245. ACCESSORIES) Omit for direct mounting units.

Circuit Type or Lamp Type (see Elect. Data): F42-A1

T = Lamp Test (option - available FAN-IN Series only): T-WO

Lens Color
W = White
R = Red
G = Green
B = Blue
A = Amber
Y = Yellow

Collar Color
0 = Black
9 = White
Not for Neons

Clear and semi-clear lenses also available.

LED's

S42-SL5-WO

Model No. (see Mech. Data)

LED Assembly (see Elect. Data)

Lens Color
Translucent Clear
W = White = CW
R = Red = CR

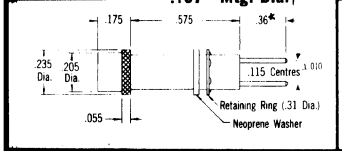
Collar Color
0 = Black
9 = White

Data Display Products

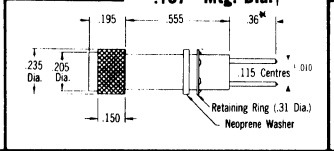
5428 W. 104th Street, Los Angeles, Calif. 90045 • Phone (213) 641-1232

LED's, Self-Driven & Standard Incandescents, Neons — PANEL INDICATOR LIGHTS

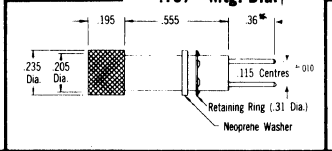
MODEL 31 — W/O Driver only — .187" Mtg. Dia.†



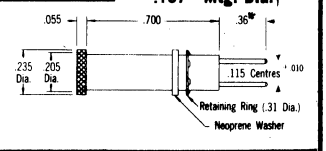
MODEL 32 — W/O Driver only — .187" Mtg. Dia.†



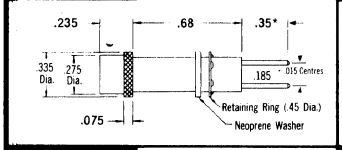
MODEL 33 — W/O Driver only — .187" Mtg. Dia.†



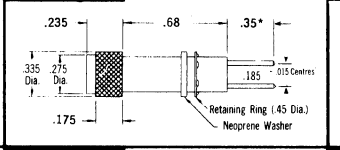
MODEL 34 — W/O Driver only — .187" Mtg. Dia.†



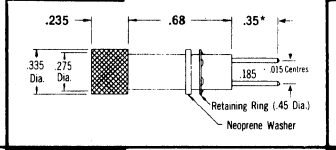
MODEL 41 — .25" Mtg. Dia.†



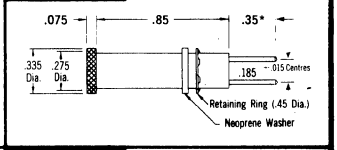
MODEL 42 — .25" Mtg. Dia.†



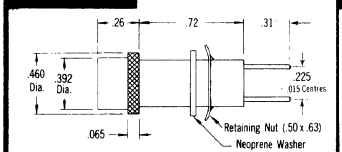
MODEL 43 — .25" Mtg. Dia.†



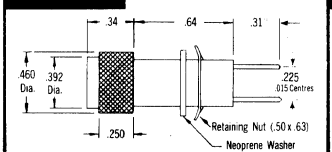
MODEL 44 — .25" Mtg. Dia.†



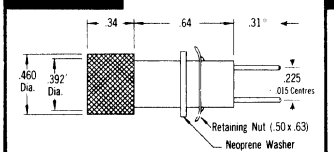
MODEL 61 — .375" Mtg. Dia.†



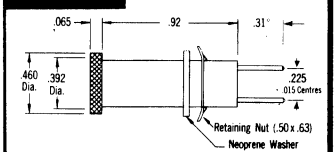
MODEL 62 — .375" Mtg. Dia.†



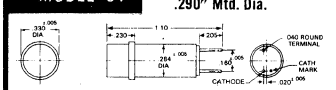
MODEL 63 — .375" Mtg. Dia.†



MODEL 64 — .375" Mtg. Dia.†



MODEL 91 — STD. CARTRIDGE .290" Mtd. Dia.



(available with LED, incandescent and neon lights)

NOTES: † Reducing collars available for other diameters. Neoprene Washer: Eliminates rotation of mounted unit

Terminals: Wire-Wrap, gold plated 0.025" square

* Other terminal lengths available (see Bulletin 7245)

On LED types, cathode terminal is shorter

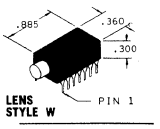
P.C. BOARD INDICATORS

T² Lite

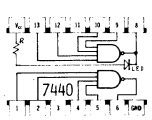
P.C. Board indicators with built-in lamp driver and choice of logic functions. Standard Dual-In-Line package includes:

- Choice of Standard 74 or 74H Series I.C.
- LED with limiting resistor or long-life Incandescent lamp with keep-alive bias resistor.
- Easily replaceable (if necessary) — use any standard DIP socket.

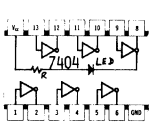
TYPICAL CIRCUITS (Others Available)



LENS STYLE W



LENS STYLE R



Note 1: Output at terminal 8 is used wherever available.
2: Parallel additional gates externally if higher current lamp is required with non-buffers.

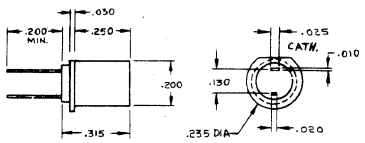
ELECTRICAL DATA: Typical @ 25°C ambient, 5 VDC. For I.C. data, consult any mfrs. data sheet.

	Lamp	ION	IOFF	Brightness	Yrs.
LED	SL 1	18MA	——	1200 FT-L	Over
	SL 2	35MA	——	2400 FT-L	50
	05	18MA	8MA	.04 MSCP	2
	1	60MA	20MA	.05 MSCP	18

LEDy-BUG

Model PC-3 for P.C. Board applications.
GaAsP Diode — Red

- Fresnel lens for best light diffusion
- Consistently high brightness (1500 ft-L @ 20 mA)
- Wide-angle viewing (180° Approx.)
- Centered LED for uniform light distribution



PRICING (ea.)

1-99	100-999	1000-4999
.89	.62	.55

HOW TO ORDER:

PC3 - SL1 - XX

- Model
- LED Type
- Lens Color: R = Red, Translucent; CR = Clear Red; W = White, Translucent; CW = Clear White

PRICE: All lamp types; lens style "W"

74 Series

Circuit Type	1-99	100-999	1000-4999
00,04,10, 20,30,40 51	$1.86	$1.35	$0.98
11,21 72,73,74	1.98 2.20	1.46 1.66	1.08 1.26
For Lens Style "R" add:	.12	.10	.08

HOW TO ORDER:

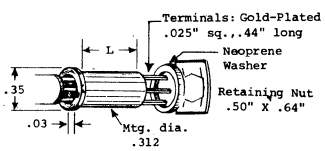
R 7440 - 05 - W 0

- R: Lens Style See Illus.
- 7440: Ckt. Lamp Type See Elec. Data
- W: Lens Colors — Translucent: W = White, *Y = Yellow, *A = Amber, R = Red, *B = Blue, *G = Green; Clear: = CW, = *CA, = CR, = *CB, = *CG
- 05: Min. Marking On Device
- For Lens Style R only
- 0: Collar Color — 0 = Black, 9 = White

* For Incandescent Only

ACCESSORIES

PANEL MOUNT SOCKET: For front panel replaceability of ¼" mounting units, when ordered as cartridge type. Add "C" before standard P/N, i.e. F42-A1-WO becomes CF42-A1-WO.



Color: Black Material: Acetal

Model	L	For Light Models
PS40	.95	41, 42, 43 F41, F42, F43 S41, S42, S43
PS44	1.07	44, F44, S44

TERMINAL ORIENTATION SAME AS LIGHTS

PRICE (all models)

1-99	100-999	1000-4999
.65	.50	.39

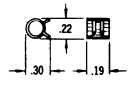
ORDERING INFORMATION

PS40 - 3

- Model No. (Table Above)
- No. of Terminals

Special Mounting Clips for closer centers, easier installation and removal with ordinary nose pliers.

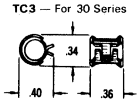
Part No.		10-99	100-999	1,000-9,999
TC3, TC4, or TC9	Alternate	.06	.045	.035
	Extra	.08	.06	.045



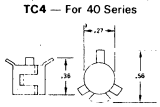
TC3 — For 30 Series

Crimp Terminals (Gold plated for .025" square Wire-Wrap posts)

Part No.	Wire Size	10-99	100-999	1000-4999
CS24	22-28GA	0.15	0.11	0.08

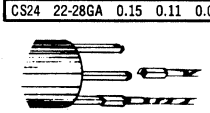


TC4 — For 40 Series



TC9 — For Model 91

Use with NW5 Neoprene Washer (see Bulletin 7245 titled Accessories)



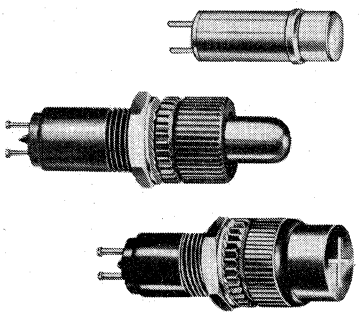
LEGENDS are available on all models: See Bulletin 7204.

ata DISPLAY PRODUCTS

5428 W. 104th Street, Los Angeles, Calif. 90045 • Phone (213) 641-1232

1,500,000 VISUAL INDICATORS

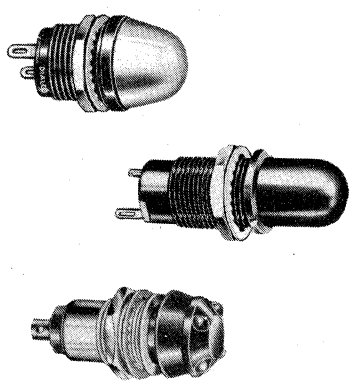
INDICATOR LIGHTS, ILLUMINATED SWITCHES, READOUT DISPLAYS



ULTRA-MINIATURE INDICATORS

Meet requirements of MIL-L-3661B. Incandescent, neon and LED. Mount in 3/8" clearance hole.

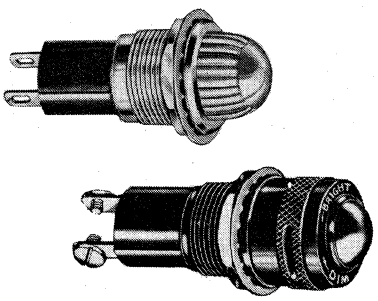
Ask for Catalog UM1200.



SUB-MINIATURE INDICATORS

Incandescent and neon. Mount in 13/32" to 17/32" clearance holes. Meet or exceed environmental requirements of MIL-L-6723 and MIL-L-3661B.

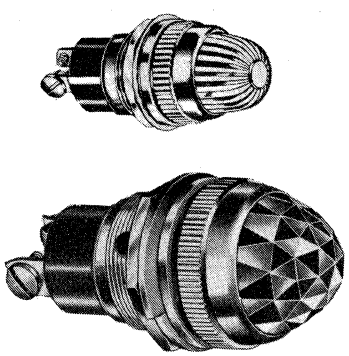
Ask for Catalogs L-157, L-158, L-178.



MINIATURE AND LARGE INDICATORS

Incandescent and neon. Miniature units mount in 9/16" or 11/16" clearance holes, large units in 1" or 1 3/16" hole. Wide choice of cap shapes and colors, also caps with mechanical dimming feature.

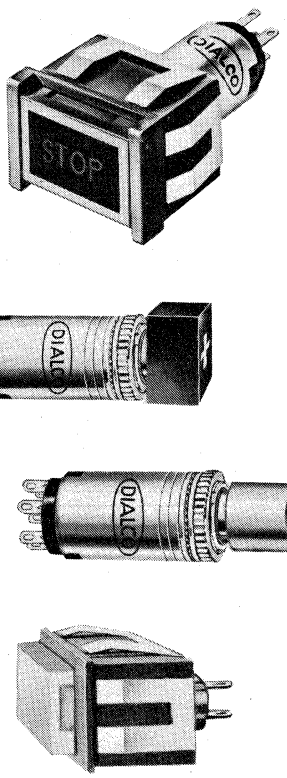
Ask for Catalog L-161.



OIL-TIGHT INDICATORS

Incandescent and neon. Mount in 11/16", 1" or 1 3/16" clearance holes. For heavy duty.

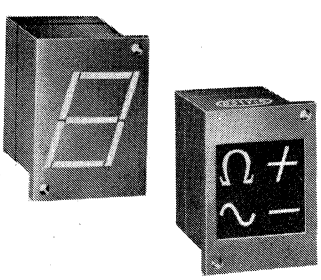
Ask for Catalog L-200.



LIGHTED SWITCHES AND MATCHING INDICATORS

Low-profile snap-in switches and standard mounting switches. Momentary non-snap, snap or alternate switch actions. Ratings up to 5 A. Cap sizes include 1/2" 5/8" and 3/4" round or square; 3/4" x 1" rectangle.

Ask for Catalog L-210.



SINGLE-PLANE READOUTS

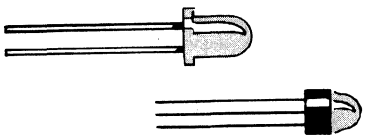
Incandescent and neon — 5 to 170 volts. 3/4" or 1" characters. Display 10 numbers and 10 letters. Compatible caption models.

Ask for Catalog L-181.

DIALIGHT CORPORATION
A NORTH AMERICAN PHILIPS COMPANY
• 60 STEWART AVE., BROOKLYN, N. Y. 11237 • AREA CODE (212) 497-7600

TO CHOOSE FROM DIALCO®

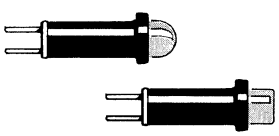
. . . AND INDUSTRY'S BROADEST LINE OF LED DISPLAY DEVICES



DIODE-LITE™ LIGHT SOURCES

Diffusing particles in plastic encapsulant provide large, soft light source for panel light, status indicator and A/N display applications.

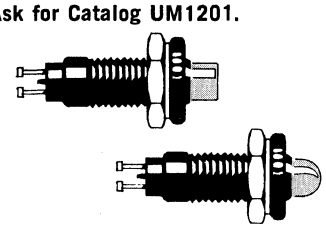
Ask for Catalog LS7001 & LS7011.



INDICATOR LIGHT CARTRIDGES

IC-compatible ultra-miniature cartridges with DIODE-LITE light source are interchangeable with incandescent types using DC power source. Red or amber.

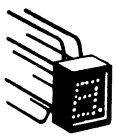
Ask for Catalog UM1201.



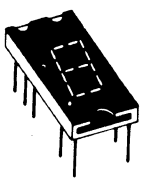
INDICATOR LIGHT ASSEMBLIES

Cartridge with DIODE-LITE in housing with mounting hardware ready for installation. Interchangeable with DIALCO ultra-miniature incandescent types.

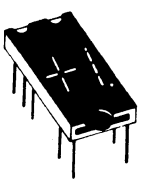
Ask for Catalog UM1211.



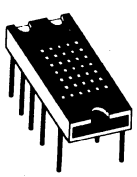
.125″ CHARACTER



.270″ CHARACTER



PLUS-MINUS ONE, .270″ CHARACTER

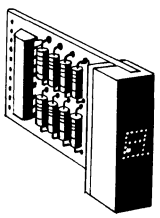


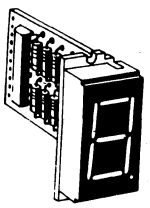
ALPHA-NUMERIC .300″ CHARACTER

READOUT MODULES

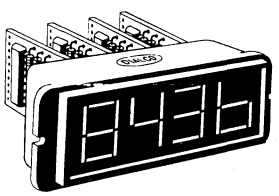
Character heights from .125″ to .625″. Dot, dot matrix and segmented formats for both numeric and full alpha-numeric displays. Wide angle (140°) viewing. IC compatible. See full readout catalog listing below.

.125″ OR .205″ CHARACTER

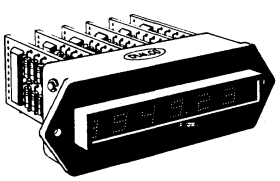




.625″ CHARACTER



.625″ CHARACTER



.125″ OR .205″ CHARACTER

READOUT PACKAGES AND ASSEMBLIES

Single-digit packages in character heights from .125″ to .625″ include decoder/driver and resistors mounted on PC board. Bezel assemblies ready for panel mounting available with up to 10 display packages. See full readout catalog listing below.

CURRENT DIALCO® LITERATURE

LIGHT SOURCES AND INDICATORS

LS7001 . . . 521 Series Gallium Arsenide Phosphide lamps
LS7011 . . . 521 Series Gallium Arsenide Phosphide lamps
LS7031 . . . 547 Series LED Circuit Board Indicator
LS7041 . . . 549 Series LED Pi-Pin lamp
UM1201. . . 507 Series Solid State Datalamp Cartridge
UM1211. . . 249 Series Solid State Indicator light

READOUT MODULES AND DECODER/DRIVERS

RO5001 . . . 745 Series Readout — .125″ character
RO5011 . . . 704 Series Decoder/Drivers
RO5051 . . . 745 Series Readout — .270″ character
RO5071 . . . 745-0005 Alpha-Numeric Display — .300″ character

READOUT PACKAGES AND ASSEMBLIES

RO5021 . . . 749 Series Readout Assembly — .125″ or .205″ character
RO5031 . . . 739 Series Readout Assembly — .625 character
RO5041 . . . 730 Series Readout — .625″ character
RO5061 . . . 740 Series Readout — .125″ or .205″ character

ADDITIONAL INDICATOR LIGHT CATALOGS

L-168 . . . . Sub-Sub-Miniature Indicators
L-170 . . . . Placard Lights
L-201 . . . . Press-to-Test Indicators
L-211 . . . . Flashing Indicators
CR680. . . . Cross Reference of Dialight Catalog Nos. to Military Type Designations & MS Drawings

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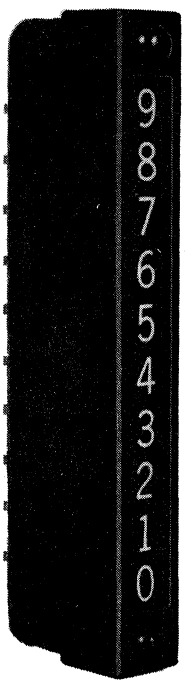
A NORTH AMERICAN PHILIPS COMPANY

d² display devices

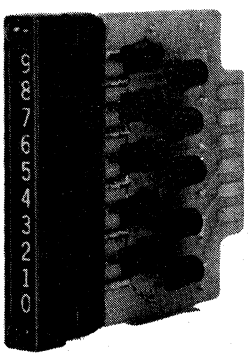
DIGISTRIP front relampable DIGITAL DISPLAYS

For a wide range of console and instrument display applications. Can be mounted horizontally or vertically, directly on p.c. boards, or ganged for high-density readout.

All Digistrip models are available with standard 0-9 legend, or with custom read-out information.



Digistrip II
3″ legend area.



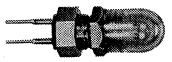
Digistrip I with high-gain transistor drivers on integral printed circuit board.

Digistrip I
1½″ legend area.

MINIATURE T-1 INDICATOR LIGHTS

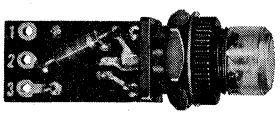
Designed to provide the brightest light in the least space. Available off-the-shelf, or designed to your application.

QUICK-LENS
Front-relampable miniature indicator light with built in light reflector for maximum brightness, even in high ambient light.

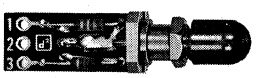


MINI-LENS
Front relampable, micro-miniature indicator light, featuring minimum panel spacing. Can be RFI shielded. Threaded body can mount directly to panel.

FLUSH-LENS
For panel mounting without protrusion. Available with RFI shield. Unit is relampable from rear of panel. No solder connections required.

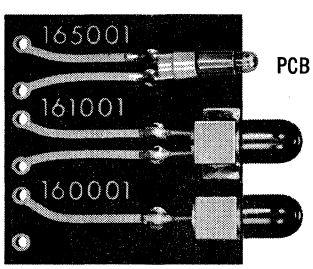


TRANS-LENS



TDML

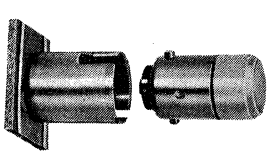
Each front relampable, with high-gain transistor driver on compact, integral p.c. board. Minimum depth behind panel. Both available in "bare board" configuration for customer to install own components. Trans-Lens is transistor-driven version of Quick-Lens; TDML is transistor-driven version of Mini-Lens.



PCB LIGHT

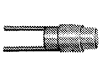
P.C. BOARD INDICATORS

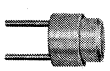
SINGLE-SIDED BOARDS
DOUBLE-SIDED BOARDS
] TEST LENS

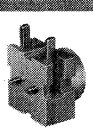


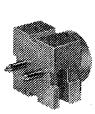
ADAPTER LENS AND SOCKET

Midget T-1¾ flanged base lamp adaptor used with T-3¼ printed circuit mounted socket. Furnished with or without integral color filter.



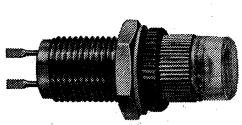






T-1 UNBASED ---------- **T-1¾ BI-PIN** ----------

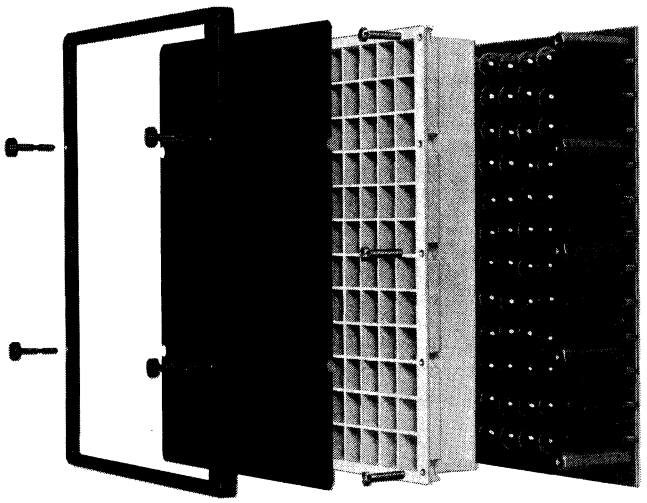
Basic sockets for custom designed lamp holders or p.c. board mounting used as lighting chassis for back lighted display. Also available in side mounting.



TWIST-LENS
Quick-change lens, available in clear or colors. Waterproof and RFI shielded units available. Uses T-1¾ Bi-Pin base lamp for high brightness.

All illustrations are actual size

d² display devices, inc
mailing address: **p. o. box 667 encinitas, california 92024**
plant location: **second and E streets (714) 753-0113**



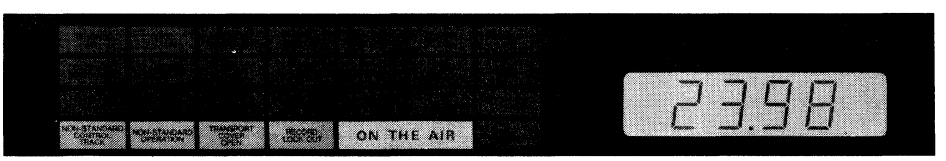
panels and laminates

BACK LIGHTED PANELS

Exploded view shows a typical backlighted panel application with printed circuit board lighting chassis containing lamps and sockets, light baffle (eggcrate) to divide message areas, and legend screen with front bezel. Application shown is relampable from front of panel. Rear relamping is also available.

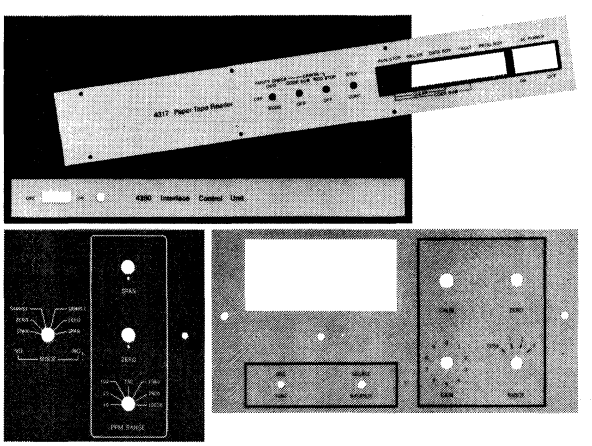
POLYESTER DEAD FRONT LAMINATES

Used in conjunction with backlighted panels, or provided separately, are DF991 legend screen laminates. Except for permanently visible graphics that may be desired all nomenclature is invisible until backlighted. Standard background is black, but colored dead front laminates are also available. .010" and double .010" thickness are used.



POLYCARBONATE AND ACRYLIC LAMINATES

Offered in dead front as noted above for polyester laminates. Thickness ranges from .020" to .250". Used for LED devices as well as incandescent lamps. All laminates are provided with or without pressure sensitive adhesive backing, depending upon application. All laminates feature color matching to FED STD 595, Pantone, or customer supplied color chips.



NON-ILLUMINATED LAMINATES

Supplied on .010" adhesive backed polyester film non-illuminated laminates are used to replace conventional painting and printing of metal panels. Screen printing of graphics is sub-surface to protect markings from being scratched off. Holes for switches, knobs, etc. are steel rule die cut. Background color is matched to customer requirements.

Write for detailed specification sheets

display devices, inc
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plant location: **second and E streets (714) 753-0113**

DRAKE INDICATOR LIGHTS..

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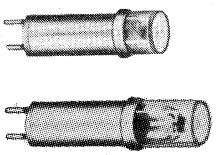
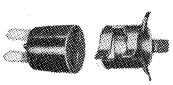
CARTRIDGE



— **LAMPS,** bodies aluminum, 6 volts and up, long life incandescent or neon, fit Drake or any mfgr.'s holders. Inexpensive all plastic cartridges also available.

— **LAMPHOLDERS,** black anodized aluminum, indexed to accept lamps with legends; ideal for data processing or other computer applications — commercial or Military.



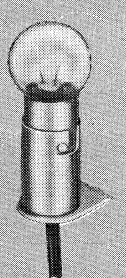
— **CONNECTOR AND FASTENER,** economical for commercial application with cartridge lamp eliminating lampholder.

ALL PHOTOS THIS PAGE APPROX. ¾ ACTUAL SIZE

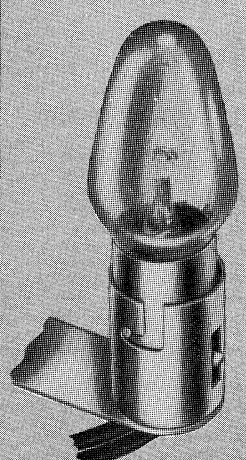
LAMPHOLDERS

Thousands of lampholder and bracket combinations for any application. The more popular are detailed in Brochure 6504 or Data Sheets 7217-A, 7301-A and 7307.

"MIDGI-WEDG" — Midget Wedge — Inexpensive, subminiature, ideal for equipment designs with space at a premium, with lugs or wire leads. Printed circuit units are also available. ←



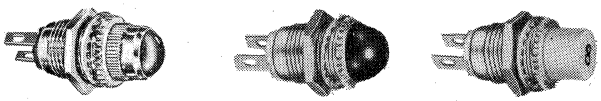
MINIATURE BAYONET — For instruments, radio, TV, automotive, marine and other miniaturized devices, with and without housings. →



CANDELABRA SCREW — For illumination, on-off indicators in appliances and other equipment. →

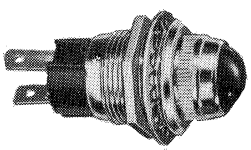
DC CAND. BAYONET — Rugged construction for appliances, vending machines and automotive. ←

"TINYLITES"



Exclusive Drake, economical, use midget screw base lamp for limited space requirements (overall size occupies only ⅓ cubic inch of space). Lenses: Convex w/bezel, dome, or flat faced lens with or without legend.

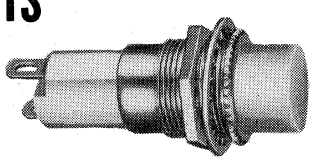
"PSB" SLIDE BASE INDICATOR LIGHTS



Uses Sylvania PSB slide base lamps; choice of 9 styles of lenses and solder or screw base lugs.

"DELUXE MOLDED" INDICATOR LIGHTS

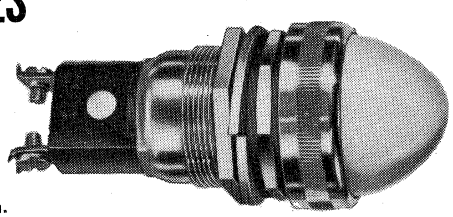
Request Data Sheets 6809, 7102 & 7103



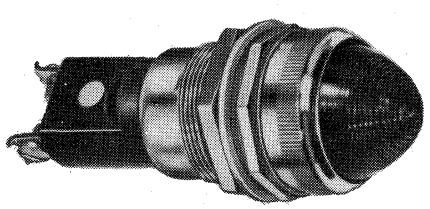
Drake's durable and finest — using T3¼ min. bayonet lamps and 120 V. incandescent for commercial application. Incandescent or neon. Screw or friction fit lenses of many shapes and variety, also mech. dimmer for Military use. "Titelite" type for water-proof and oil-tite application.

"TITELITES"

Request Data Sheet 7308



1¼" Lens Dia.



1" Lens Dia. Available for MIL-L-3661/38

Oil, water or dust-proof indicator lights with many lens styles for most incandescent lamps.

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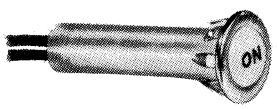
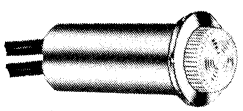
"GLO-LITES"

NEW "Slender Glo-Lite"



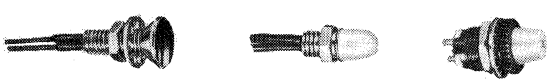


Drake just introduced the "Slender" Glo-Lite featuring a press fit to mount, no additional fastener necessary, fits 5/16" Dia. panel hole on 7/16" centers. Folder 7203-A.

The regular "Glo-Lites," larger in diameter, are commercial one-piece nylon, amber, red or white body and lens (flush or protruding lens with or without metal bezels). Built-in resistor and long life neon lamp. Choice of "Twist-Mount" plug button or nut mount; wire or lug termination. Regular "Glo-Lites" Folder 7212.

ALL PHOTOS APPROXIMATELY ¾ ACTUAL SIZE.

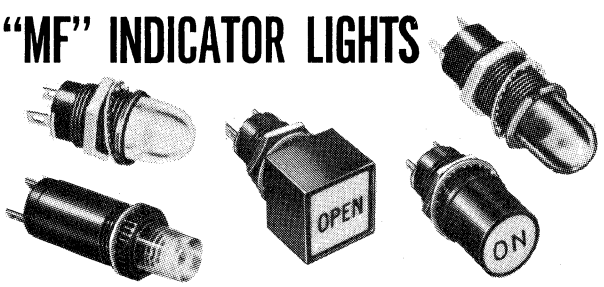
"ASTROLITES" and "GEMLITES"



"Astrolites" — Military or commercial — are Drake's tiniest, with built-in long life incandescent T1 lamp. Choice of 5, 12 volts; wire leads.

"Gemlites," small for commercial application with 2 lug termination using T1 Sub-Midget Flanged replaceable lamp in 5, 12 and 28 volts.

"MF" INDICATOR LIGHTS



Incandescent and neon Midget Flanged lamps are used both for commercial and Military having hundreds of varieties, lens shapes and colors including "Press-to-Test," "Titelite," etc. **Request "SPICE OF LIFE"-7100 Brochure.**

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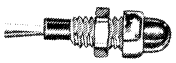
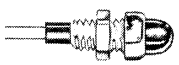
SOLID STATE INDICATOR LIGHTS

NEW!

"SOLID STATE ASTROLITES"



With Wire Leads
6039-004-304



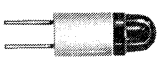
With Wire Terminals
6039-005-304

L.E.D. CARTRIDGES

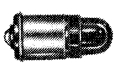
Without Lens -304

With Cylindrical Lens -604

BI-PIN & MIDGET FLANGED L.E.D.'s



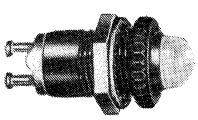
(ANS) 7324



(ANS) 322

For details write for Solid State Data Sheet 7201

L.E.D. INDICATOR LIGHT



Series 6200

D.C. or A.C. 2.2 thru 28 Volts available.
For details write for Data Sheet 7402

ONLY ABOVE PHOTOS - ACTUAL SIZE

DRAKE

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on the Complete Drake Line

Lit. No.	Description
6504	Lampholders (Includes D. S. 7205, 7217-A, 7301, 7307)
6802-B	Cartridge Lamps and Holders
7100	Midget Indicator Lights
7200-A	Distributor Catalog Sheet
7201	LED Indicator Lights (Includes 7313 and 7402)
7203-A	"Slender Glo-Lite" Indicator Lights
7212	Larger Dia. "Glo-Lites" Folder
7214	"Lab-Lite Kits"
7304	"Slender Glo-Lite" Cross Ref.
7305	Illuminated Switch and Companion Indicator Lights
7308	"J" Slot Bezel 1" Lens and 1¼" Lens Ind. Lights
7315	P. C. Board Cartridge Connector
7316	Midgi-Lite
7317	Military Cross Reference
7323	How To Order and Representative Listing
7401	Chart All Indicator Lights
7403	Instrument Lights
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7406	UL and CSA Approved Components
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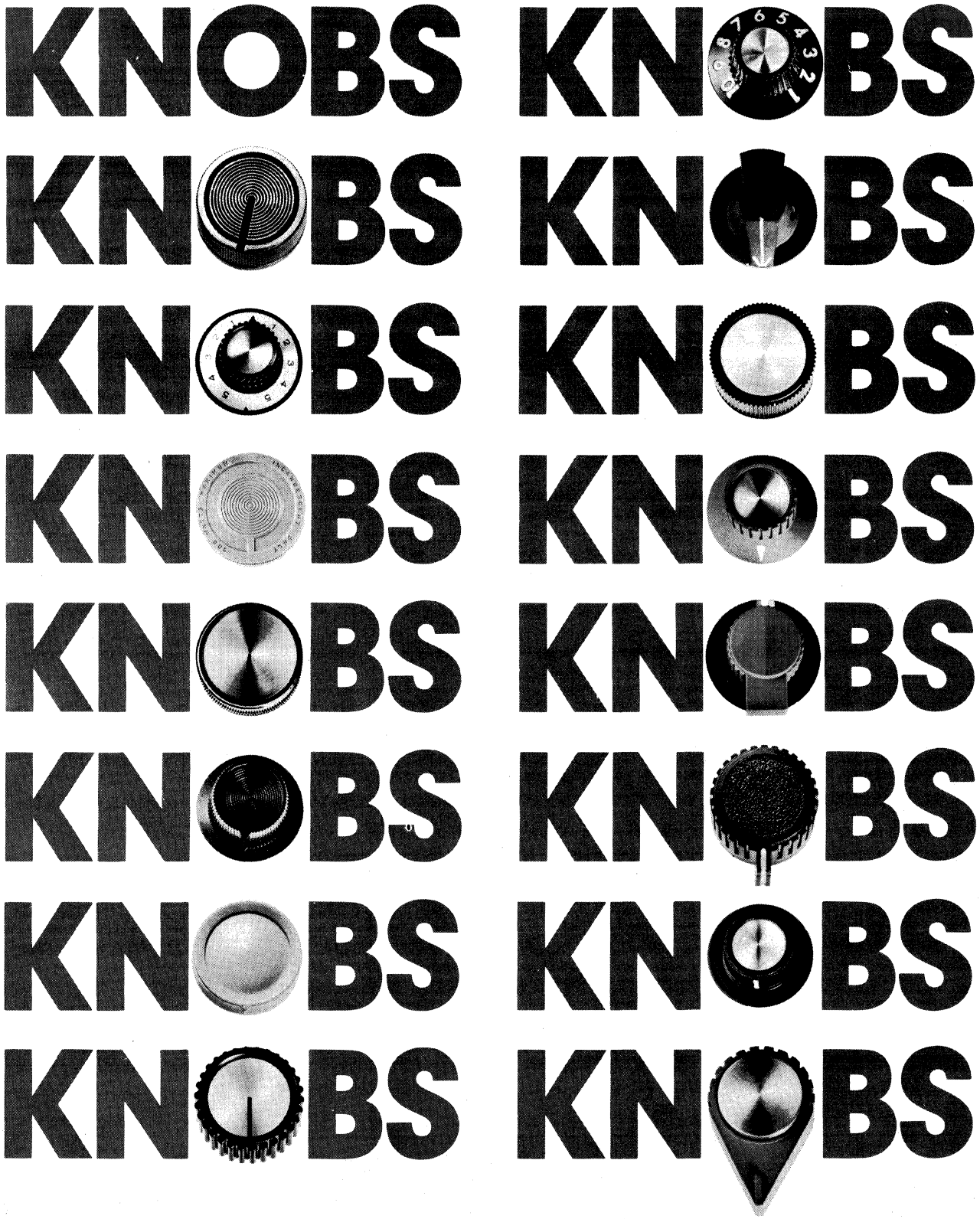

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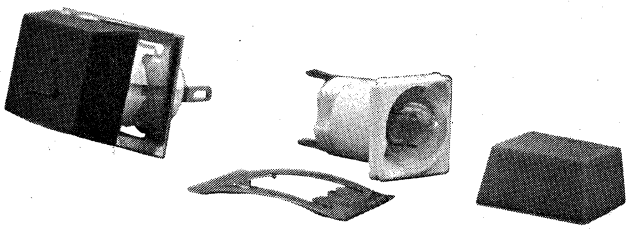
INDICATING LIGHTS

CR103 TYPE B MINIATURE SQUARE INDICATING LIGHTS



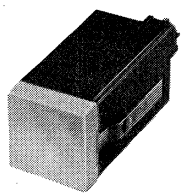
The CR103 Type B general-purpose miniature indicating light is a small, "square look" unit that provides positive visual indication on control panels and consoles, data processing equipment, and wherever production and automated systems exist. A complete light consists of a base unit with bulb, lens and spring clip.

FEATURES

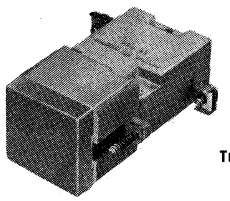
2-pin type lamp replaceable from front of panel; interchangeable lenses of snap-on construction; choice of red, white, green, or yellow lenses; optional arrow indicator on lens ideal for flow charts; low power requirement of 6, 12, or 24 volts; simple one-hole mounting.

Write for Bulletin GEA-7398

CR103 TYPE C SQUARE INDICATING LIGHTS



Full-voltage type



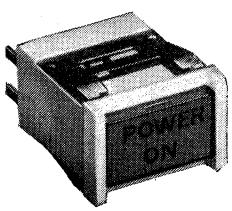
Transformer type

CR103 C square indicating lights are designed for use in a wide variety of applications such as: business machines, operator panels, consoles, control desks, motor control centers, and for the panel building, electronic and intrumentation fields.

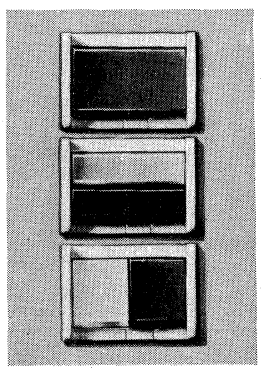
Full voltage and transformer types in a variety of colors are available. Lenses may be translucent type or transparent type used with a diffuser. Legends can be engraved and filled on translucent lenses.

Write for Bulletin GEA-7366

CR103 TYPE D INDICATING LIGHTS



With solid lens cap installed



Solid or split color fields give added flexibility. Colors can be mixed in the split field forms for even more combinations.

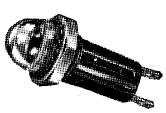
General Electric's new line of CR103 Type D indicating lights are designed for a wide variety of applications such as control and instrument panels, office machines, laboratory instruments, computers and other data processing equipment. Matching illuminated push button switches are shown in Section 5100 on page of General Electric switches.

FEATURES

- Units snap into panels from front without tools, and can be gang-mounted horizontally to save space or for group functions.
- Convenient slide-on lens caps in five colors; four housing colors. Units are single button only. and have solid horizontally- or vertically-split color fields. 2-lamp and 4-lamp forms are available.
- Legend inserts for all forms can be printed or engraved on acetate or similar material of 10 mils or less thickness.

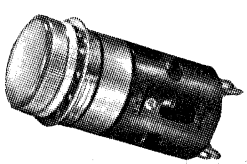
Write for Bulletin GEA-7390

CR103 TYPE H INDICATING LIGHTS

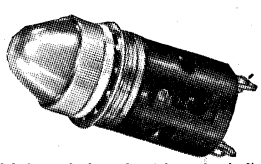


With spherical lens for $1\frac{1}{16}$-in. mtg. hole

With crown lens for $1\frac{5}{32}$-in. mtg. hole



With crown lens for 1-in. mtg. hole



With torpedo lens for 1-in. mtg. hole

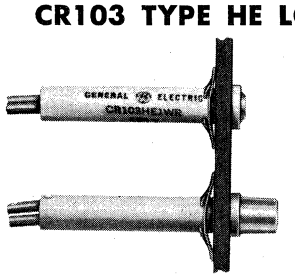
CR103 Type H indicating lights give bright visual indication of circuit operating conditions for applications where oil-tightness is not required.

FEATURES

- **Vivid Colors** — yellow (amber), blue, green, red, white and clear.
- **Even Illumination** — Lexan diffuses light and gives off an even glow.
- **Durable** — lenses will not shatter, resist high temperatures.
- **Compact** — forms for $1\frac{5}{32}$, $1\frac{1}{16}$, or 1-inch mounting holes.
- **Rating Flexibility** — wide variety of lamp voltages available. Lamp is supplied by the customer.
- **Ease of Installation** — lamps and lenses install from the front.

Write for Bulletin GEA-8119

CR103 TYPE HE LOW-COST MINIATURE INDICATING LIGHTS



CR103 Type HE indicating lights are new, low-cost units for applications requiring a minimum of space. They are ideally suited for business machines, major appliances, small panels, meters, gages, timers, illuminated pointers, dial indicators, and many other places where panel appearance and visual display are important.

Only $1\frac{11}{16}$" long, they mount with a speed nut in a $\frac{5}{16}$" dia hole. Choice of amber, clear, red, or white lenses in flush or cylindrical lens style. Body colors are black, gray, tan, or white. For 120, 240, or 480 volts.

Write for Bulletin GEA-8119

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section **988-60.** Schenectady, N. Y. 12345.

GENERAL ELECTRIC

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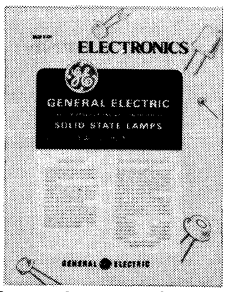
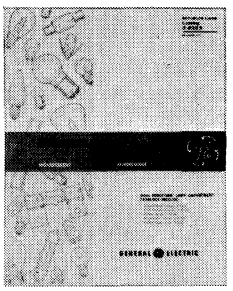


Solid State Lamps: 4 pages. Data covers 11 infrared and 4 visible Solid State Lamps, previously called Light Emitting Diodes, plus 2 SSL Numeric Readout displays. Diameter range 0.080" to 0.230".

Solid State Lamps (3-1240)

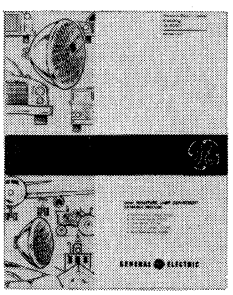
Sub-Miniature Lamps: 24 pages. Data covers over 200 sub-miniature lamps. Diameters ¼" and smaller. Lamp life up to 60,000 hours.

Sub-Miniature Lamps (3-6252)



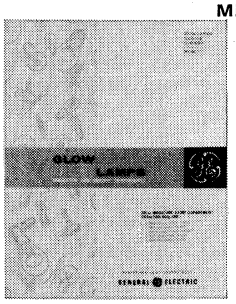
Miniature Lamps: 40 pages. Data covers over 500 miniature lamps ranging up to 20,000 hours average rated life. With a design voltage range of from 1.2 to 55, and candlepower range from .02 to 250. Diameter range from 11/32" to 2 1/16".

Miniature Lamps (3-6253)



Sealed Beam Lamps: 16 pages. Data covers over 180 Sealed Beam lamps, ranging from 4½" to 8" in diameter, with a design voltage range of from 4.0 to 115, and initial candlepower of from 150 to 600,000.

Sealed Beam Lamps (3-6251)



Glow Lamp: 8 pages. Data covers 77 Neon Glow Indicator and Circuit Component lamps. Diameters ranging from ¼" to 1¾".

Glow Lamps (3-6254)

GE makes over 1000 miniature lamps. There's one for practically every application. You can save time and money by selecting the lamp you need before your product design is frozen. Consider factors like size, power source, shock, life, light, temperature and assembly cost. Get complete and up-to-date electrical and physical specifications from the five updated General Electric catalogs shown above.

To order your new ones, contact one of the offices below, or write General Electric Company, Miniature Lamp Products Department, Inquiry Bureau, #EEM, Nela Park, Cleveland, Ohio 44112.

GENERAL ELECTRIC

For helpful service contact one of these offices:

ATLANTA, GA.	120 Ottley Drive, N. E. P.O. Box 13917	30324	875-0921
BALTIMORE, MD.	1401 Parker Rd. Mail: P.O. Box 7427, Baltimore, Md.	21227	242-5700
BOSTON, MASS.	50 Industrial Place, Newton Upper Falls, Mass.	02164	332-6200
CHARLOTTE, N. C.	1001 Tuckaseegee Rd. Mail: P.O. Box 17362	28211	376-6585
CHICAGO, ILL.	550 West Jackson Blvd.	60606	332-4712
CINCINNATI, OHIO	49 Central Ave.	45202	421-6810
CLEVELAND, OHIO	12910 Taft Ave.	44108	266-4337
COLUMBUS, OHIO	800 Northwest Blvd.	43212	294-4115
DALLAS, TEXAS	6500 Cedar Springs Road	75235	351-3725
DENVER, COLO.	6501 Stapleton Dr., North	80216	388-4611
DETROIT, MICH.	15135 Hamilton Ave.	48203	883-0200
HONOLULU, HAWAII	413 Marine Finance Bldg. 1109 Bethel St.	96813	537-3280
HOUSTON, TEXAS	5615 Lymbar Drive	77035	923-2549
INDIANAPOLIS, IND.	2511-F-1 East 46 St.	46205	547-5511
N. KANSAS CITY, MO.	535 East 14th Ave.	64116	471-0123
LOS ALTOS, CALIF.	349 First St.	94022	948-5000
LOS ANGELES, CALIF.	2747 S. Malt Ave.	90040	723-2541
MEMPHIS, TENN.	2021 S. Latham St.	38109	948-2642
MIAMI, FLA.	3655 N.W. 71st St.	33147	693-3811
MILWAUKEE, WIS.	8100 West Florist Ave., Mail: P.O. Box 299	53201	462-3860
MINNEAPOLIS, MINN.	500 Stinson Blvd.	55413	331-4050
NEWARK, N.J.	133 Boyd Street	07103	824-5200
NEW ORLEANS, LA.	4800 River Road, Mail: Box 10236, Jefferson Branch	70121	835-6421
NEW YORK, N.Y.	219 E. 42 St.	10017	750-2000
OAKLAND, CALIF.	999-98th Avenue	94603	569-3422
OKLAHOMA CITY, OKLA.	Executive Terrace Bldg., 2809 N.W. Expressway	73112	842-4028
PHILADELPHIA, PA.	Rt. 202, At Expressway, King of Prussia, Pa.	19406	688-5900
PITTSBURGH, PA.	238 W. Carson St.	15219	471-9050
PORTLAND, ORE.	2800 N.W. Nela St.	97210	223-2101
RICHMOND, VA.	1510 Willow Lawn Dr., Mail: P.O. Box 8627	23226	282-7644
ROCHESTER, N. Y.	Gibbs St. Bldg., 31 Gibbs St., Room 500	14604	454-2990
ST. LOUIS, MO.	1530 Fairview Ave.	63132	429-6930
SALT LAKE CITY, UTAH	6501 Stapleton Drive N. Denver, Colorado	80216	388-4611
UTICA, N. Y.	c/o Radio Receiver Dept., P.O. Box 175, 1001 Broad St.	13501	733-0922

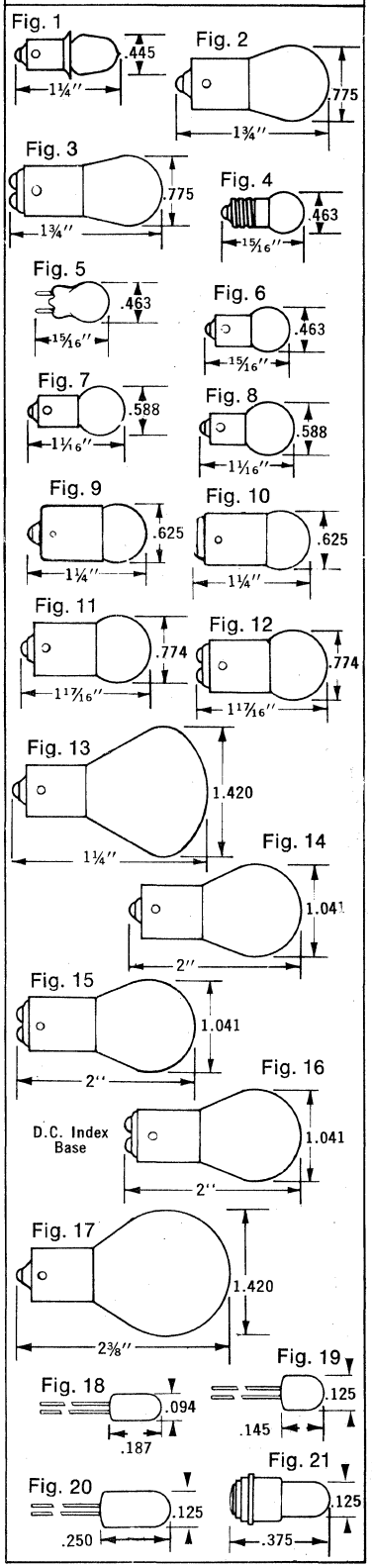
GTE SYLVANIA | MINIATURE LAMPS, SOCKETS & LENSES

Industry Standard Lamps For Complete Information Send for Catalog SD-1A

LAMP LISTING BY BULB SIZE, VOLTAGE

Bulb	Line No.	Lamp No.	Ordering No.	Volts	Amperes	M.S.C.P.	Fig. No.
B-3½	1	PR4	30304-0	2.33	.27	.40	1
	2	PR2	30302-0	2.38	.50	.80	1
	3	PR6	30306-0	2.47	.30	.45	1
	4	PR3	30303-0	3.57	.50	1.50	1
	5	PR7	30307-0	3.7	.30	.90	1
	6	PR13	30313-0	4.75	.50	2.20	1
	7	PR12	30312-0	5.95	.50	3.10	1
	8	PR18	30318-0	7.2	.55	5.5	1
B-6	9	1003	33639-0	12.8	.94	15	2
	10	1004	33641-0	12.8	.94	15	3
C-7	11	7C7	32104-5	115-125	7W		—
G-3½	12	123	32211-0	1.25	.30	.10	4
	13	14	32114-0	2.47	.30	.50	4
	14	13	32113-0	3.7	.30	.98	4
	15	12	32110-0	6.3	.15	.35	5
	16	51	32152-0	7.5	.22	1	6
	17	53	32156-0	14.4	.12	1	6
	18	53X	32159-0	14.4	.12	1	6
	19	1445	33768-0	14.4	.135	.7	6
	20	1447	33772-0	18.	.15	1.5	4
G-4½	21	136	32215-0	1.25	.60	.20	7
	22	27	32120-0	4.9	.30	1.4	7
	23	31	32122-0	6.15	.30	2.0	7
	24	55	32161-0	7.0	.41	2.0	8
	25	57	32163-0	14.0	.24	2.0	8
	26	57X	32164-0	14.0	.24	2.0	8
	27	1895	34116-0	14.0	.27	2.0	8
G-5	28	301	32306-0	28.0	.17	3.0	9
	29	302	32309-0	28.0	.17	3.0	10
	30	81	32187-0	6.5	1.02	6.0	11
	31	82	32189-0	6.5	1.02	6.0	12
	32	63	32167-0	7.0	.63	3.0	11
	33	89	32192-0	13.0	.58	6.0	11
G-6	34	67	32172-0	13.5	.59	4.0	11
	35	303	32312-0	28.0	.30	6.0	11
RP-11	36	1183	33705-0	5.5	6.25	50	13
	37	1133	33678-0	6.2	3.91	32	13
	38	1195	33708-0	12.5	3.0	50	13
S-6	39	6S6	32103-5	120	6W	—	—
S-8	40	87	32190-0	6.8	1.91	15	14
	41	88	32191-0	6.8	1.91	15	15
	42	93	32195-0	12.8	1.04	15	14
	43	93IF	32196-0	12.8	1.04	—	14
	44	1176	33701-0	12.8/ 14.0	1.34 .59	21 6	16 16
	45	1034	33656-0	12.8/ 14.0	1.80 .59	32 3	16 16
	46	1076	33670-0	12.8	1.80	32	15
	47	1157	33695-0	12.8/ 14.0	2.10 .59	32 3	16 16
	48	1156	33694-0	12.8	2.10	32	14
	49	305	32319-0	28.0	.51	15	14
	50	307	32324-0	28.0	.67	21	14
	51	308	32329-0	28.0	.67	21	15
S-11	52	309	32333-0	28.0	.9	32	17
T-¾	53	6833	36409-0	5.0	.06	.05	18
T-1	54	6832	36407-0	5.0	.06	.05	18
Short	55	7152	36425-0	5.0	.115	.15	19
T-1	56	680	33441-0	5.0	.06	.03	20
	57	682	33432-0	5.0	.06	.029	21
	60	683	33447-0	5.C	.06	.05	20
	61	685	33431-0	5.0	.06	.048	21
	62	713	33452-0	5.0	.075	.09	20
	63	714	33600-0	5.0	.075	.08	21
	64	715	33455-0	5.0	.115	.15	20
	65	718	33602-0	5.0	.115	.132	21
	66	6838	36413-0	28.0	.024	.15	20
	67	6839	36348-0	28.0	.024	.15	21

BULB/BASE COMBINATIONS



LAMP PRICES

Lamp No.	Line No.	Price Each 10	100	500
PR2	2	$ .15	$ .13	$ .11
PR3	4	.15	.13	.11
PR4	1	.16	.14	.11
PR6	3	.15	.13	.11
PR7	5	.21	.18	.15
PR12	7	.16	.14	.11
PR13	6	.15	.13	.11
PR18	8	.23	.20	.16
6S6	39	.36	.21	.18
7C7	11	.33	.19	.16
12	15	.21	.18	.14
13	14	.13	.11	.09
14	13	.13	.11	.09
27	22	.16	.14	.11
31	23	.20	.17	.14
41	92	.21	.18	.15
43	93	.21	.18	.15
44	98	.11	.09	.07
45	94	.18	.15	.12
46	99	.10	.09	.07
47	97	.11	.09	.07
48	90	.21	.18	.15
49	91	.18	.15	.12
51	16	.11	.09	.07
53	17	.12	.10	.08
53X	18	.17	.14	.11
55	24	.12	.10	.08
57	25	.13	.11	.08
57X	26	.14	.12	.09
63	30	.16	.14	.11
67	32	.17	.14	.11
81	34	.19	.16	.13
82	35	.19	.16	.13
87	40	.30	.25	.20
88	41	.30	.25	.20
89	31	.17	.14	.11
93	42	.25	.21	.17
93IF	43	.39	.33	.26
112	117	.13	.11	.09
123	12	.14	.12	.10
136	21	.18	.16	.13
158	105	.16	.14	.11
161	102	.16	.15	.11
168	109	.17	.14	.11
194	106	.16	.14	.11
222	118	.35	.30	.24
301	28	.36	.30	.24
302	29	.34	.29	.23
303	33	.34	.29	.23
305	49	.51	.43	.34
307	50	.51	.43	.34
308	51	.60	.50	.40
309	52	.68	.57	.46
313	114	.27	.23	.18
327	83	.54	.45	.37
328	72	.43	.36	.29
330	81	.72	.61	.49
331	69	.81	.69	.57
334	85	.81	.68	.55
344	75	1.51	1.16	.80
382	78	1.07	.91	.75
387	87	.61	.52	.42
388	89	1.27	1.08	.89
680	56	1.66	1.40	1.13
682	57	2.00	1.68	1.36
683	60	1.66	1.32	1.13
685	61	2.00	1.68	1.36

SYLVANIA MINIATURE LIGHTING PRODUCTS INC. 526 Elm Street, Kearny, New Jersey 07032/(201) 997-1850
West Main Street, Hillsboro, N.H. 03244/(603) 464-5533

GTE SYLVANIA | MINIATURE LAMPS, SOCKETS & LENSES

Industry Standard Lamps (continued)

LAMP LISTING BY BULB SIZE, VOLTAGE

Bulb	Line No.	Lamp No.	Ordering No.	Volts	Amperes	M.S.C.P.	Fig. No.
T-1¾	68	1728	33896-0	1.35	.06	.006	22
	69	331	33327-0	1.35	.06	.006	23
	70	7931	36201-0	1.35	.06	.006	24
	71	1784	33927-0	6.0	.20	.60	22
	72	328	33317-0	6.0	.20	.34 (@5 V)	23
	73	7328	36221-0	6.0	.20	.60	24
	74	1869	33992-0	10.0	.014	.004	22
	75	344	33337-0	10.0	.014	.004	23
	76	7344	36229-0	10.0	.014	.004	24
	77	2182	34224-0	14.0	.08	.30	22
	78	382	33369-0	14.0	.08	.30	23
	79	7382	36276-0	14.0	.08	.30	24
	80	2162	34211-0	14.0	.10	.5	22
	81	330	33324-0	14.0	.08	.5	23
	82	1764	33916-0	28.0	.04	.34	22
	83	327	33309-0	28.0	.04	.34	23
	84	7327	36245-0	28.0	.04	.34	24
	85	334	33329-0	28.0	.04	.34	25
	86	2187	34226-0	28.0	.04	.30	22
	87	387	33375-0	28.0	.04	.30	23
	88	7387	36266-0	28.0	.04	.30	24
	89	388	33376-0	28.0	.04	.30	25
T-3¼	90	48	32147-0	2.0	.06	.04	26
	91	49	32148-0	2.0	.06	.04	27
	92	41	32134-0	2.5	.50	.50	26
	93	43	32136-0	2.5	.50	.50	27
	94	45	32139-0	3.2	.35	.50	27
	95	1850	33977-0	5.0	.09	.25	27
	96	1847	33974-0	6.3	.15	.38	27
	97	47	32142-0	6.3	.15	.52	27
	98	44	32137-0	6.3	.25	.90	27
	99	46	32141-0	6.3	.25	.90	27
	100	1888	34104-0	7.0	.50	2.0	27
	101	1816	33950-0	13.0	.33	3.0	27
	102	161	32225-0	14.0	.19	1.0	28
	103	1815	33949-0	14.0	.20	1.4	27
	104	1891	34106-0	14.0	.24	2.0	27
	105	158	32223-0	14.0	.24	2.0	28
	106	194	32226-0	14.0	.27	2.0	28
	107	1889	34105-0	14.0	.27	2.0	27
	108	1893	34115-0	14.0	.33	2.0	27
	109	168	32241-0	14.0	.35	3.0	28
	110	1813	33946-0	14.4	.10	.86	27
	111	1819	33953-0	28.0	.04	.34	27
	112	1829	33962-0	28.0	.07	1.0	27
	113	1820	33955-0	28.0	.10	1.6	27
	114	313	32345-0	28.0	.17	3.5	27
	115	1864	33987-0	28.0	.17	3.0	27
T-4½	116	1495	33808-0	28.0	.30	6.0	29
TL-3	117	112	32208-0	1.2	.22	—	30
	118	222	32236-0	2.25	.25	—	30

BULB/BASE COMBINATIONS

Fig. 22

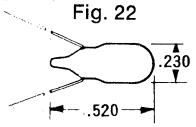


Fig. 23

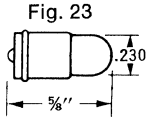


Fig. 24

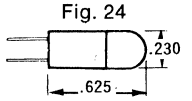


Fig. 25

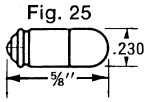


Fig. 26

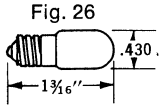


Fig. 27

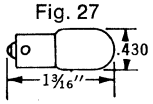


Fig. 28

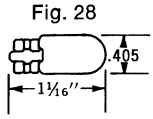


Fig. 29

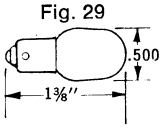


Fig. 30

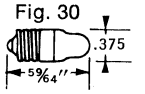
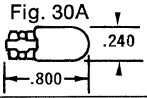


Fig. 30A



LAMP PRICES

Lamp No.	Line No.	Price Each 10	100	500
713	62	$1.66	$1.40	$1.13
714	63	2.00	1.68	1.36
715	64	1.66	1.40	1.13
718	65	2.00	1.68	1.36
1003	9	.25	.21	.17
1004	10	.25	.21	.17
1034	45	.34	.29	.23
1076	46	.39	.33	.26
1133	37	.45	.38	.31
1156	48	.35	.29	.23
1157	47	.34	.29	.23
1176	44	.32	.27	.22
1183	36	.59	.50	.40
1195	38	.90	.76	.61
1445	19	.16	.14	.11
1447	20	.17	.15	.12
1495	116	.36	.30	.24
1728	68	.41	.35	.28
1764	82	.45	.38	.31
1784	71	.62	.53	.43
1813	110	.22	.19	.16
1815	103	.19	.16	.13
1816	101	.19	.16	.13
1819	111	.28	.24	.19
1820	113	.30	.26	.21
1829	112	.29	.25	.20
1847	96	.15	.13	.10
1850	95	.29	.25	.20
1864	115	.38	.32	.26
1869	74	.98	.83	.68
1888	100	.23	.19	.15
1889	107	.17	.14	.11
1891	104	.13	.11	.09
1893	108	.15	.13	.10
1895	27	.18	.15	.12
2162	80	.56	.48	.39
2182	77	.54	.46	.38
2187	86	.79	.67	.55
6832	54	3.00	2.65	2.30
6833	53	2.18	1.83	1.47
6838	66	1.96	1.67	1.37
6839	67	2.39	2.03	1.67
7152	55	3.36	2.85	2.34
7327	84	.72	.61	.50
7328	73	.62	.54	.45
7344	76	1.23	1.05	.86
7382	79	.98	.83	.68
7387	88	.96	.82	.67
7931	70	.75	.65	.54

Most Popular Telephone & Switchboard Lamps (T-2 Bulbs)

Lamp No.	Ordering No.	Volts	Amperes	M.S.C.P.	End Foot Candles	Primary Service	M.O.L.	Fig. No.	Price Each For 10	100	500
6C	30630-0	6.0	.040	—	180	Switchboards	1 1/16	31	$.75	$.45	$.37
53B	35299-0	6.0	.240	.24	2000	Special Length Handsets	.797	32	.82	.49	.41
10ESB	31063-0	10.0	.040	.07	450	Keysets	.915	33	.76	.46	.38
51A	31069-0	10.0	.040	.05	450	Keysets	.915	32	.82	.49	.41
52A	32470-0	24.0	.030	—	600	Commercial Equipment	.915	32	.82	.49	.41
24E	32450-0	24.0	.035	.85	600	Switchboards	1 1/16	31	.75	.45	.37
24X	32495-0	24.0	.035	.85	600	Spec. Punched Base Switchbds.	1 1/16	34	.75	.45	.37
48C	34830-0	48.0	.035	—	425	Switchboards	1 1/16	31	.83	.50	.42
55C	35530-0	55.0	.050	—	1400	Switchboards	1 1/16	31	.83	.50	.42

Note: All lamps above except 53B may be ordered with other A.N.S.I bases. Consult factory.

DIMENSIONAL DRAWINGS

Fig. 31

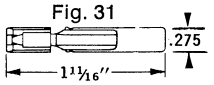


Fig. 32

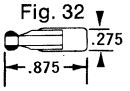


Fig. 33

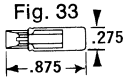
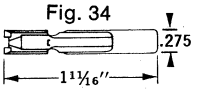


Fig. 34



SYLVANIA MINIATURE LIGHTING PRODUCTS INC. 526 Elm Street, Kearny, New Jersey 07032/(201) 997-1850
West Main Street, Hillsboro, N.H. 03244/(603) 464-5533

GTE SYLVANIA | MINIATURE LAMPS, SOCKETS & LENSES

Complete Pilot Lamp Assemblies for Panel Mounting (T-2 Bulbs)

Complete Voltage Range from 6 to 120 Volts
Life Up to 20,000 Hours

Description	Ordering No.	Volts	Amperes	M.S.C.P.	Fig. No.	Price Each 10	100	500
Lamp 6PSB	30672-0	6.0	.140	.12	35	$ .90	$ .54	$ .45
Lamp 12PSB	31272-0	12.0	.170	.35	35	.90	.54	.45
Lamp 24PSB	32472-0	24.0	.073	.50	35	.90	.54	.45
Lamp 28PSB	32972-0	28.0	.040	.29	35	.90	.54	.45
Lamp 48PSB	34872-0	48.0	.053	.70	35	.90	.54	.45
Lamp 60PSB	36072-0	60.0	.050	.73	35	.90	.54	.45
Lamp 120PSB	32072-0	120.0	.025	.36	35	.90	.54	.45
Metal Socket	30099-0				36	1.26	.76	.63
Jeweled Lens Red	30100-0				37	.60	.36	.30
Jeweled Lens Green	30102-0				37	.60	.36	.30
Jeweled Lens Blue	30103-0				37	.60	.36	.30
Jeweled Lens Amber	30106-0				37	.60	.36	.30
Transparent Lens Red	30110-0				38	.27	.16	.13
Transparent Lens Green	30112-0				38	.27	.16	.13
Transparent Lens Blue	30113-0				38	.27	.16	.13
Transparent Lens Amber	30111-0				38	.27	.16	.13
Transparent Lens Yellow	30114-0				38	.27	.16	.13
Transparent Lens Clear	30116-0				38	.27	.16	.13
Translucent Lens Red	30130-0				39	.27	.16	.13
Translucent Lens Green	30132-0				39	.27	.16	.13
Translucent Lens Yellow	30131-0				39	.27	.16	.13
Translucent Lens White	30133-0				39	.27	.16	.13

DIMENSIONAL DRAWINGS

Fig. 35

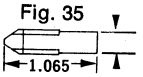


Fig. 36

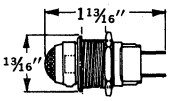


Fig. 37 Fig. 38 Fig. 39

Lower Cost Indicator Lamp Assemblies for Panel Mounting

Voltage Range from 4 to 48 Volts
Life up to 15,000 Hours

Description	Ordering No.	Volts	Amperes	M.S.C.P.	Fig. No.	Price Each 10	100	500
Lamp 4ESB	30450-0	4.0	.040	.03	33	$ .82	$ .49	$ .41
Lamp 6ESB	30650-0	6.0	.040	.03	33	.82	.49	.41
Lamp 10ASB	31040-0	10.0	.010	Glow	33	.82	.49	.41
Lamp 10CSB	31030-0	10.0	.017	.01	33	.82	.49	.41
Lamp 12ESB	31255-0	12.0	.040	.09	33	.82	.49	.41
Lamp 16CSB	31630-0	16.0	.017	.016	33	.82	.49	.41
Lamp 16ESB	31650-0	16.0	.040	.17	33	.82	.49	.41
Lamp 24CSB	32490-0	24.0	.017	.02	33	.82	.49	.41
Lamp 24ESB	32455-0	24.0	.040	.12	33	.82	.49	.41
Lamp 28ESB	32900-0	28.0	.040	.25	33	.82	.49	.41
Lamp 48ESB	34861-0	48.0	.040	.44	33	1.09	.66	.55
Panel Socket	30153-0	Use Lenses Below			40	.52	.31	.26
Round Lens Red	30160-0	Use with 30153-0 Panel Socket Above			41	.24	.15	.12
Round Lens Clear	30161-0				41	.24	.15	.12
Round Lens Amber	30162-0				41	.24	.15	.12
Round Lens White	30163-0				41	.24	.15	.12
Round Lens Green	30164-0				41	.24	.15	.12
Round Lens Blue	30165-0				41	.24	.15	.12
Square Lens Red	30170-0				42	.24	.15	.12
Square Lens Clear	30171-0				42	.24	.15	.12
Square Lens Amber	30172-0				42	.24	.15	.12
Square Lens White	30173-0				42	.24	.15	.12
Square Lens Green	30174-0				42	.24	.15	.12
Square Lens Blue	30175-0				42	.24	.15	.12
Strip Sockets—12 Hole	31250-0	½ inch Centers		Use Caps Below	43	4.87	2.94	2.45
Strip Sockets—12 Hole	31275-0	¾ inch Centers			44	4.87	2.94	2.45
Round Single Socket	30150-0				45	.38	.23	.19
Rectangular Single Socket	30151-0				46	.38	.23	.19

DIMENSIONAL DRAWINGS

Fig. 33

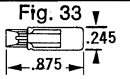


Fig. 40

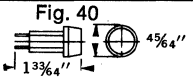


Fig. 41

Fig. 43
Slot size: 5⅞" long, .505-.510 wide, 1/16" radius at corner

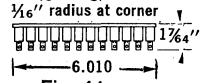


Fig. 42

Fig. 44
Slot size: 8⅞" long, .505-.510 wide, ¼" radius at corner

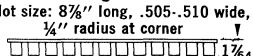


Fig. 45

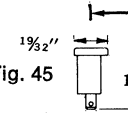
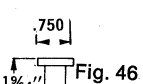
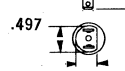
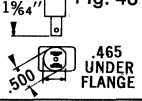


Fig. 46







The caps below may be used with **Strip Sockets** Round Single Socket (30150-0) and Rectangular Single Socket (30151-0).
Use Profax up to 24 volts and Pyrex over 28 volts or 1.2 watts.

SMALL PROFAX CAPS

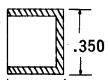
Color	Ordering No.
Red	37001-0
Yellow	37002-0
White	37003-0
Green	37004-0
Blue	37005-0

LARGE PROFAX CAPS

Color	Ordering No.
Red	38001-0
Yellow	38002-0
White	38003-0
Pearl White	38006-0
Green	38004-0
Blue	38005-0
Orange	38007-0

PYREX CAPS (Cemented to Bulb)

Color	Ordering No.
Red	38071-0
Yellow	38072-0
White	38073-0
Green	38074-0
Blue	38075-0



Price Each 10	100	500
$ .14	$.08	$ .07

P.C. Board Applications

Sylvania manufactures a complete line of lamps for printed circuit board applications. The T-¾, T-1, T-1¾, and T-2 lamps are available with .020" pins or with pin sockets which make the lamp easily replaceable. Typical examples are:

Bulb	Lamp No.	Ordering No.	Volts	Amperes	M.S.C.P.	Fig. No.	Price Each 10	100	500
Bulb T-¾	7112AS15	36442-0	5.0	.021	.034	47	$3.53	$3.00	$2.47
Bulb T-1	7022AS15	36438-0	5.0	.021	.034	48	2.20	1.87	1.54
Bulb T-1¾	7387	36266-0	28.0	.040	.30	24	.96	.82	.67
Bulb T-1¾	7387PS	36267-0	28.0	.040	.30	49	1.16	.99	.82
Bulb T-2	10ESTP	31052-5	10.0	.040	.07	50	.63	.53	.43
In addition the new wedge base lamps are becoming increasingly popular for PC applications.									
Bulb T1¾	73	33284-0	14.0	.08	.30	30A	.29	.25	.20
Bulb T3¼	194	32226-0	14.0	.27	2.0	28	.16	.14	.11
Bulb T3¼	650	33469-0	28.0	.50	.40	28	.39	.33	.26

DIMENSIONAL DRAWINGS

Fig. 24

Fig. 49

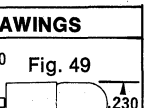


Fig. 47

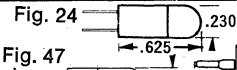


Fig. 48

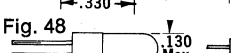
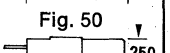


Fig. 50



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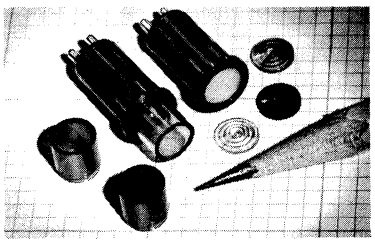
Indicator Lite selection trade-offs got you stymied?

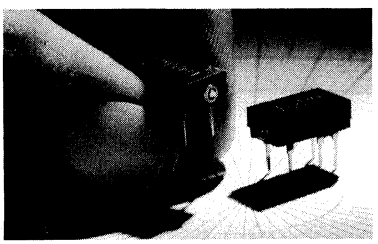
Turn to Eldema/Genisco for single-source solutions

Whatever your design requirements—miniaturization; economy; long-term reliability; mounting flexibility; solid-state, incandescent or neon light sources—You'll find the optimum answer in Genisco's extensive Eldema's indicator lite line.



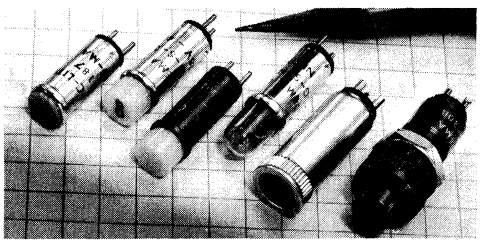
RIB-LOC® MINIATURE LITES. They're low-cost and convenient to install from the front of the panel. No mounting hardware needed. Their rugged polyamid molded "ribbed" housings fit firmly in 0.312" punched holes. Heat resistant polycarbonate lenses in standard colors are available. They use either long-life incandescent (T-1 3/4) or neon (NE-2H) lamps.

For details request Catalog BP-100.



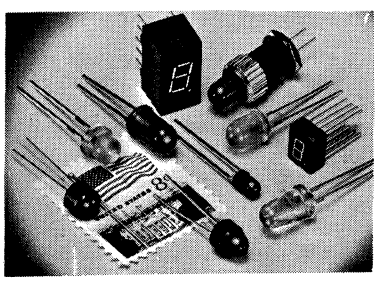
ID SOLID STATE STATUS INDICATOR. Compatible with IC logic levels, its MINI-DIP housing with 0.200" terminal spacing is designed for easy P.C. board mounting. Its LED lamp employs a unique lens to provide wide-angle viewing (160° or more). High brightness is achieved from only 5 VDC/10mA. The glass-filled phenolic molded case includes a built-in series resistor.

For details request Catalog ID-100.



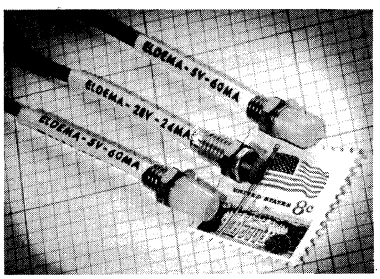
C-LITE CARTRIDGES/D-HOLDERS. Originated by Eldema, this concept has proven a reliable, space-saving and versatile solution for a host of applications. The 2-pin C-LITE cartridges are easily insertable, from the front of the panel, into single or multiple mating D-HOLDERS. They come in LED, incandescent or neon lamp versions. A complete range of plastic lens shapes and colors and standard lamp ratings from 3 to 28VDC are available as well as higher voltage and extended-life types. They meet MIL-L-3661 requirements.

For details request Catalog CD-100B.



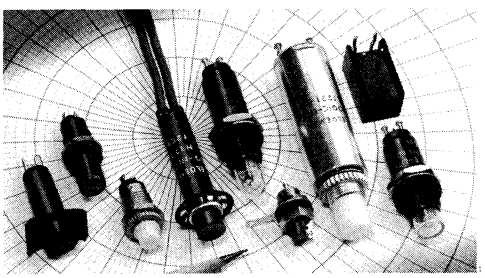
LED LAMPS/NUMERIC DISPLAYS. Eldema's broad line of LED lamps/numeric displays cover most requirements. They come in a wide variety of packages. Their low power consumption is compatible with IC outputs. High intensity, ultra-long-term operation is assured by their all-solid-state construction. They provide optimum viewing angles. The 7-segment numeric displays come in .122" and .270", nom., character height versions. Eldema also offers a low-cost mounting kit that allows lamp insertion from the panel front.

For details request LED Data Sheets.



J-LITES—Subminiature, high-reliability types. Meets requirements of MIL-L-3661. Their long-term reliability, low power requirements, resistance to shock and vibration, combined with easy, trouble-free installation and small size make them ideal for most any critical miniaturized application. They come in flat, dome or Fresnel dome lens configurations. Insulated wire leads simplify circuit interconnection. Front panel mounting in 0.193" holes. Available in LED, incandescent or neon lamp versions.

For details request Catalogs J-200, JD-100.



B-LITES. These miniature, low-cost, plastic units are easily mounted in 5/16" diameter holes with push-on retainers. They mount in a wide range of panel thicknesses and require minimum space behind the panel. The units come in LED or neon lamp versions and domed or flat-top lens configurations.

For details request Catalogs B-100 and SSL-100.

H-LITES. They're subminiature and relampable from the panel front with T-1 bulbs. They come in a variety of mounting styles for either 1/4" or 5/16" hole diameters. RFI and water-tight versions are available. forms to MIL-L-3661.

For details request Catalog HL-200.

E-LITES. Rugged Mil-type construction with black or clear anodized aluminum bodies, tin-plated terminals and high dielectric strength. They mount in panels up to 1/4" thick. LED or neon light sources. Domed or flat-top high impact lenses.

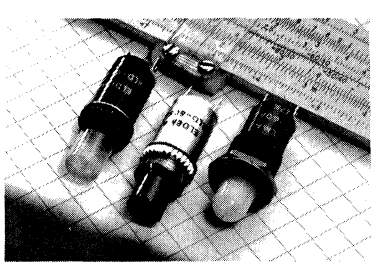
For details request Catalogs E-100A and SSL-100.

LOGIC-LITES®. Interfacing with IC levels, they incorporate active transistor-driver networks along with the lamp in a complete assembly. Various configurations are available for panel and PC board mounting.

For details request Catalog L-100.

Q-SERIES CLIPS/SOCKETS. Convenient and inexpensive, they are ideal to enhance mounting flexibility.

For details request Catalog Q-100.



R-LITES. Easy installation of lens caps and bulbs from panel front. Accommodates T-1 3/4 incandescent or T-2 neon midget flange-base lamps. Rear or front mounting configurations. Black or clear anodized finishes. Lens caps come in flat top, dome or skirted versions with either smooth or internal Fresnel rings. Available with moisture-seal gaskets. Eyelet-lug contacts simplify wiring. Meets requirements or MIL-L-3661.

For details request Catalog RL-200A.

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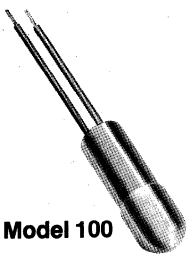
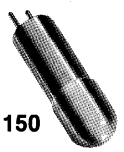
Sub-Miniature

100 Series



Model 100



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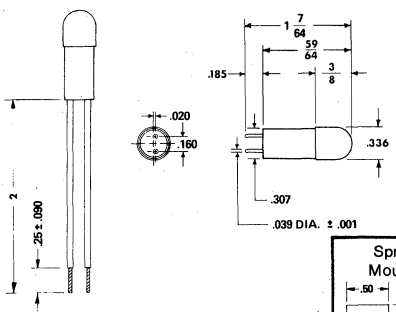
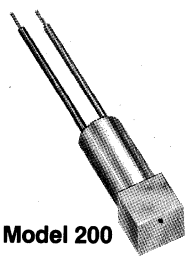


200 Series



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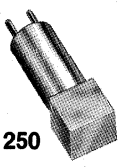

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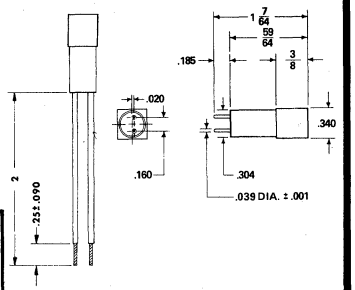
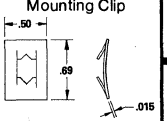
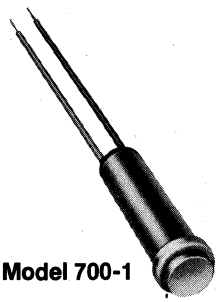


Spring Steel Mounting Clip



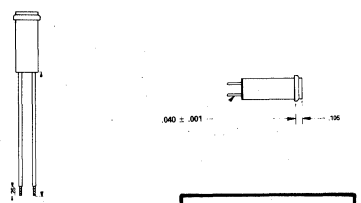
Phenolic Finish

700 Series

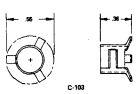


Model 700-1

Model 750-1

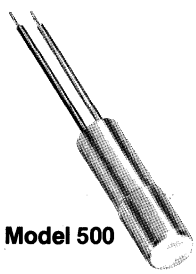


Optional

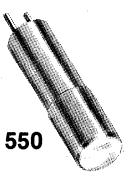


Barrel Fastner

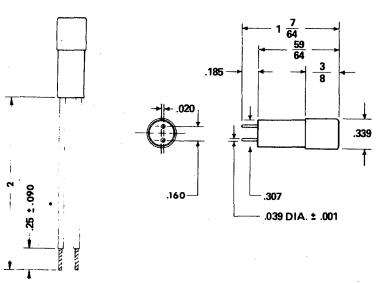
500 Series



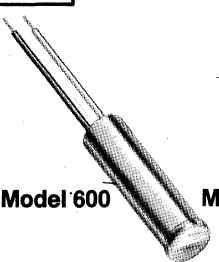
Model 500



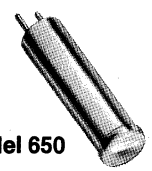
Model 550



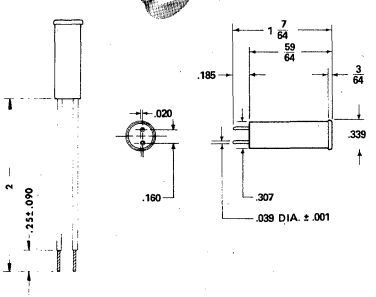
600 Series

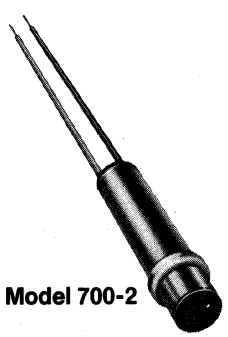


Model 600

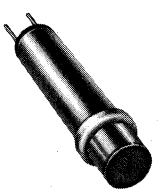


Model 650

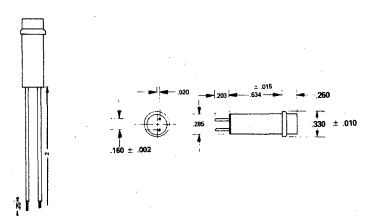




Model 700-2



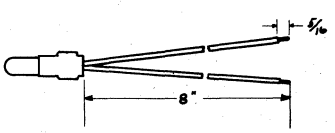
Model 750-2

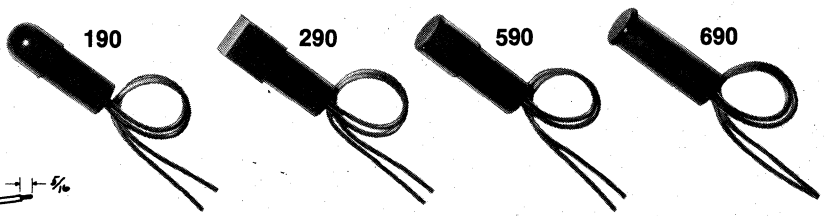


Economy Series

Incandescent only

Series 100
Series 200
Series 500
Series 600





Friction fit lamp units shipped unassembled.
Incandescent bulbs with 28 AWG insulated 8" stranded leads NOT sealed against moisture and dust.

General Illumination, Inc.
2256 Terminal Road, St. Paul MN 55113
Telephone: (612) 633-1388

Standard features

- Built-in T 1¾ incandescent or T2 neon bulbs.
- Standard termination - 2" stranded insulated leads (incandescent); 1¾" solid insulated leads (neon) or BiPins. (Other lead lengths available upon request).
- Rapid assembly with non-corrosive tinnerman speed nut (furnished).
- Ultra-Long life bulbs.
- Sealed against moisture and dust.
- Optically engineered lens provides full 180° visibility.
- Explosion proof - meets requirements of MIL-E-5400.
- Simplified one piece plastic constructed lens and body.
- Choice of five transparent and five translucent colors.

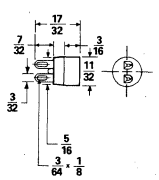
General specifications

- Front mounting in 5/16" clearance hole.
- Center-to-center spacing ½".
- Materials: high impact butyrate plastic body and lens: 22 AWG PVC 1/32" insulated leads; 105° C.; 600 volt (7/30), or BiPins - Brass ½ hard, gold plated.
- Hot stamping legends available; four 6 pt. (5/64"); three 8 pt. (3/32"); or three 10 pt. (1/8"), characters in black or white (not available on 100 series).
- Unless otherwise specified, all tolerances: .005 decimals, and 1/64" fractions.

Special features for 700 Series cartridge light

- Stainless steel BiPin terminal contacts (insulated from body) or 2" stranded insulated leads.
- Front mounting in 9/32" clearance hole.
- Rapid assembly with non-corrosive barrel fastener (optional).
- Anodized aluminum body - internally insulated.
- Assembly built to meet MIL-L-3661.

S-101 socket available for BiPin assemblies



Bulb specifications

Incandescent (use bulb type number)

Bulb Type	Operating Voltage	Current Amperes	Hours Life
High Brightness			
H524	5.0	.180	50,000
H529	6.3	.200	50,000
H533	10.0	.070	50,000
H538	14.0	.080	50,000
HM550	24.0	.037	7,000
HM553	28.0	.040	25,000
Standard Brightness			
M522	3.0	.015	10,000
M525	5.0	.036	90,000
M526	5.0	.066	10,000
M525	6.0	.039	75,000
M525	6.3	.040	50,000
M801	10.0	.014	10,000
M540	10.0	.036	100,000
M542	14.0	.035	20,000
HM550	18.0	.032	100,000
HM553	24.0	.037	150,000
M555	28.0	.040	50,000

Note: Other bulb types available upon request.

Neon (use bulb type number)

Bulb Type	Circuit Volts AC	Circuit Volts DC	Starting Volts AC	Starting Volts DC	Watts	Resistor Attached
High Brightness - Dark Starting						
C2A	115	150	95	135	1/4	None*
RC2X	115	150	95	135	1/4	30 k ohm
Standard Brightness						
A9A	115	115	65	90	1/15	None*
RA9X	115	115	65	90	1/15	100 k ohm

Economy version available — (unit not sealed and no insulation on leads). To order place "N" before bulb type.

NOTE: *Neon assemblies without resistor attached require a current limiting device in the circuit.

Lens color codes

(Use Color Code Numbers)

1	Transparent Amber	6	Translucent Yellow†
2	Transparent Red	7	Translucent Red†
3	Transparent Blue*	8	Translucent Blue*†
4	Transparent Green*	9	Translucent Green*†
5	Transparent Clear	10	Translucent White†

NOTE: *Blue and green lenses not recommended for use with neon bulbs.

NOTE: †Standard colors for 700 series vary slightly from standard colors Series 100 - 200 - 500 - 600.

How to order

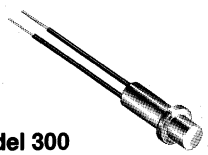
Example:

100	6	H538
Model	Lens Color	Bulb Type

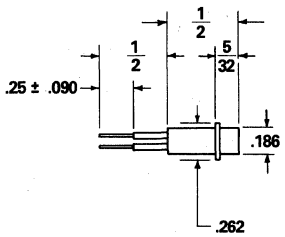
General Illumination, Inc.
2256 Terminal Road, St. Paul MN 55113
Telephone: (612) 633-1388

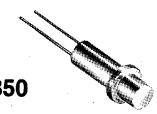
Ultra-Miniature

300 Series

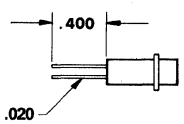


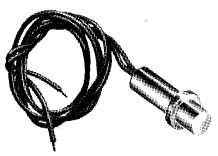
Model 300



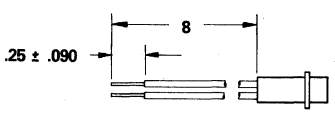


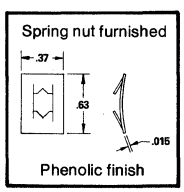
Model 350





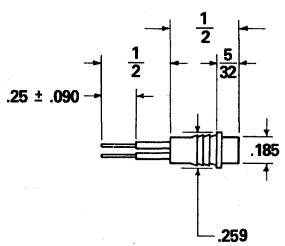
Model 390

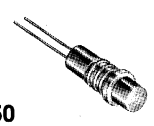




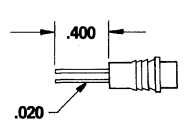
400 Series

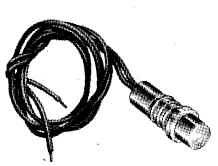
Model 400



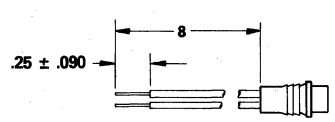


Model 450





Model 490



Standard features and specifications

- Built-in T1 incandescent; neon; or LED's.
- Standard termination - ½" (nominal) solid insulated wire leads (incandescent or neon) or BiPins or 8" stranded insulated leads (incandescent only). Other lead lengths available on request.
- Rapid Assembly - Front mounting into 3/16" clearance hole with non-corrosive tinnerman speed nut (300 series) or ribbed body for "snap-in" panel mounting (400 series).
- Center-to-center mounting space - 3/8" series 300, and 5/16" series 400.
- Sealed against moisture and dust.
- Optically engineered lens provides full 180° visibility.
- Explosion proof - meets requirements of MIL-E-5400.
- Simplified one piece plastic constructed lens and body.
- Choice of 5 transparent and 5 translucent colors.
- Materials: High impact butyrate plastic body and lens. 30 AWG solid PVC .010 insulated leads, 105° C. 300 volts. BiPin - nickel or gold finish.
- Hot stamping legends available: Two 6 pt. (5/64") or one 8 pt. (3/32") characters in black or white.

Bulb specifications

Incandescent (use bulb type number)

Bulb Type	Operating Voltage	Current Amperes	Hours Life
High Brightness			
HM609	5.0	.115	40,000
HM619	6.0	.066	18,000
HM619	6.3	.067	10,000
HM628	12.0	.060	16,000
HM642	28.0	.024	16,000
Standard Brightness			
HM605	5.0	.020	5,000
HM619	5.0	.060	200,000
HM628	10.0	.055	160,000
HM631	14.0	.023	200,000
HM642	24.0	.022	110,000

NOTE: Other bulb types available upon request.

Neon (use bulb type number)

Bulb Type	Circuit Volts AC	Breakdown Volts AC	Resistor Attached
M711	115	100	None*
RM711X	115	100	390K ohm

NOTE: *Neon assemblies without resistor attached require a current limiting device in the circuit.

Lens color code

1	Transparent Amber	6	Translucent Yellow
2	Transparent Red	7	Translucent Red
3	Transparent Blue*	8	Translucent Blue*
4	Transparent Green*	9	Translucent Green*
5	Transparent Clear	10	Translucent White

NOTE: *Blue and green lenses not recommended for use with neon bulbs.

How to order

Example:

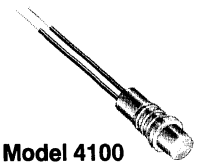
300	6	HM642
Model	Lens Color	Bulb Type

General Illumination, Inc.
2256 Terminal Road, St. Paul MN 55113
Telephone: (612) 633-1388

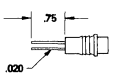
LED Indicators

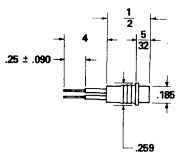
Ultra-Miniature

Model 4000



Model 4100





Operating specifications

Part No. XXXX-X-	Voltage	Current (mA)	Internal Resistor (Ohms)
001	1.6 - 2	20	None
002	5	20	220
003	6	20	220
004	10	20	470
005	12	20	470
006	15	20	680
007	28	20	1000

Standard features

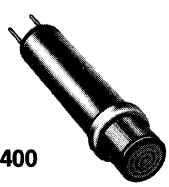
- High brightness LED.
- Ultra miniature size.
- One piece lens and body.
- IC compatible.
- Built-in resistor — to operate at a variety of voltages.
- Solid state reliability.
- Operating and storage junction temperature — 55° C to +100° C.
- Front of panel mounting into 3/16" clearance hole.
- Ribbed body "snaps" into panel (no mounting hardware required).
- Standard termination: 4" color coded insulated leads or BiPin. (NOTE: other lead lengths available).

How to order

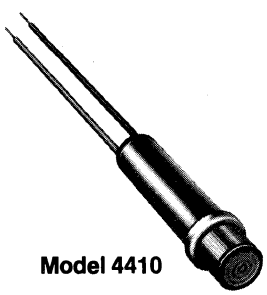
Example:

4100	2	005
Model	Lens Color	Voltage Requirement

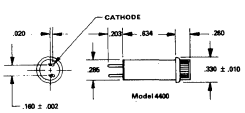
Cartridge

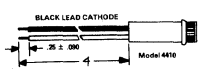


Model 4400



Model 4410





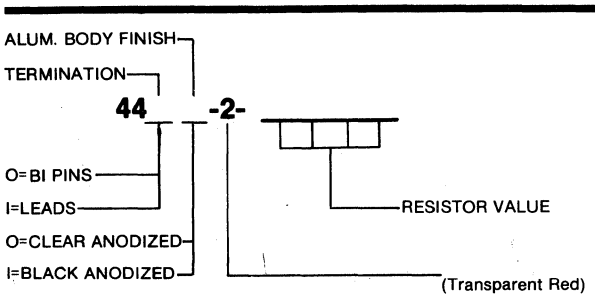
Operating specifications

Part No. XXXX-X-	Voltage	Current (mA)	Internal Resistor (Ohms)
001	1.5 - 2	50	None
002	5	73	47
003	6	35	180
004	10	20	430
005	12	15	820
006	15	10	1300
007	28	10	2700

Standard features

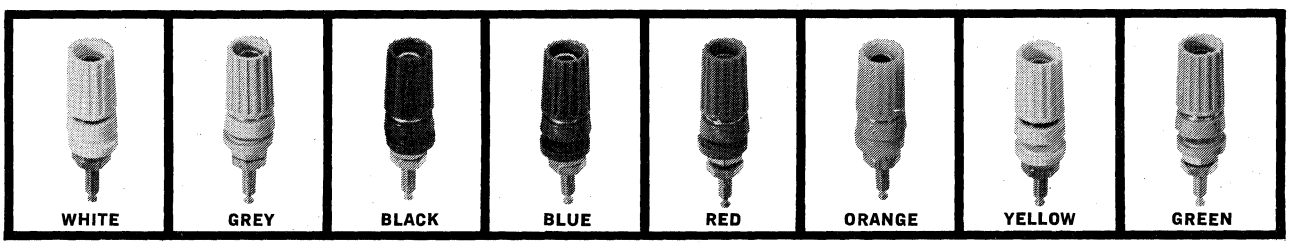
- High brightness LED.
- Long life.
- Solid state reliability.
- Bright clear or black anodized aluminum.
- Stainless steel polarized BiPins or color coded 4" stranded leads. (NOTE: other lead lengths available).
- Built-in resistor — to operate at a variety of voltages.
- Front panel mounting in .28" clearance hole.

How to order

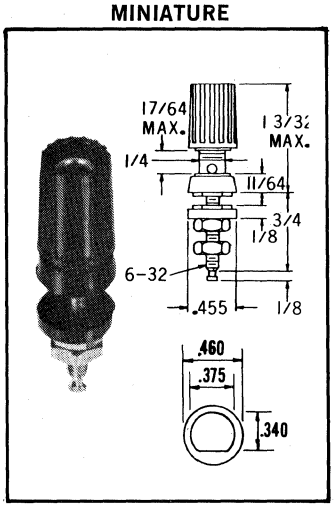


binding posts

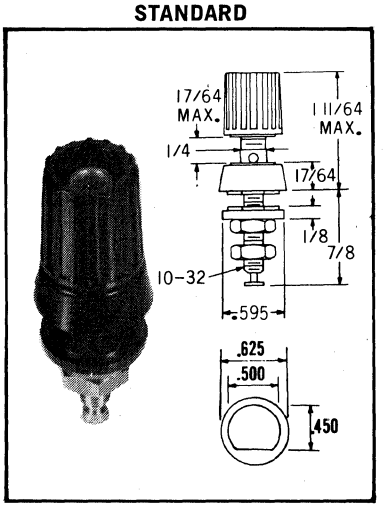
A high quality temporary input terminal for electronic instruments with sensitive and selective measuring capabilities. (See specifications section for voltage, ampere ratings and applicable military specifications.) The fluted design of the Binding Post knob matches any NOBEX control knob series for a co-ordinated front panel. All plastic parts of the assembly are injection molded of polycarbonate resin for excellent insulation resistance and dimensional stability. NOBEX Binding Posts are available in eight (8) standard opaque colors with custom colors available on special order. Series 810 and 820 Binding Posts are stocked with gold plated brass or copper inserts, Series 850 Dual Binding Posts with gold plated brass inserts. The assembly mounts in a round or "D" flat hole with insulator and two (2) brass hexagon nuts supplied for panel mounting. NOBEX Binding Posts are designed to be compatible with all commonly used methods of connection. NOBEX high quality is assured by a one (1) year factory replacement warranty.



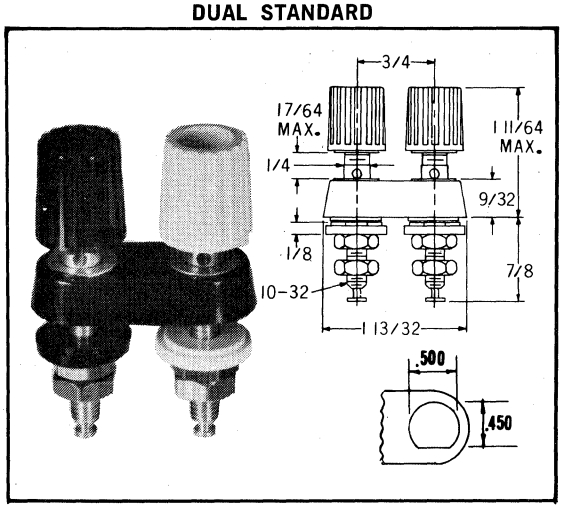
MINIATURE



STANDARD



DUAL STANDARD



ordering information

TYPE	INSERTS	WHITE	GREY	BLACK	BLUE	RED	ORANGE	YELLOW	GREEN
MINIATURE	BRASS	820-25	820-35	820-45	820-55	820-65	820-70	820-75	820-95
	COPPER	825-25	825-35	825-45	825-55	825-65	825-70	825-75	825-95
STANDARD	BRASS	810-25	810-35	810-45	810-55	810-65	810-70	810-75	810-95
	COPPER	815-25	815-35	815-45	815-55	815-65	815-70	815-75	815-95
STANDARD DUAL	BRASS	BLACK/BLACK			BLACK/WHITE			BLACK/RED	
		850-45-45			850-45-25			850-45-65	

specifications

Binding Post Locking Knob, Insulator and Washer

Injection molded of high heat and impact resistant Polycarbonate resin.

Shaft and Inserts

Brass with flash gold plating. Copper, tellurium alloy, flash gold plating.

Mounting Nuts

Brass, finished machined hexagon stock.

Service Rated

Standard Binding Posts are rated at 30 amperes, 1000 volts working. Miniature Binding Posts are rated at 15 amperes, 1000 volts working.

Polycarbonate Plastic exceeds Mil-P-20693, Type IV Military Specifications for nylon compounded parts.

Manufactured in U.S.A.

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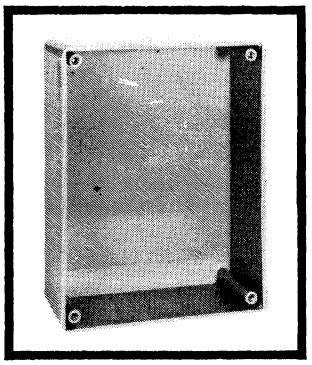
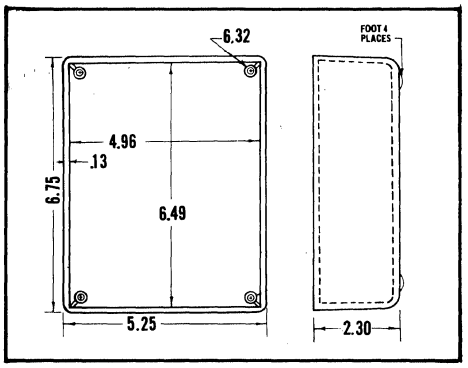
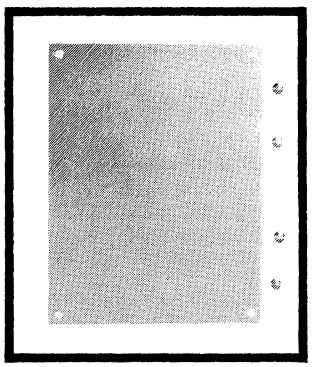
NOBEX® components

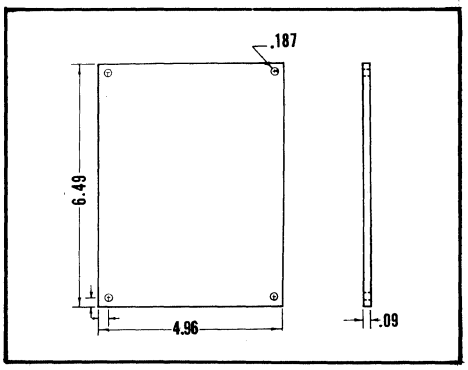
NOBEX DIVISION
GRIFFITH PLASTICS CORPORATION

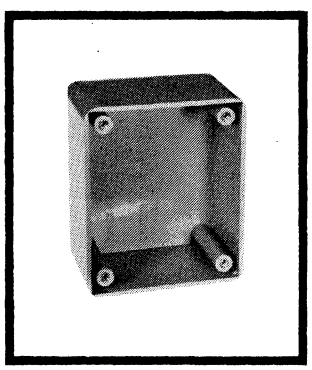
instrument cases

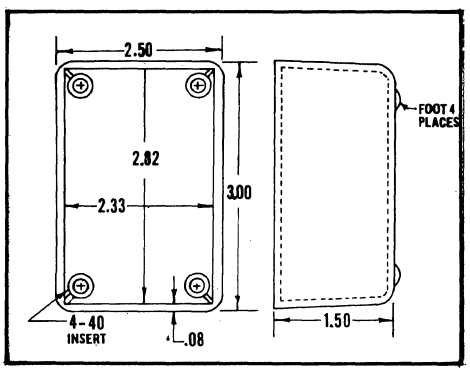


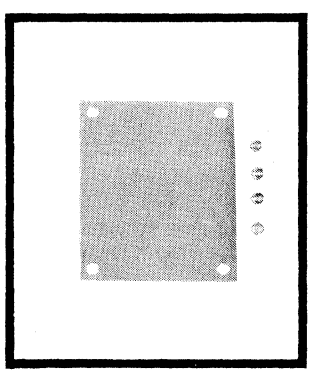


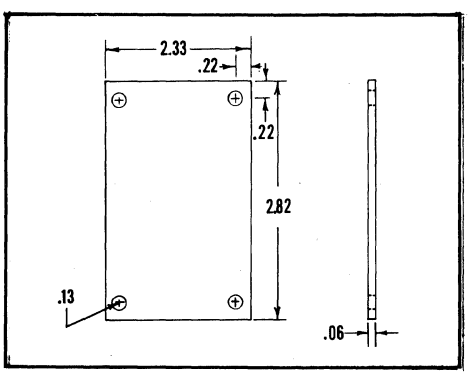


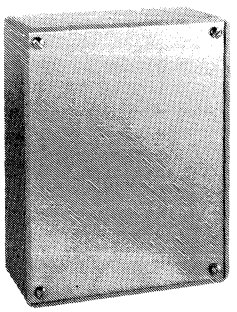












NOBEX manufactures the only line of portable Instrument Cases that are virtually unbreakable under normal use. Series 875 and 895 Instrument Cases are injection molded of tough, impact resistant A.B.S. plastic in a soft semi-gloss finish. The A.B.S. material is easily machined and will not chip, crack, or break during machining operations. NOBEX Instrument Cases are available in a variety of attractive colors for the "Custom Look" in portable electronic equipment. Colors can be custom matched to customer specifications with quantity orders. Mounting bosses are each equipped with a threaded brass insert for reliable panel mounting. NOBEX offers beautiful satin finished, brushed aluminum panels for use with Series 875 and 895 Instrument Cases. Stock panels are cut to size, finished and packaged with protective covering and four (4) panel fastening screws. As with all NOBEX Mechanical Components, Instrument Cases are backed by a one (1) year factory replacement warranty.

ordering information

DESCRIPTION	CATALOG NUMBER
LARGE CASE, GREY	875-35
LARGE CASE, BLACK	875-45
LARGE CASE, TELEPHONE RED	875-60
LARGE COVER	876-C
SMALL CASE, GREY	895-35
SMALL CASE, BLACK	895-45
SMALL CASE, TELEPHONE RED	895-60
SMALL COVER	896-C

Manufactured in U.S.A.

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NOBEX®
components

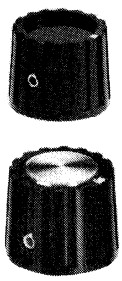
100 and 500 series thermoplastic control knobs, designs patented

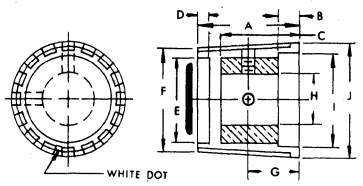
NOBEX offers the designer the most comprehensive selection of matching instrument quality control knobs in the industry. This wide variety of sizes and types, many not offered anywhere else, represents an expanding line of products for an ever changing electronic industry.

NOBEX firsts include the patented Color Coding Cap system for use with the 100 Series Knobs. NOBEX is still the only manufacturer to offer a Miniature Series of 7/16" through 5/8" base diameter knobs. Many items standard with NOBEX would be expensive "specials" with our competitors.

The control knobs shown below are available in the 100 Series (plain top) or in the 500 Series (with decorative aluminum cap) from factory and distributor inventories. The drawings and charts to the right of each knob contain the sizes and part numbers of the knobs available in each style. Control knobs are stocked with two (2) set screws and shaft diameters indicated in the charts.

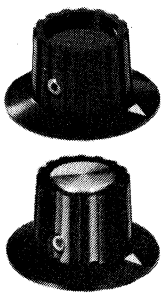
ROUND

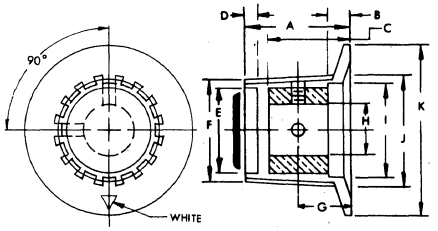




Part No.'s		Dimensions Available										Stock
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	Colors
1-123	1-523	.500	.090	.375	.055	.305	.390	.215	.125	.320	.445	B, G, R
1-103	1-503	.500	.090	.375	.060	.340	.455	.215	.125	.375	.500	B, G, R
1-125	1-525	.500	.090	.375	.060	.400	.520	.215	.125	.435	.565	B, G, R
125	525	.500	.090	.375	.060	.400	.520	.215	.250	.435	.565	B, G, R
1-127	1-527	.500	.090	.375	.060	.460	.575	.215	.125	.510	.620	B, G, R
127	527	.500	.090	.375	.060	.460	.575	.215	.250	.510	.620	B, G, R
1-105	1-505	.630	.090	.500	.060	.560	.725	.250	.125	.620	.785	B, G
105	505	.630	.090	.500	.060	.560	.725	.250	.250	.620	.785	B, G
107	507	.750	.080	.570	.105	.770	.950	.250	.250	.800	1.015	B, G
109	509	.750	.120	.570	.105	.965	1.190	.250	.250	.980	1.260	B, G
111	511	.750	.090	.625	.105	1.200	1.450	.250	.250	1.310	1.515	B, G
115	515	.875	.100	.625	.105	1.870	2.140	.312	.250	1.950	2.220	B, G

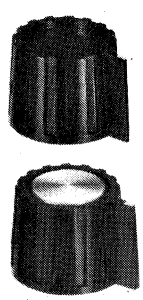
ROUND DIAL

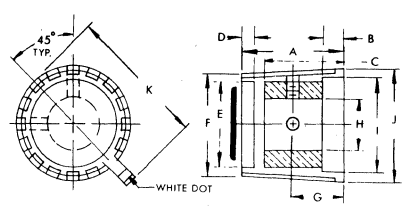




Part No.'s		Dimensions Available											Stock
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	K	Colors
1-123-D	1-523-D	.500	.090	.375	.055	.305	.390	.215	.125	.320	.445	.700	B
1-103-D	1-503-D	.500	.090	.375	.060	.340	.455	.215	.125	.375	.500	.765	B
1-125-D	1-525-D	.500	.090	.375	.060	.400	.520	.215	.125	.435	.565	.820	B
125-D	525-D	.500	.090	.375	.060	.400	.520	.215	.250	.435	.565	.820	B
1-127-D	1-527-D	.500	.090	.375	.060	.460	.575	.215	.125	.510	.620	.940	B
127-D	527-D	.500	.090	.375	.060	.460	.575	.215	.250	.510	.620	.940	B
1-105-D	1-505-D	.630	.090	.500	.060	.560	.725	.250	.125	.620	.785	1.180	B
105-D	505-D	.630	.090	.500	.060	.560	.725	.250	.250	.620	.785	1.180	B
107-D	507-D	.750	.080	.570	.105	.770	.950	.250	.250	.800	1.015	1.500	B
109-D	509-D	.750	.120	.570	.105	.965	1.190	.250	.250	.980	1.260	1.750	B
111-D	511-D	.750	.090	.625	.105	1.200	1.450	.250	.250	1.310	1.515	2.120	B
115-D	515-D	.875	.100	.625	.105	1.870	2.140	.312	.250	1.950	2.200	3.010	B

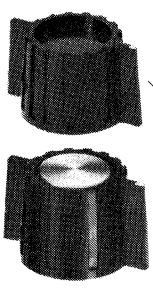
ONE BAR

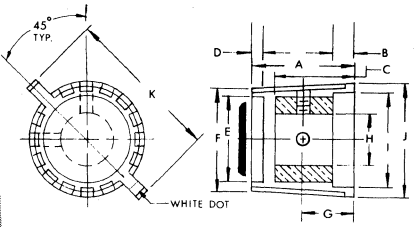




Part No.'s		Dimensions Available											Stock
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	K	Colors
1-123-1	1-523-1	.500	.090	.375	.055	.305	.390	.215	.125	.320	.445	.480	B, G
1-103-1	1-503-1	.500	.090	.375	.060	.340	.455	.215	.125	.375	.500	.560	B, G
1-125-1	1-525-1	.500	.090	.375	.060	.400	.520	.215	.125	.435	.565	.625	B, G
125-1	525-1	.500	.090	.375	.060	.400	.520	.215	.250	.435	.565	.625	B, G
1-127-1	1-527-1	.500	.090	.375	.060	.460	.575	.215	.125	.510	.620	.710	B, G
127-1	527-1	.500	.090	.375	.060	.460	.575	.215	.250	.510	.620	.710	B, G
1-105-1	1-505-1	.630	.090	.500	.060	.560	.725	.250	.125	.620	.785	.880	B, G
105-1	505-1	.630	.090	.500	.060	.560	.725	.250	.250	.620	.785	.880	B, G
107-1	507-1	.750	.080	.570	.105	.770	.950	.250	.250	.800	1.015	1.150	B, G

TWO BAR





Part No.'s		Dimensions Available											Stock
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	K	Colors
1-124	1-524	.500	.090	.375	.055	.305	.390	.215	.125	.320	.445	.570	B, G
1-104	1-504	.500	.090	.375	.060	.340	.455	.215	.125	.375	.500	.680	B, G
1-126	1-526	.500	.090	.375	.060	.400	.520	.215	.125	.435	.565	.740	B, G
126	526	.500	.090	.375	.060	.400	.520	.215	.250	.435	.565	.740	B, G
1-128	1-528	.500	.090	.375	.060	.460	.575	.215	.125	.510	.620	.850	B, G
128	528	.500	.090	.375	.060	.460	.575	.215	.250	.510	.620	.850	B, G
1-106	1-506	.630	.090	.500	.060	.560	.725	.250	.125	.620	.785	1.030	B, G
106	506	.630	.090	.500	.060	.560	.725	.250	.250	.620	.785	1.030	B, G
108	508	.750	.080	.570	.105	.770	.950	.250	.250	.800	1.015	1.340	B, G
110	510	.750	.120	.570	.105	.965	1.190	.250	.250	.980	1.260	1.620	B, G

Manufactured in U.S.A.

U.S. Patent Nos. 203,933 and 3,313,057

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NOBEX®
components

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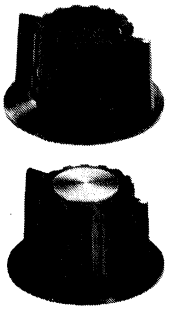
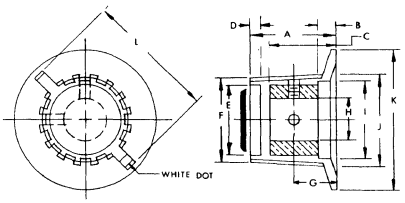
GRIFFITH PLASTICS CORPORATION

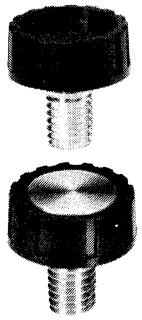
ROUND BAR DIAL

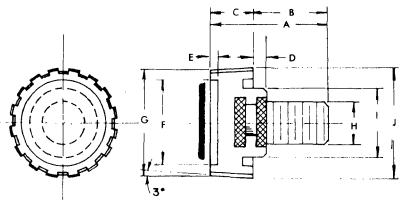




Part No.'s		Dimensions Available												Stock Colors
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	K	L	
1-124-D	1-524-D	.500	.090	.375	.055	.305	.390	.215	.125	.320	.445	.700	.570	B
1-104-D	1-504-D	.500	.090	.375	.060	.340	.455	.215	.125	.375	.500	.765	.680	B
1-126-D	1-526-D	.500	.090	.375	.060	.400	.520	.215	.125	.435	.565	.820	.740	B
126-D	526-D	.500	.090	.375	.060	.400	.520	.215	.250	.435	.565	.820	.740	B
1-128-D	1-528-D	.500	.090	.375	.060	.460	.575	.215	.125	.510	.620	.940	.850	B
128-D	528-D	.500	.090	.375	.060	.460	.575	.215	.250	.510	.620	.940	.850	B
1-106-D	1-506-D	.630	.090	.500	.060	.560	.725	.250	.125	.620	.785	1.180	1.030	B
106-D	506-D	.630	.090	.500	.060	.560	.725	.250	.250	.620	.785	1.180	1.030	B
108-D	508-D	.750	.080	.570	105	.770	.950	.250	.250	.800	1.015	1.500	1.340	B
110-D	510-D	.750	.120	.570	.105	.965	1.190	.250	.250	.980	1.260	1.750	1.620	B

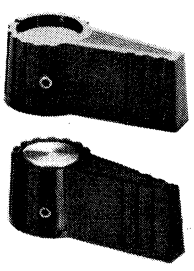
THUMBSCREW

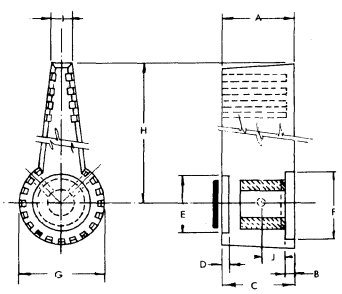




Part No.'s		Dimensions Available										Stock Colors
Plain Top	Alum. Cap	A	B	C	D	E	F	G	Thread	I	J	
107-TS-18	507-TS-18	1.000	.625	.375	.125	.100	.765	.940	10-32	.510	.985	B
107-TS-25	507-TS-25	1.000	.625	.375	.125	.100	.765	.940	1/4-20	.510	.985	B
107-TS-31	507-TS-31	1.000	.625	.375	.125	.100	.765	.940	5/16-18	.510	.985	B
107-TS-37	507-TS-37	1.000	.625	.375	.125	.100	.765	.940	3/8-16	.510	.985	B, G
111-TS-18	511-TS-18	1.000	.625	.375	.125	.100	1.195	1.490	10-32	.625	1.515	B
111-TS-25	511-TS-25	1.000	.625	.375	.125	.100	1.195	1.490	1/4-20	.625	1.515	B
111-TS-31	511-TS-31	1.000	.625	.375	.125	.100	1.195	1.490	5/16-18	.625	1.515	B
111-TS-37	511-TS-37	1.000	.625	.375	.125	.100	1.195	1.490	3/8-16	.625	1.515	B, G

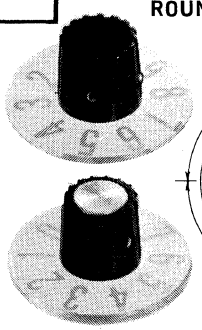
LEVER

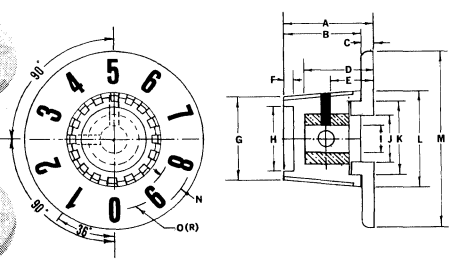




Part No.'s		Dimensions Available										Stock Colors
Plain Top	Alum. Cap	A	B	C	D	E	F	G	H	I	J	
1021	5021	.630	.100	.500	.060	.560	.615	.790	1.125	.280	.250	B, G
1022	5022	.630	.100	.500	.060	.560	.615	.790	2.125	.280	.250	B, G

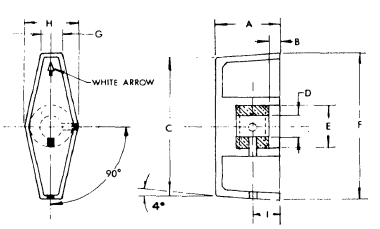
ROUND NUMBERED CLEAR DIAL





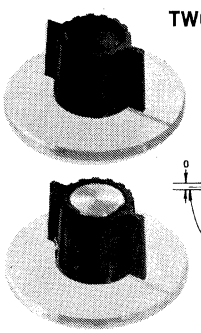
Part No.	Dimensions Available														Stock Colors
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
B1-127-CD09	.570	.505	.065	.455	.315	.055	.575	.460	.127	.370	.490	.625	1.410	.250	.500(R)
B127-CD09	570	.505	.065	.455	.315	.055	.575	.460	.252	.370	.490	.625	1.410	.250	.500(R)
B1-105-CD09	.705	.625	.080	.580	.330	.065	.725	.560	.127	.440	.600	.790	1.750	.375	.660(R)
B105-CD09	.705	.625	.080	.580	.330	.065	.725	.560	.252	.440	.600	.790	1.750	.375	.660(R)
B107-CD09	.840	.760	.080	.650	.330	.100	.945	.770	.252	.440	.800	1.020	2.125	.375	.750(R)

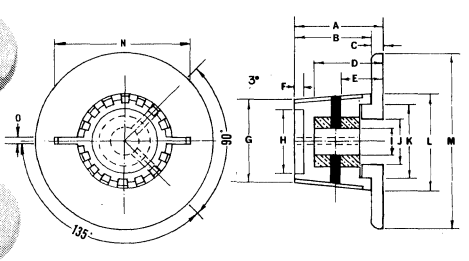
POINTER



Part No.	Indicator	Dimensions Available									Stock Colors
		A	B	C	D	E	F	G	H	I	
100-U	No Arrow	.750	.130	1.200	.250	.520	1.310	.280	.620	.250	B, G, R
100-1	1 Arrow	.750	.130	1.200	.250	.520	1.310	.280	.620	.250	B, G, R
100-2	2 Arrows	.750	.130	1.200	.250	.520	1.310	.280	.620	.250	B, G, R
101-U	No Arrow	.750	.130	1.615	.250	.520	1.700	.280	.620	.250	B, G, R
101-1	1 Arrow	.750	.130	1.615	.250	.520	1.700	.280	.620	.250	B, G, R
101-2	2 Arrows	.750	.130	1.615	.250	.520	1.700	.280	.620	.250	B, G, R

TWO BAR LINED CLEAR DIAL





Part No.	Dimensions Available														Stock Colors
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
B1-128-CDL	.570	.505	.065	.455	.315	.055	.575	.460	.127	.370	.490	.625	1.410	.855	.040
B128-CDL	.570	.505	.065	.455	.315	.055	.575	.460	.252	.370	.490	.625	1.410	.855	.040
B1-105-CDL	.705	.625	.080	.580	.330	.065	.725	.560	.127	.440	.600	.790	1.750	1.040	.050
B105-CDL	.705	.625	.080	.580	.330	.065	.725	.560	.252	.440	.600	.790	1.750	1.040	.050
B107-CDL	.840	.760	.080	.650	.330	.100	.945	.770	.252	.440	.800	1.020	2.125	1.345	.090

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990) Color Code Designation: B=Black, G=Grey, R=Red

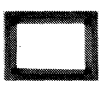
1027 CALIFORNIA DRIVE • BURLINGAME, CALIFORNIA 94010
TELEPHONE (415) 344-7691 • TWX 910-374-2840

NOBEX® components

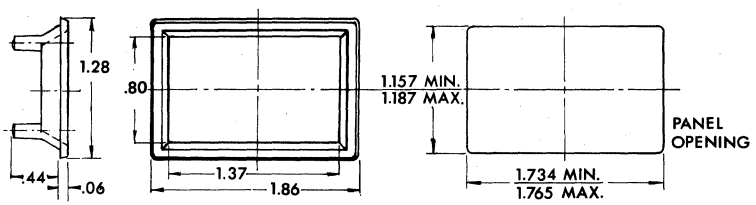
alpha-numeric display bezels

DIGIBEZEL®

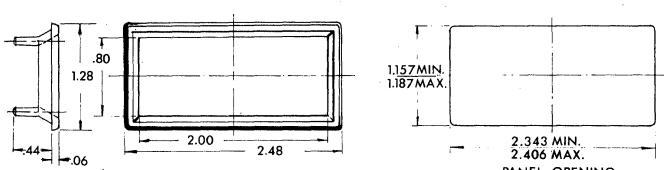
The first and only low cost, easy to assemble standard bezel for alpha-numeric displays. DIGIBEZEL will enhance the front panel lines of instruments and systems incorporating digital displays while providing maximum contrast in high ambient light conditions. DIGIBEZEL is a three piece assembly consisting of a front panel bezel, retaining frame and a circular polarized filter in one of four colors. Rear mounted spring clips eliminate visible mounting hardware. Seven standard sizes accommodate the most commonly used display devices in the industry, including the latest L.E.D. displays.



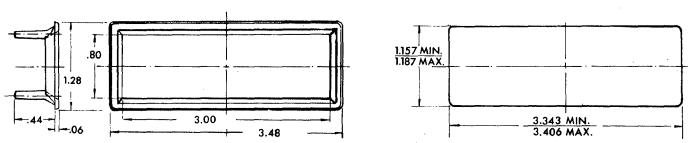
MODEL 905

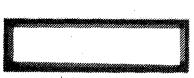


MODEL 910

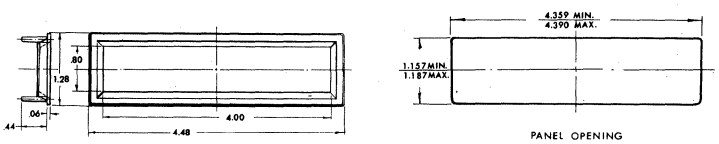


MODEL 915





MODEL 920

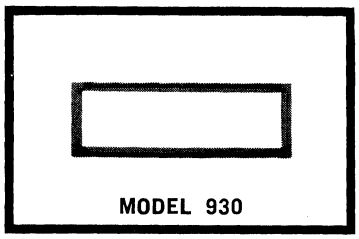


Manufactured in U.S.A.

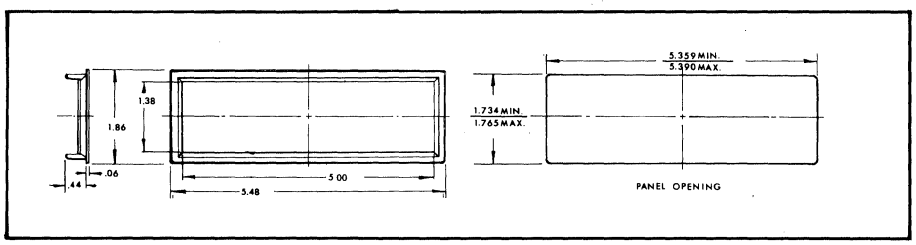
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

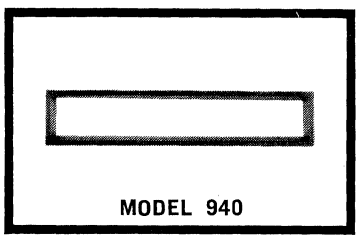
NOBEX®
components

NOBEX DIVISION
GRIFFITH PLASTICS CORPORATION

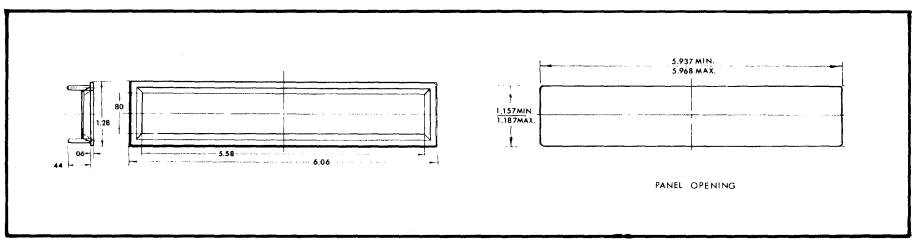


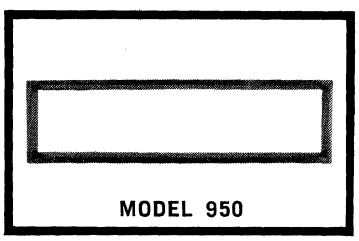
MODEL 930



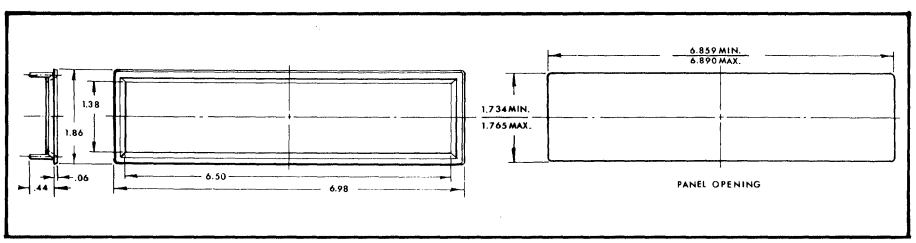


MODEL 940

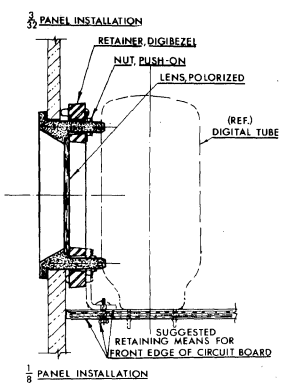




MODEL 950



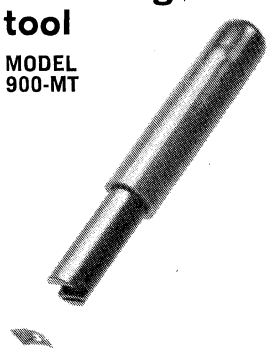
installation



DIGIBEZEL is easily installed to the panel of the instrument by placing the back side (with bosses) through the rectangular hole cut into the front panel with "top" and "bottom" markings appropriately located. After the front bezel has been placed in the location the polarized filter is then inserted from the back into the recess provided. The DIGIBEZEL retainer is then placed onto the rear bosses using the correct side for appropriate panel thickness (Side 1 for 3/32", Side 2 for 1/8" thick panel) to secure the filter and bezel to the front panel. All three parts of the assembly are held together and in place by rear mounting spring clips.

mounting tool

MODEL 900-MT



An optional mounting tool is available from NOBEX for added convenience with DIGIBEZEL installation. The mounting tool is specifically designed to be used with the spring clip hardware supplied with each DIGIBEZEL assembly. The tool is manufactured of aluminum with an easy grip handle.

specifications

Bezel & Filter Retainer

Injection molded of high heat ABS-polycarbonate thermoplastic resin.

Lens Filter

Circular polarized filter laminated acetate sheet.

Mounting Clip

Spring Steel Black Oxide Finish

ordering information

FILTER COLOR	MODEL 905	MODEL 910	MODEL 915	MODEL 920	MODEL 930	MODEL 940	MODEL 950
NEUTRAL FILTER	905-15	910-15	915-15	920-15	930-15	940-15	950-15
RED FILTER	905-60	910-60	915-60	920-60	930-60	940-60	950-60
AMBER FILTER	905-70	910-70	915-70	920-70	930-70	940-70	950-70
GREEN FILTER	905-90	910-90	915-90	920-90	930-90	940-90	950-90

U.S. Patent No. 3,551,630 Foreign Patents Pending

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

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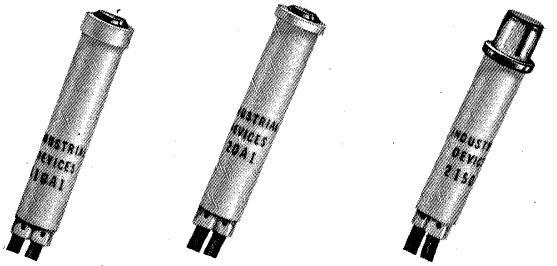
NOBEX® components

IDI PILOT AND INDICATOR LIGHTS

glo-dot

Miniature neon pilot lights
Mounting hole: 5/16" diameter.

Series 2110A **Series 2120A** **Series 2150A**



Color	Stock Models Available		
Red	2110A1	2120A1	2150A1
Clear	2110A2	—	—
Amber	2110A3	2120A3	2150A3
White	2110A4	2120A4	2150A4

SPECIFICATIONS

(COMMON TO ALL STOCK MODELS — Except GLO-DOT 2990D and 2990P and OMNI-GLO 1051A and 1090A Series.)

Voltage: 105-125 A.C.

Leads: 4½" 105°C plastic stripped ½".

Lamp: High brightness neon with built-in resistor.

Speednut: Hardened spring steel, rust-resistant finish.

glo-dot 2990p series

One-piece lens body 6, 12 and 28 volt incandescent pilot lights.

Mounting Hole: ½" diameter with plug bezel and low profile lens.

Color	6 Volt Part No.	12 Volt Part No.	28 Volt Part No.
Red	2990P1-6V	2990P1-12V	2990P1-28V
Amber	2990P3-6V	2990P3-12V	2990P3-28V
White	2990P4-6V	2990P4-12V	2990P4-28V
Green	2990P5-6V	2990P5-12V	2990P5-28V
Blue	2990P6-6V	2990P6-12V	2990P6-28V
Yellow	2990P7-6V	2990P7-12V	2990P7-28V

glo-dot 2990d series

One-piece lens body 6, 12 and 28 volt incandescent pilot lights.

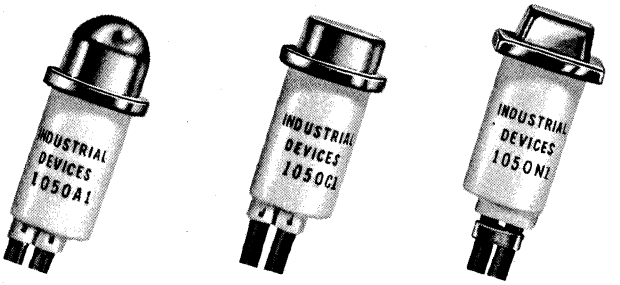
Mounting Hole: 5/16" diameter.

Color	6 Volt Part No.	12 Volt Part No.	28 Volt Part No.
Red	2990D1-6V	2990D1-12V	2990D1-28V
Amber	2990D3-6V	2990D3-12V	2990D3-28V
White	2990D4-6V	2990D4-12V	2990D4-28V
Green	2990D5-6V	2990D5-12V	2990D5-28V
Blue	2990D6-6V	2990D6-12V	2990D6-28V
Yellow	2990D7-6V	2990D7-12V	2990D7-28V

omni-glow

Versatile general purpose pilot lights.
Mounting Hole: ½" diameter.

Series 1050A, 1051A, 1090A **1050C** **1050N**



Color	Stock Models Available		
Red	1050A1	1050C1	1050N1
Clear	1050A2	—	—
Amber	1050A3	1050C3	1050N3
White	1050A4	1050C4	1050N4

Color	6 Volt Part No.	12 Volt Part No.	28 Volt Part No.	250 Volt Part No.
Red	1090A1-6V	1090A1-12V	1090A1-28V	1051A1
Clear	—	—	—	1051A2
Amber	1090A3-6V	1090A3-12V	1090A3-28V	1051A3
White	1090A4-6V	1090A4-12V	1090A4-28V	1051A4
Green	1090A5-6V	1090A5-12V	1090A5-28V	—
Blue	1090A6-6V	1090A6-12V	1090A6-28V	—

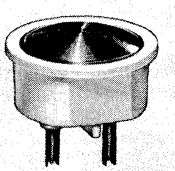
* Matches the Series 1050A in appearance.

omni-glow

Versatile general purpose neon pilot lights.
Mounting Hole: 7/8" diameter.

SERIES 2620K

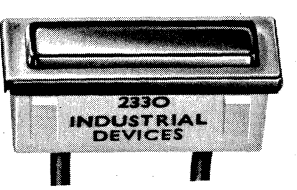
Color	Stock Models Available
Red	2620K1
Clear	—
Amber	2620K3
White	2620K4



line-o-lite

Will snap-fit into panels .050-.070" thick without speednut, other thicknesses with speednut.

Mounting Hole:
1 3/32" x .395/.400".

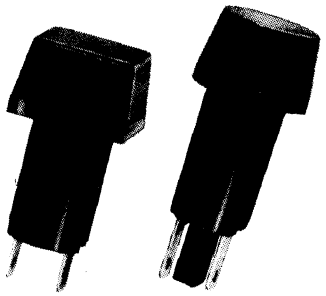


SERIES 2330D

Color	Stock Models Available
Red	2330D1
Clear	—
Amber	2330D3
White	2330D4

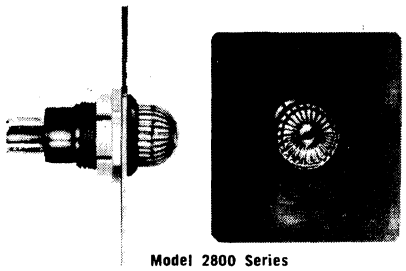
MINI-SLIDE

PILOT LIGHT ASSEMBLIES



Model 3040 Series **Model 3060 Series**

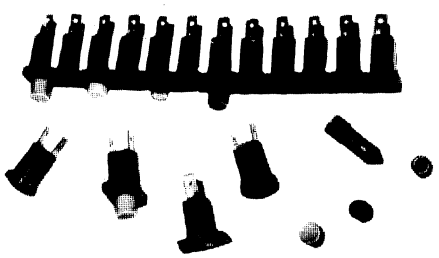
- Two lens shapes, round and square for either model series.
- Sockets for "Pilot" lamps including 120 volt lamp and "Indicator" lamps.



Model 2800 Series

- Screw-in design for easy relamping from front of pane.
- Unique torque-limiting, self-locking nylon mounting nut.

INDIVIDUAL SOCKETS
MULTI-SOCKET STRIPS • END CAPS



- Round and rectangular single sockets.
- Socket strips of 12 sockets on ½" or ¾" centers, individual or common ground.

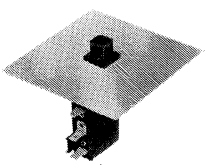
- Attractive on or off. Uniform brilliant light.
- Economical yet reliable and rugged.
- Lenses in a full range of colors.
- Easy to install with push-on speednut mounting, simple panel preparation. Keyed to prevent rotation.
- Lenses can be imprinted.
- Easy relamping from front of panel. No special tools needed.
- Lamps are extreme., long-lived, rugged, reliable, available from 4 volts to 120 volts.
- U.L. approved (phenolic sockets) for 120 volts.
- Either solder or use quick-connect receptacles.

SHORT SLIDE-BASE LAMPS

A complete line of rugged, long-life miniature incandescent lamps is available to fit Industrial Devices individual and multi-socket strips. Several types are offered to cover a wide range of voltages up to 120 volts and ratings up to three watts. Lamps are available in two lengths; the shorter "Indicator" and the longer "Pilot" lamps.

luma switch — Versatile, new, lighted on-off pushbutton control. Custom specifications available on request. SPST alternate action push-on, push-off. Lamp: High brightness neon with built in resistor. Rated at 10 Amps, 125 VAC. Mounting hole: ½" diameter.

Color	Square Lens	Round Lens
Red	3300A1	3300B1
Clear	3300A2	3300B2
Amber	3300A3	3300B3
White	3300A4	3300B4



SOLID STATE PILOT LIGHTS

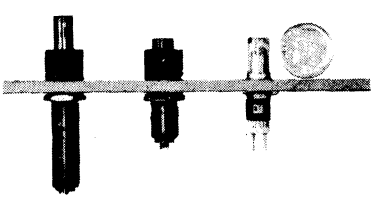
Glo-dot and Mini-cator pilot lights are available with light emitting diodes as well as other types of light sources. They can be supplied with current limiting resistors as well as built-in rectifier diodes for AC service.

Specials . . .
of every description

IDI specializes in designing and adapting pilot lights to particular specifications. We can supply a wide variety of different lens shapes, colors, imprints, mounting styles, leads and terminals. Lights can be provided in complete cost cutting assemblies, to meet any design requirement. Whatever your production calls for, pilot light or complete pilot light assembly, IDI manufacturing expertise will provide quick economical service.

MINI-CATOR

MINIATURE INDICATOR LIGHTS



For use in electronic instrumentation, computers, display panels, precision machinery and electronic equipment in general — including military applications. Neon models available for 65 VAC (90 VDC) and over, with or without built-in resistor. Incandescent models available for 6.3V-.20A, 14V-.08A and 28V-.04A, as well as other voltages and currents. MINI-CATOR consists of replaceable lamp cartridge and mating lampholder. Lamp cartridge has nylon body for long-life ruggedness. Lampholder with built-in resistor for neon cartridges available.

- Lens available in variety of colors, with or without imprints.
- Lampholders mount in ⅜" hole for space economy.
- Lamp cartridge may be mounted directly in 19/64" dia. hole with mounting clip and lamp connector.

INDUSTRIAL DEVICES, INC.
Edgewater, New Jersey 07020 Phone: (201) 224-4700

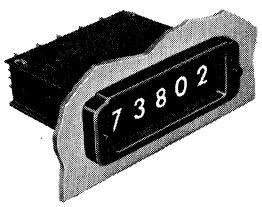
IEE® World's broadest

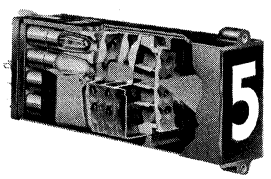
Industrial Electronic Engineers, Inc. • 7740 Lemona Avenue,

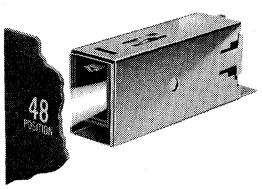
REAR PROJECTION DISPLAYS

- High legibility character heights from .375" to 3.375"
- Excellent contrast/brilliance . . . viewing distances from 8' to 70'
- Project ANY message, symbol, . . . ANY color
- Wide range of individual display modules and assemblies availble

Incandescent rear-projection readouts engineered to offer the simplest, (passive, non-mechanical) least expensive, highly legible data displays. IEE companion driver/decoder units are available to provide simple TTL or DTL interfacing.



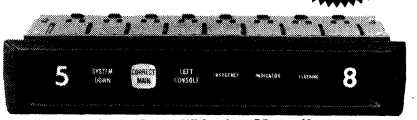




SERIES	Character Height	Viewing Distance	Character Brightness
0010	.937"	20 Ft.	75 ft-L
0080	3.375"	70 Ft.	45 ft-L
0120	.59"	12 Ft.	100 ft-L
0123	.59"	12 Ft.	80 ft-L
0160	1.562"	30 Ft.	45 ft-L
0220	.59"	12 Ft.	100 ft-L
0280	.375"	8 Ft.	200 ft-L
0340	.375"	8 Ft.	30 ft-L
0345	.375"	8 Ft.	30 ft-L
0360	2.00"	40 Ft.	40 ft-L
0400	.50"	10 Ft.	30 ft-L
0405	.50"	10 Ft.	30 ft-L
0865	.50"	10 Ft.	30 ft-L
0880	.50"	10 Ft.	30 ft-L
1002	.45"	8 Ft.	12 ft-L
1100	.59"	12 Ft.	100 ft-L

SERIES 1100

NEW!



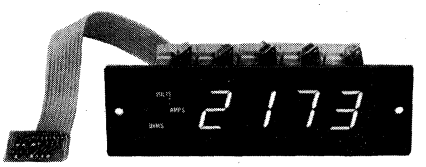
Low Cost "Display-Mates" features bright .6" characters

- .60" standard height message readable from 20 feet
- Complete "plug-in" package ready for panel mounting
- Quick front panel removal for lamp/film service
- 12 message positions; numerals, messages, symbols, colors, etc.
- 5, 14, 28 volt lamps — compatible with DTL/TTL input
- Light output — 100 ft-L (328 lamp @ 6.0 V)

Companion Series 7800 Driver Decoders

- Low cost — long life
- Single power supply required for lamps and logic
- Memory/Non-memory

7-BAR SEGMENT DISPLAY

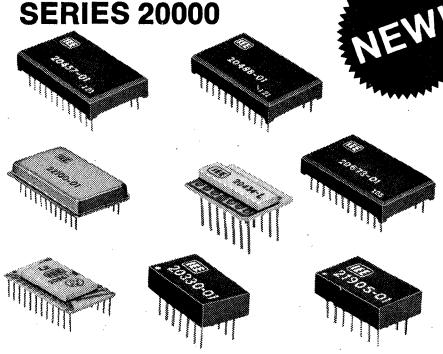


Series 1080-.78" H characters, Series 1040-.50" H characters, Series 1060-2" H characters.

- Crisp, bright, easy-to-read single plane displays.
- Simplified, complete-package concept eliminates additional mounting hardware.
- Optional 9-bar segment display for hexadecimal applications.
- Choice of 5 screen colors and variety of film colors.
- Lamp replacement from front or rear.
- Caption modules for message capability.
- Economical driver/decoders available for all models.
- Wide choice of lamps.

DRIVER/DECODERS SERIES 20000

NEW!



Types 20861 and 22100 Hybrids

- One Militarized, self contained hermetically sealed, 24 pin DIP package.
- Drive up to twelve 150 ma lamps
- DTL and TTL compatible

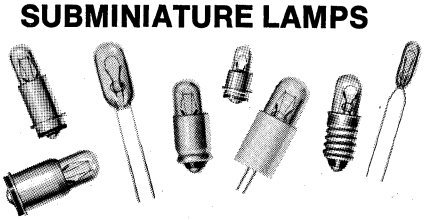
Types 20488, 20673, and 20457 Hybrids

- One standard 24 pin DIP drives up to twelve 300 ma lamps
- TTL compatible — memory, lamp blanking available

Types 20330, 20434 and 21905 Hybrid Hex Drivers

- 14 Pin Plastic DIPS drive up to six 300 ma lamps
- Ceramic, hermetically sealed 20434 drives 150 ma lamps

SUBMINIATURE LAMPS



Subminiature incandescent lamps in all standard sizes, T ¾ through T 1¾

- Savings up to 50%
- Each lamp carefully aged and selected for maximum stability and reliability
- Send for latest catalog, engineering samples and name of nearest distributor

line of readouts

Van Nuys, Calif. 91405 • Telephone: (213) 787-0311 • TWX 910-495-1707

LIQUID CRYSTAL DISPLAYS

NEW!

- Transmissive & reflective styles
- Two character heights (.433" and 1")
- Optimum readability for low or high ambient lighting
- Microwatt power consumption
- Direct MOS drive
- Low Cost

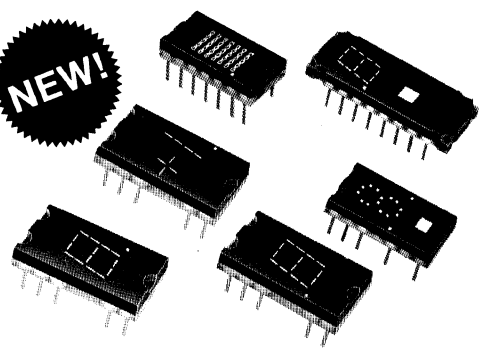
The series 1500 (Transmissive) and 1603 (Reflective) plus IEE's new 1" character unit offer a full range of state-of-the-art liquid crystal displays, optimized for any viewing condition. The 1500/1600 series are 3½ decade units with 4 floating decimals and plus or minus one. A colon is included for such applications as clocks.

The new 1" character unit offers designers a four-digit capability on an extremely low cost-to-use basis. Call IEE for applications help on large-character liquid crystal display requirements.

LIGHT EMITTING DIODE DISPLAYS

NEW!

- Bright LED numeric & alpha-numeric displays encapsulated in transparent plastic flat packs
- Available with integral LSI logic chip for BCD, Hexadecimal decoding and pulse count accumulation
- Single plane, wide-angle high visibility
- 0.270" (6,858mm) high characters
- Standard 14, 16 pin dual in-line packages



The IEE 1700 series LED display packages offer a wide choice of numeric and alphameric readout possibilities, including several with integral logic. These accept, store and display BCD, hexadecimal or pulse count directly on a single substrate with transparent encapsulant. Logic units provide constant current drive for the LEDS; they are designed for easy system interface.

The externally-driven displays, encapsulated in clear plastic, are compatible with most TTL and DTL decoder circuits, and have low power requirements.

CUE-SWITCH®

NEW!

- TRANSPARENT thin membrane matrix switch
- Use over any surface — yet read printed, projected, lighted graphics
- Light weight, low profile
- Sealed — impervious to dust, spills
- True fingertip pressure (4-9 oz.) actuation
- No mechanical linkages, springs or buttons

INTELLIGENT SWITCHING from IEE. The CUE SWITCH's transparent sandwich form allows direct see-through of ANY graphic data to the touch surface of the switch. Standard porduct line now available to designers includes lighted "touch button" assemblies on .8" centers, bezel units combined with rear projected readouts, units of up to 8 switch units wide and 3x4 matrices with adding machine or touch-tone format. Call for applications assistance on custom requirements.

nimo®— 64 GUN MINI-CRT

- 1.5" brilliant True-Form data display
- Unmatched legibility and contrast ratio
- Letters, numbers or symbols
- Costs as litte as 60¢ a message
- An effective ROM for fixed data
- Extremely simple, inexpensive TTL interfacing

The nimo MINI-CRT display offers designers a small, simplified, inexpensive, display for such applications as character entry verification on data input peripherals, optical scanners point-of-sale (reservation) terminals, teaching machines, etc.

No internal or external focusing or deflection is needed for each of the 64 guns to produce a letter, numeral or character up to .6" high, or a complete mesage of up to 3 lines of 6 characters.

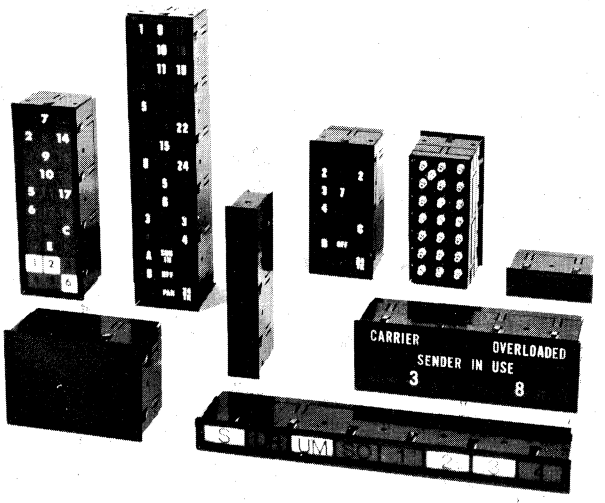
"LINKS BETWEEN MAN AND MACHINE"
INFO-LITE CORPORATION
46-10 104th STREET • CORONA, N. Y. 11368

PHONE: (212) 476-1287
For your Local Representative, see Yellow Pages.

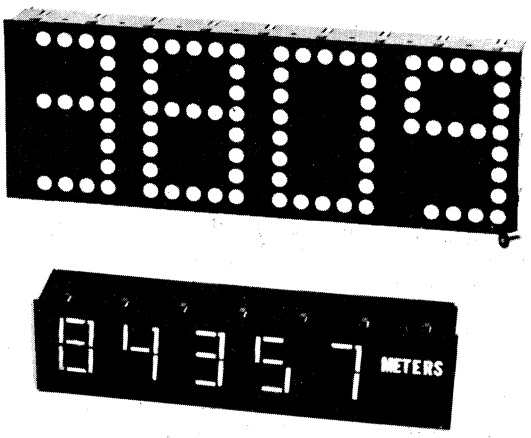
LIGHTED INDICATORS

SERIES 68011, 68012, 68013 AND 68014
EASY TO SPECIFY • REDUCE INSTALLED COST

Any group of messages/symbols can be displayed in any combination of colors • Front panel graphics are back lighted using Std. MFB T 1¾" lamps • Basic message module sizes: ⅜" Sq, ⅜" x ¾", ⅜" x 1⅛", ⅜" x 1½", or multiples of these • Units are supplied in an attractive package with bezel and "Black-Out" front panel, ready to snap into rectangular panel cutout • Common ground reduces installation time . Servicing can be done from the front • Lamp drivers and special logic available.



U. S. Pat. #3,703,720

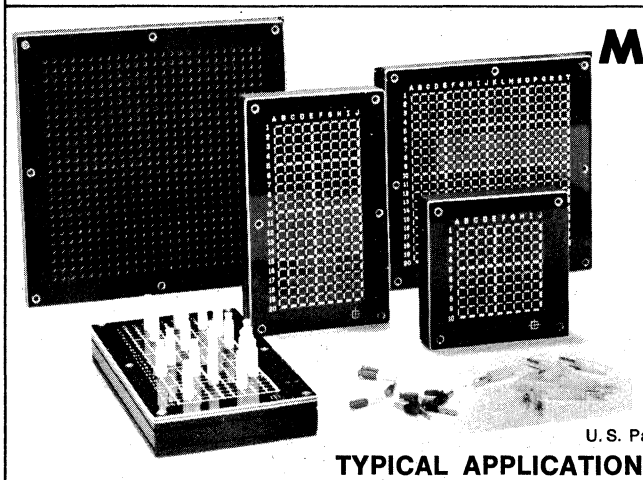


U. S. Pat. #3,703,720

NUMERIC READOUTS

(.7", 1", 2", 3" and 5½")
SERIES 68030, 68031, 68032, 68033 AND 68036
SUPPLIED READY TO INSTALL • WITH AND W/O LOGIC

For viewing to 150 ft • They are supplied with bezel, "Black-Out" front panel and ready to install into panel cutout • Message modules and ± indicators maye be integrated into the assembly • NEMA 9 dust/water tight mtg hdwr available • Mating decoder-drivers (Memory and/or decade counting optional) are socket mounted • All servicing can be done from the front • Special readout systems to perform a wide variety of logic/control functions are available.



U. S. Pat. #3,631,374

MATRIX PROGRAM BOARDS

SERIES 2000 w/.250" GRID—SERIES 1000 w/.130" GRID

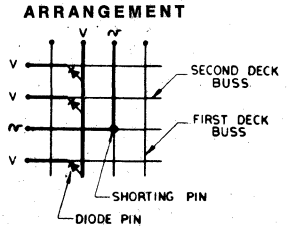
FEATURES:

- **Reliable closed entry contacts**
- **Rugged programming pins that will not bend**
- **Rapid and convenient programming/switching**
- **Components insertion into network without soldering**
- **Attractive and compact/package**
- **Low capacitance for high frequency applications**

TYPICAL APPLICATIONS

NUMERIC CONTROLLED EQUIPMENT	STATUS INDICATORS
LOGIC MEMORIES	DATA LOGGING
POWER DISTRIBUTORS	VENDING MACHINE CONTROL
CIRCUIT/COMPONENT TEST PROGRAMMERS	THERMO-COUPLE SELECTORS
LIGHTING SYSTEMS	BATCHING PROGRAMMERS
CODE GENERATORS	FUNCTION GENERATORS
PROGRAMMABLE DIODE MATRICES	SEQUENCE PROGRAMMERS
COMMUNICATIONS DISTRIBUTORS	PULSE CODE PROGRAMMERS

2 DECK CONTACT ARRANGEMENT

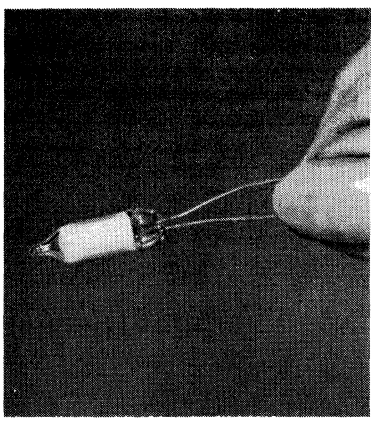


INTER-MARKET INCORPORATED

1920 WAUKEGAN ROAD • GLENVIEW, ILLINOIS 60025 • (312) 729-5330 • TWX: 910-651-1997

LAMPS • LIGHTED DEVICES • THUMBWHEEL SWITCHES

SERIES RF LAMPS "GREEN GLOW" LAMPS AND INDICATOR LIGHTS



Unique high brightness, easy on the eye "green glow" lamps and indicator lights provide superior visual contrast to customary orange neon glow. Average AC life of 10,000 hours. Available as lamps alone, with lamp holders, cartridge lamps with holders and indicator lights. **Write for Bulletin GG-72 and furnish specific requirements.**

Series RF Lamps

4.8 to 6.5 mm. dia., 19 to 25 mm. long, plus 25 mm. leads. Resistor can be welded in one lead if specified.

Series NLH Holders

Five standard types for inexpensive conversion of Series RF lamps into indicator light assemblies.

Series CG Cartridge Lamps

Anodized aluminum body cartridge lamps with CLH black or silver anodized aluminum lamp holders. 7.1 mm. dia., 29.6 mm. long. Interchangeable with MIL-3661 cartridge lamps.

Series BG Indicator Lights

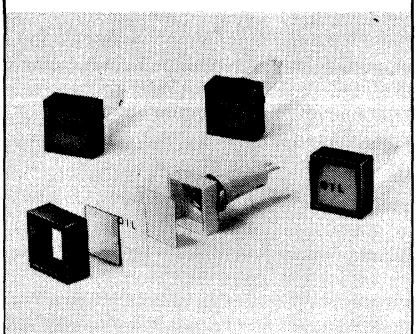
10 to 17 mm. dia., 26 to 40 mm. long. Chrome plated bronze or green plastic bodies. With or without resistors.

Electrical Specifications

115V. AC, 1.5mA, 1/7 to 1/4 W., Max. Breakdown 80V. AC, Min. Maintaining 55V. DC, Series Resistance 33K to 47K.

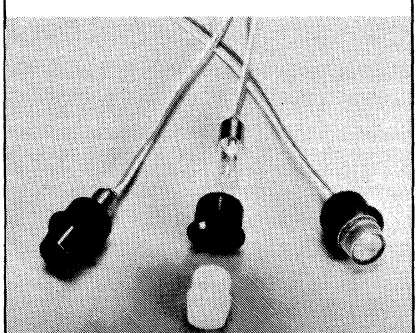
☐ Write for Complete Catalog of ImLec Incandescent, Neon, Green Glow and LED Lamps.

SERIES BFJ INDICATOR LIGHTS WITH CUSTOMIZED LEGENDS



Series BFJ provides customized legends photographically imprinted on film inserted between colored lens and diffuser. Lens size 12 mm. sq. in choice of five colors. 35.7 mm. overall length. In 6, 14, or 28V. Pigtails available. **Write for Bulletin LD-73 and furnish specific requirements.**

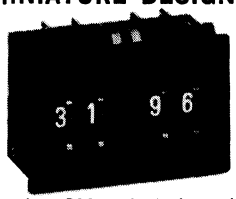
SERIES BFF INDICATOR LIGHTS FOR EASY INSTALLATION



Series BFF consists of a rubber bushing which fits into ⅜" dia. panel hole with no retaining nut or clip required; lens caps in choice of six colors snap into bushing; and incandescent, LED, neon or Green Glow lamps insert into bushing from behind panel. Install bushings from front of panel and "marry" lamp assembly at any convenient time. Simplifies lamp replacement. **Write for Bulletin LD-73 and furnish specific requirements.**

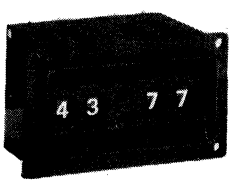
☐ Write for Complete Catalog of ImLec Incandescent, Neon, Green Glow and LED Lighted Devices.

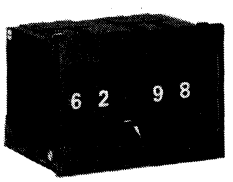
SERIES SM FRONT MOUNT THUMBWHEEL SWITCHES WITH "SLIM MINI" SUBMINIATURE DESIGN



Each Series SM switch is only 7.92 mm. wide to conserve up to 40% in panel width. Bank up to 30 switches, 33.02 mm. high. Front mounting for faster installation, neater panels. Pin terminations for direct PCB insertion provide reliable connection with reduced soldering time. Available with extended boards for mounting diodes or resistors. Decimal versions in 10 or 11 position and 10 position BCD with and without complements. **Write for Bulletin SM and furnish specific requirements.**

SERIES IR AND IF THUMBWHEEL SWITCHES INTERMEDIATE SIZE, REAR OR FRONT MOUNTING





Each intermediate switch is 12.7 to 12.8 mm. wide. Series IR for rear mounting 47.62 mm. high. Series IF for front mounting 53.97 mm. high. Decimal and BCD versions in 10 or 16 position with and without complements available.

Also available are pre-engineered, off-the-shelf modules with extended board circuitry to satisfy many common applications, i.e. decade counter with decoder/driver, parity modules and magnitude comparator modules. **Write for Bulletin I and furnish specific requirements.**

☐ Write for Complete Catalog of ImLec Printed Circuit Thumbwheel Switches and Accessories.

INTER-MARKET INCORPORATED

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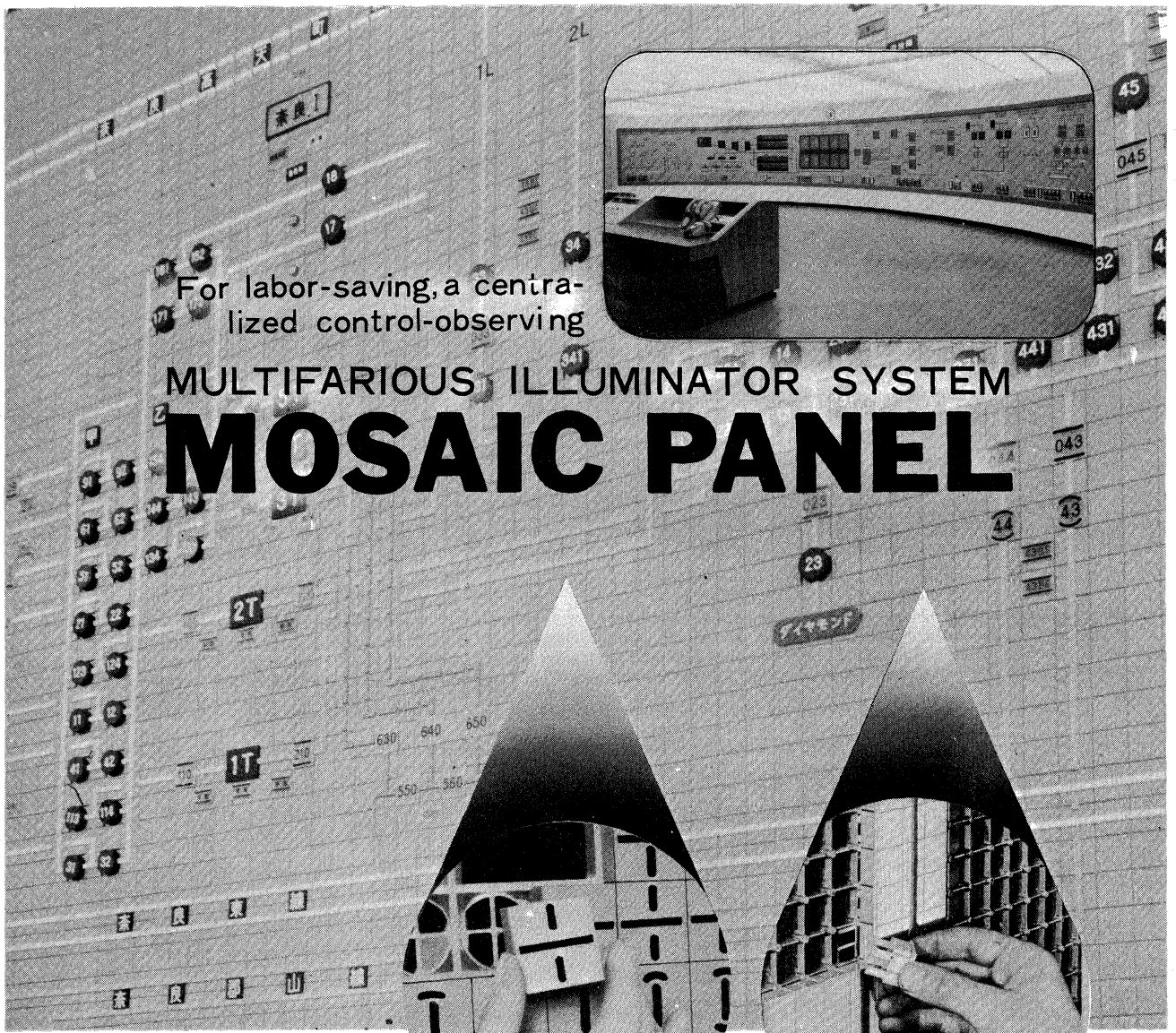
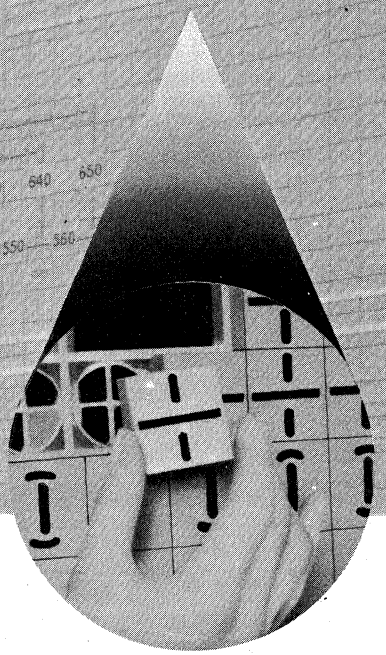
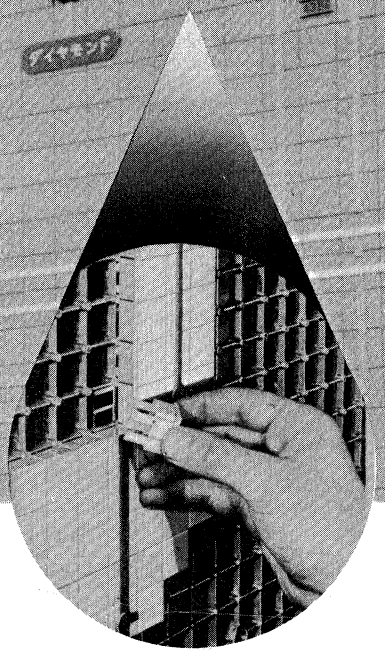


For labor-saving, a centralized control-observing

MULTIFARIOUS ILLUMINATOR SYSTEM

MOSAIC PANEL





SCREW FITTING SYSTEM

- Blocks in thermosetting material
- Resistant to change under the influence of temperature or vibration
- Strong illumination by plug-in lamps up to 3 watt
- 2 block dimension: 45 x 45·25.5 x 25.5m/m
- Suitable for mounting heavy instruments and switch on this system

CLIP FITTING SYSTEM

- Block in polycarbonate
- Suitable for boards mounted by the user
- Fast and easy changing of blocks, lamp-sockets and instruments
- Can be changed by a single operater
- Low cost-price
- 2 block dimentions: 24 x 24·48 x 48m/m

KCC SHOKAI LTD.

Head Office: No.31, 4-chome, Ouchi-dori, Nada-ku, Kobe, Japan Phone: (078) 871-0271/3

U.S.K.C.C INDUSTRIES, INC., 418 MacArthur Avenve, Redwood-City, Calif. U.S.A.

Japan Cotton Co., Houston Branch 834 Houston Natural Gas Bldg Houston, Texas 77002 U.S.A.

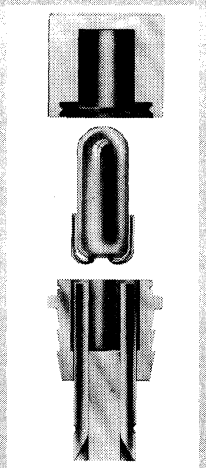
Nichimen Co., Inc. 1185 Avenue of the Americas, New York, New York 10036 U.S.A.

BLOC-LITE DIVISION LVC INDUSTRIES INC.

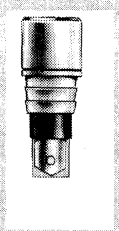
135-25 37th AVENUE • FLUSHING, NEW YORK 11354 • TEL: (212) 939-8777

MINI-BRITE "simplicity" in subminiature indicator lights

HOUSING GUIDES LAMP LEADS TO CONTACTS

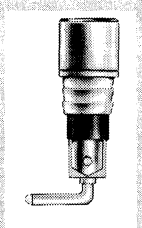


Housing is keyed so that wire leads of lamp will only be accepted by the electrical contacts.



MINI-BRITE 75001 Panel Mount

MINI-BRITE 75002 Panel/Printed Circuit Mount

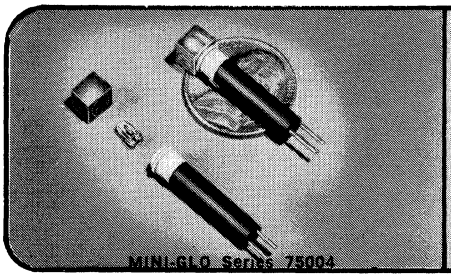


MINI-BRITE 75003 Printed Corcuit Mount

MINI-BRITE subminiature indicators have been engineered and are manufactured with the idea of achieving the ultimate in simplicity, standardization, reliability and cost reduction... this has been accomplished by the design of a unique housing and contact arrangement centered on the use of standard, wire terminal lamps... which provides light intensity comparable to units five times their size.
Conforms to MS90308. U. S. Patent #3,559,153

- **FRONT RELAMPABLE** just remove the snap on cap
- **STANDARD LAMPS** any T-1 lamp, wire lead type
- **EASY INSTALLATION** press housing into hole
- **WIRING OPTIONS** combination solder/female terminal
- **MOUNTING OPTIONS** panel mounted, panel/printed circuit
- **HIGH DENSITY PACKAGING** mount on .250 centers.
- **CODED CAPS** available in a variety of colors

Write for Bulletin 1470



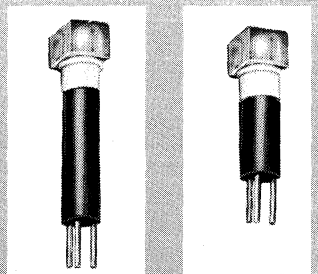
MINI-GLO Series 75004

MINI-GLO subminiature Neon indicator lights

This series of subminiature indicators provided neon bright intensity with the application of 115 VAC power. The complete indicator consists of a MINI-BRITE housing, a standard wire terminal neon lamp type USASI A1K, and a snap-on cap. The housing further incorporates an integral resistor for varying life expectancies. Except for the increased length of the housing, these indicators are compatible and have all of the features of the MINI-BRITE series.

Write for Bulletin No. 1470G

STANDARD OR SPECIAL CONFIGURATIONS



MINI-TRANS Series 75006 (NPN) 75007 (PNP)

MINI-TRANS subminiature Transistorized indicator lights

The MINI-TRANS series incorporates a silicon planar transistor, either NPN or PNP, which will turn on the indicator and provide an extremely bright indication from signal levels as low as 0.30 mA. In addition to standard circuits, specially designed physical and electrical configurations can be furnished to customer specifications. Units can be supplied with a built-in resistor of any standard value. This unique transistorized design capability is ideally suited when extremely low level signals are used for front panel indications, assuring long life and maximum brightness. A wide range of standard incandescent lamps are available to meet your requirements. Except for the increased length of the housing, these indicators are compatible and have all the features of the MINI-BRITE series.

Write for Bulletin No. 1470T

ANNUNCIATORS • LIGHT MATRICES • DISPLAY PANELS • EDGE-LIGHTED PANELS • SPECIAL INDICATORS • ALPHA/NUMERIC READOUTS.

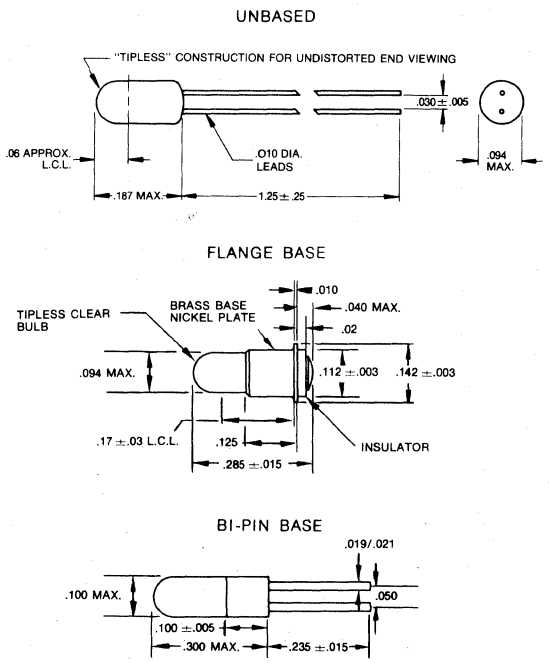
BLOC-LITE can offer specialized lighted products in a wide range of capabilities. Physical and electrical designed configurations based on customer specifications can be proposed and submitted at surprisingly low cost. Our staff will be happy to extend any engineering assistance needed to optimize your application. Please contact the factory direct, or our nearest field engineering representative.

SEE OUR CO-ORD MATRIX BOARDS • SECTION 5100

Incandescent Lamp

LAMPS, Inc., a leader in the design and manufacturing of miniature, subminiature, and microminiature lamps, every year expands its extensive product line. The charts below are only a sampling of the incandescent, line filament, special assembly, and tungsten-halogen lamps available. And we're producing lamps right now that weren't designed when EEM went to press. So, request our catalog, or even better, call our sales or engineering department right now—we'll usually stock what you need, and if we don't we can probably make it.

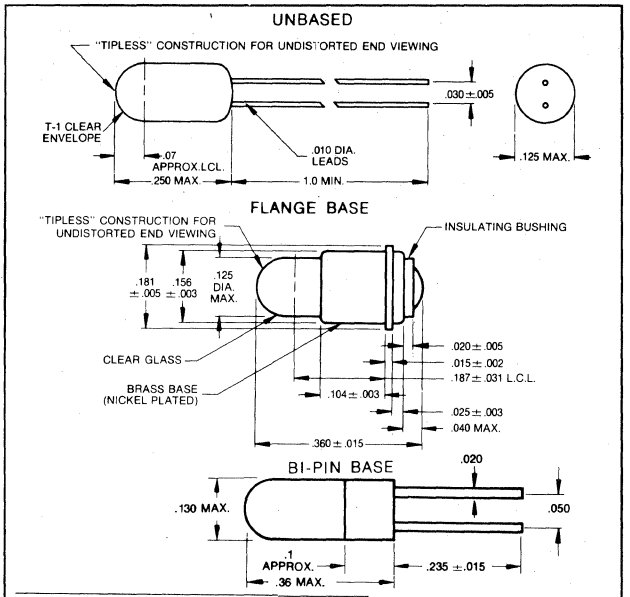
T-¾ LAMP



Design				Part Numbers		
Volts	Amps (±10%)	MSCP (Note 1)	Life (hrs.)	Unbased LAMPS	Flange LAMPS	Bi-Pin LAMPS
1.5	0.010	0.002	10,000	1	282	283
1.5	0.015	0.010	10,000	3	285	286
1.5	0.060	0.015	50,000	201	289	290
2.0	0.040	0.020	10,000	739	733	734
5.0	0.020	0.020	50,000	213	292	293
5.0	0.020	0.034	10,000	189	262	455
5.0	0.024	0.043	1,000	224	296	297
5.0	0.060	0.030	100,000	30	239	299
5.0	0.060	0.050	100,000	9	240	456
5.0	0.075	0.090	25,000	12	241	303
5.0	0.080	0.150	6,000	34	305	457
5.0	0.115	0.150	40,000	17	242	405
5.0	0.115	0.200	5,000	18	310	458
115.0	0.001 MAX.	0.010 APPROX.	5,000	249	250	313

NOTES:
1. MSCP tolerances are Nominal, ±25% and ±15%; others available on request.

T-1 LAMP



Design				Part Numbers		
Volts	Amps (±10%)	MSCP (Note 1)	Life (hrs.)	Unbased LAMPS	Flange LAMPS	Bi-Pin LAMPS
1.5	0.010†	0.002	10,000	2	21	315
1.5	0.015	0.010	10,000	4	22	316
1.5	0.060	0.015	100,000	81	88	319
1.5	0.075	0.030	16,000	73	320	321
2.2	0.040	0.020	10,000	238	326	466
2.5	0.320	0.210	10,000	203	467	329
3.0	0.008†	0.010	10,000	80	87	330
3.0	0.0125	0.005	10,000	331	273	332
3.0	0.015	0.020	5,000	138	147	333
3.0	0.0225	0.015	10,000	110	161	334
3.0	0.040	0.027	10,000	83	371	366
3.0	0.060	0.030	100,000	72	84	335
3.0	0.120	0.150	16,000	76	63	336
5.0	0.015	0.015	10,000	8	24	339
5.0	0.030	0.030	16,000	139	160	341
5.0	0.020	0.020	50,000	472	473	693
5.0	0.020	0.034	10,000	210	263	340
5.0	0.040	0.100	10,000	225	226	342
5.0	0.060	0.030	100,000	32	29	343
5.0	0.060	0.050	100,000	11	25	344
5.0	0.060	0.150	6,500	229	230	345
5.0	0.060	0.150	6,500	246	247	346
5.0	0.075	0.090	25,000	14	26	347
5.0	0.080	0.150	5,000	116	117	348
5.0	0.115	0.150	40,000	16	27	349
5.0	0.115	0.170	40,000	16-39	694	695
5.0	0.115	0.190	10,000	39	44	352
5.0	0.115	0.200	5,000	20	28	356
5.0	0.115	0.220	5,000	70	172	358
5.0	0.115	0.250	5,000	244	245	355
5.0	0.125	0.250	5,000	45	46	359
10.0	0.015	0.020	16,000	255	360	361
10.0	0.027	0.100	10,000	74	85	362
12.0	0.030	0.100	25,000	209	243	382
12.0	0.040	0.150	16,000	227	228	383
12.0	0.060	0.150	16,000	66	71	384
13.0	0.040	0.190	5,000	266	385	386
14.0	0.040	0.150	16,000	248	256	388
14.0	0.065	0.150	16,000	367	368	369
18.0	0.026	0.150	10,000	75	86	389
28.0	0.024	0.150	16,000	62	64	393
28.0	0.024	0.200	16,000	267	390	391
115.0	0.001 MAX.	0.010	5,000	95	118	396

LAMPS, INC., 19220 So. Normandie Ave., Torrance, Calif. 90502 • (213) 323-7578 • TWX: 910-346-7038
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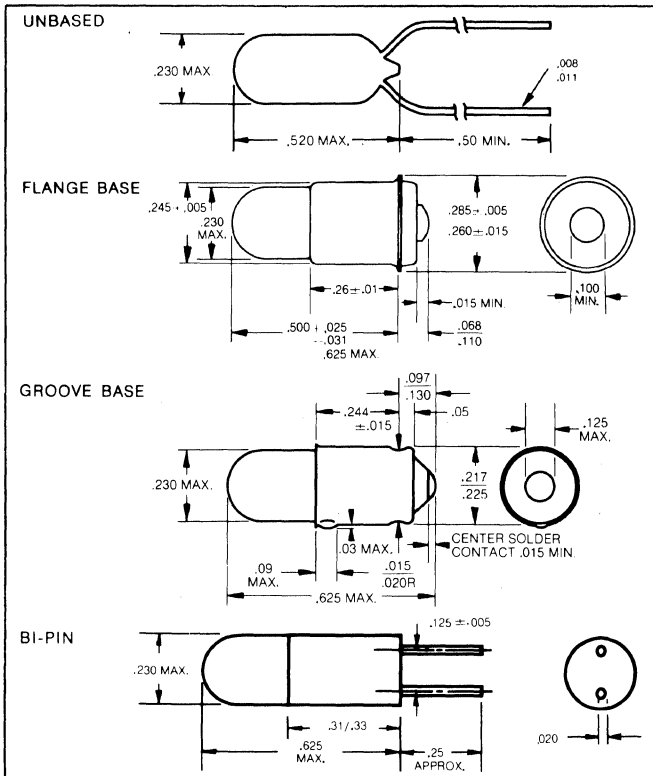
T-1¾ LAMP

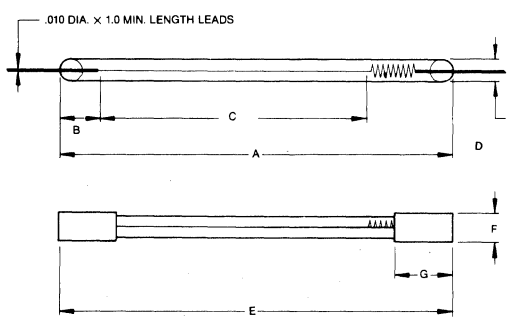


Design Volts	Design Amps (±10%)	MSCP (Note 1)	Life (hrs.)	Part Numbers Unbased LAMPS	Flange LAMPS	Groove LAMPS	Bi-Pin LAMPS
2.5	0.200	0.220	500	715	716	717	719
3.0	0.015	0.002	10,000	582	586	590	594
5.0	0.015	0.020	10,000	372	264	373	435
5.0	0.020	0.034	10,000	374	260	375	436
5.0	0.040	0.100	10,000	376	237	377	437
5.0	0.060	0.030	100,000	720	7**	722	723
5.0	0.060	0.050	100,000	724	725	726	727
5.0	0.060	0.150	6,500	378	270	379	438
5.0	0.115	0.150	40,000	415	158	416	439
6.0	0.040	0.030	10,000	598	602	606	610
6.0	0.200	0.340 @ 5V	1,000	421	328	422	442
6.0	0.200	0.440	20,000	419	453	420	441
6.3	0.040	0.020	50,000	614	618	622	626
6.3	0.180	0.400	5,000	630	634	638	642
6.3	0.200	0.400	50,000	662	666	670	674
6.3	0.200	0.550	3,000	646	650	654	658
10.0	0.014	0.008	10,000	678	682	686	688
10.0	0.040	0.080	30,000	689	690	691	692
12.0	0.060	0.150	16,000	423	424	425	443
12.0	0.100	0.440	10,000	426	236	427	444
14.0	0.080	0.300	50,000	428	184	429	445
14.0	0.080	0.500	750	703	704	705	706
18.0	0.040	0.200	1,000	707	708	709	710
28.0	0.024	0.150	16,000	430	55	431	446
28.0	0.040	0.300	25,000	711	712	713	714
28.0	0.040	0.340	1,000	480	327	432	447
28.0	0.060	0.340	25,000	433	56	434	448

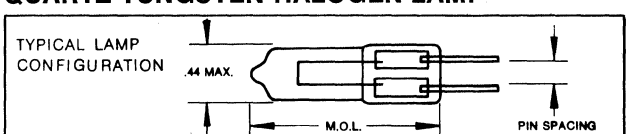
NOTES: 1. MSCP tolerances are Nominal, ±25% and ±15%; others available on request.

LINE FILAMENT LAMP

Design Volts	Design Amps (±10%)	Filam. Temp. (°K)	Life (hrs.)	Dimensions A	B	C	Min. Hot Length	D	E	F	G	Part Numbers LAMPS
2.5	0.045	2150	1,000	.88	.05	.40	.37	.052	—	—	—	111
3.0	0.400	1910	25,000	2.00	.20	1.45	1.00	.160	2.20	.190	.32	218
3.7	0.120	2380	1,000	1.30	.12	.82	.62	.094	1.40	.125	.25	219
5.0	0.480	2100	20,000	2.25	.20	1.75	1.50	.160	2.40	.190	.32	468
6.0	0.110	1980	25,000	2.00	.12	1.60	1.40	.094	2.10	.125	.25	563
6.0	0.120	1990	25,000	2.00	.12	1.45	1.00	.094	2.10	.125	.25	96
6.0	0.120	2160	5,000	1.70	.12	1.25	1.00	.094	1.80	.125	.25	105
6.0	0.400	2320	2,000	2.15	.20	1.65	1.25	.160	2.30	.190	.32	140
11.0	0.400	2080	20,000	4.50	.20	3.45	3.00	.160	4.70	.190	.32	220
12.0	0.140	1910	25,000	4.44	.12	3.93	3.70	.094	4.56	.125	.25	288
14.0	0.500	2240	5,000	4.50	.20	3.80	3.30	.160	4.70	.190	.32	211
18.0	0.120	1990	25,000	4.50	.12	3.95	3.50	.094	4.60	.125	.25	97
20.0	0.120	1990	25,000	5.00	.12	4.45	4.00	.094	5.10	.125	.25	108
29.0	0.120	1990	25,000	7.50	.12	6.65	6.50	.094	7.60	.125	.25	450
30.0	0.335	2100	20,000	10.40	.20	9.50	9.00	.160	10.60	.190	.32	40
32.0	0.180	2380	1,000	7.70	.20	6.95	6.50	.160	8.00	.190	.32	279
36.0	0.120	1990	25,000	8.80	.12	7.95	7.50	.094	8.90	.125	.25	98
38.0	0.200	2160	5,000	10.50	.15	9.45	9.00	.125	10.65	.160	.25	99
48.0	0.200	2130	5,000	12.90	.15	11.95	11.50	.125	13.10	.160	.25	100



QUARTZ TUNGSTEN-HALOGEN LAMP



Design Volts	Design Amps (±10%)	Design Watts (±10%)	Color	MSCP	Life	Part Number LAMPS	Industry*
12	8.33	100	3300	230	70	LAQ 32	FCR
12	8.33	100	3300	230	70	LAQ 33	FDX
12	8.33	100	3300	220	70	LAQ 34	FDT
24	6.25	150	3400	360	70	LAQ 1	FCS
24	6.25	150	3400	350	70	LAQ 35	FDW
24	6.25	150	3400	370	70	LAQ 36	FDS

** Ref. American National Standards Institute*

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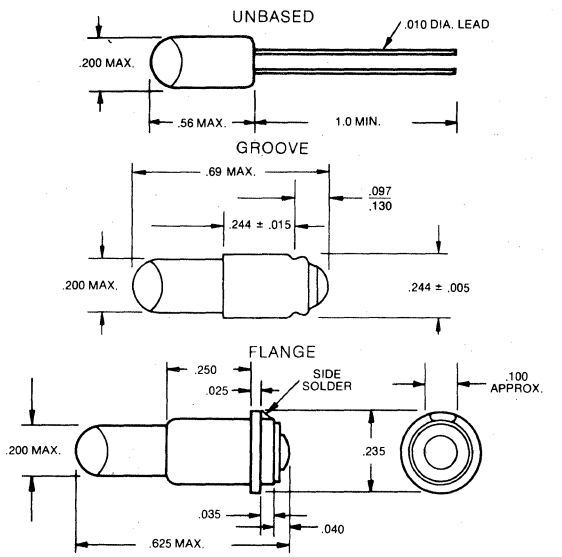
Incandescent Lamp

LAMPS, INC. TL Series lamps comprise a line of precision light sources. Control of lens configuration, combined with uniformity of filament dimensions and spacing, contribute to the consistently high output from lamp to lamp.

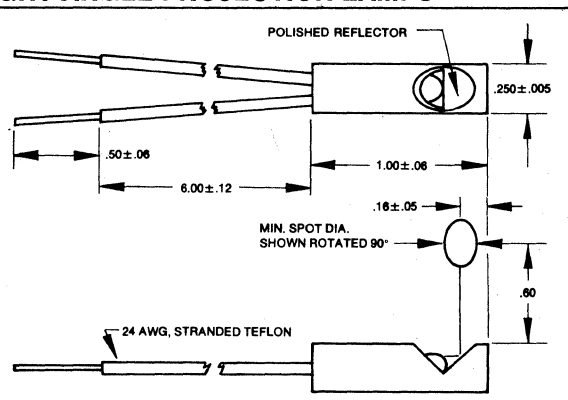
TL LAMPS



Design Volts	Amps (±10%)	Life (hrs.)	Part Numbers Unbased LAMPS	Unbased Ind.*	Groove LAMPS	Groove Ind.*	Flange LAMPS	Flange Ind.*
2.5	0.350	10,000	729	2140	253	253	732	252
2.5	0.350	10,000	730	2124	253-X	253-X	—	—
2.5	0.350	10,000	731	2136	253-1	261	—	—

** Ref. American National Standard Institute*

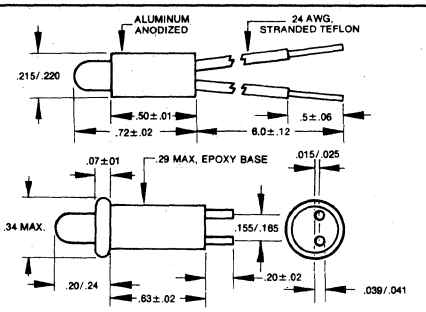
RIGHT ANGLE PROJECTION LAMPS



Design Volts	Amps (±10%)	Life (hrs.)	Spot Intensity**	Spot Dia. (in., min.)	Part Numbers LAMPS
2	0.180	12,000	180	0.12	556***
2.5	0.200	1,000	400	0.12	556
2.5	0.350	10,000	450	0.16	558
2.5	0.350	10,000	600	0.12	559
2.5	0.350	10,000	800	0.08	560
5	0.180	10,000	350	0.12	557***
6	0.200	1,000	800	0.12	557

***Foot-Candles*
****Derated*

TL LAMP ASSEMBLIES

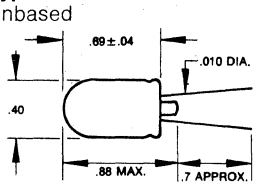


Design Volts	Amps (±10%)	Life (hrs.)	Spot Intensity**	Part Numbers LAMPS	Fig. No.
2	0.180	12,000	220	474***	1
2.5	0.200	1,000	500	474	1
2.5	0.350	10,000	800	476	1
2.5	0.350	10,000	1,000†	477	1
2.5	0.350	10,000	800	478	2
5	0.180	10,000	500	475***	1
6	0.200	1,000	1,000	475***	1

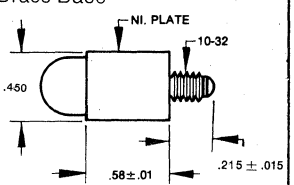
***Foot-Candles*
****Derated*
†0.06" Min. Dia. Spot

T4/TL-4 LAMPS

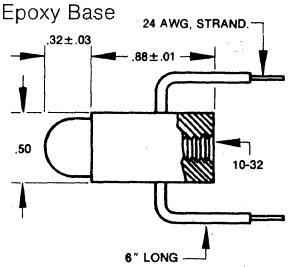
Type 1
Unbased



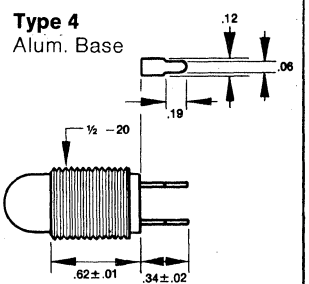
Type 3
Brass Base



Type 2
Epoxy Base



Type 4
Alum. Base



Ordering Information

Part No. Example: 4 1 1 2 1

4 Lamp Type	1 Base Type	1 Bulb Type	2 Filament Type	1 Filament Rating
(T-4/TL-4)	1 — Unbased	1 — Clear	1 — Bar	
	2 — Epoxy Base	2 — Thin Lens	2 — C-2R	See Table below
	3 — Brass Base	3 — Heavy Lens		
	4 — Alum. Base			

FILAMENT RATINGS

No.	Type	Rated (150 hrs. life) Volts	Rated (150 hrs. life) Amps	Derated (5,000 hrs. life) Volts	Derated (5,000 hrs. life) Amps
1	2	3.3	0.40	2.5	0.35
2	2	3.3	0.89	2.5	0.77
3	1	6.5	0.46	5.0	0.40
4	1	6.5	0.89	5.0	0.77
5	1	7.8	0.82	6.0	0.71
6	1	7.8	0.87	6.0	0.76

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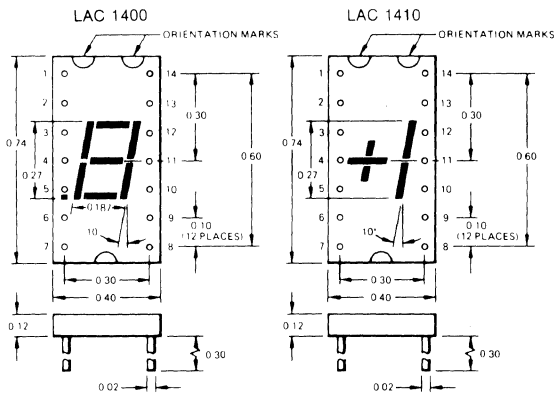
LED Displays and Lamps

LAMPS, Inc. offers an extensive line of GaAsP LED displays and lamps in red, clear, transparent or diffused lens colorations. Displays include 1, 3, and 4 character, multipurpose, and 5 x 7 dot matrix. Lamp features include improved brightness, wide angle visibility, low power requirements, and optional mounting hardware. Also, a wide variety of infrared emitters and opto-isolators are offered to meet the most stringent military and industry specifications.

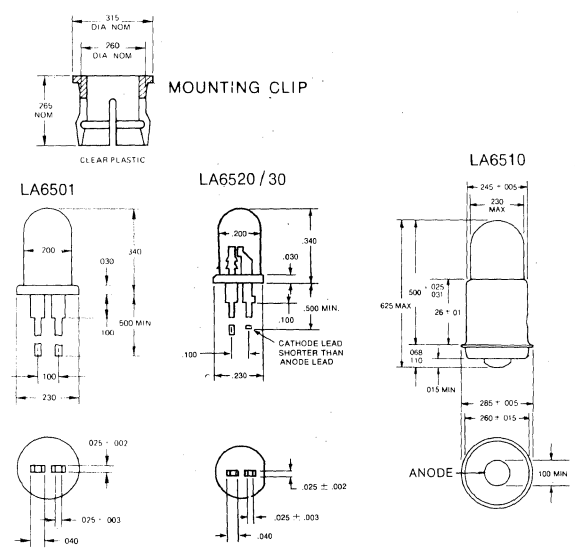
LAC1400/1500 SERIES

LAC1400 — High Luminance at Low Current . . . 500 ft. Lamberts at 10 ma. LAC1500 — High Luminance . . . 350 ft. Lamberts, typically at 20 mw.



LA6400/6500 SERIES

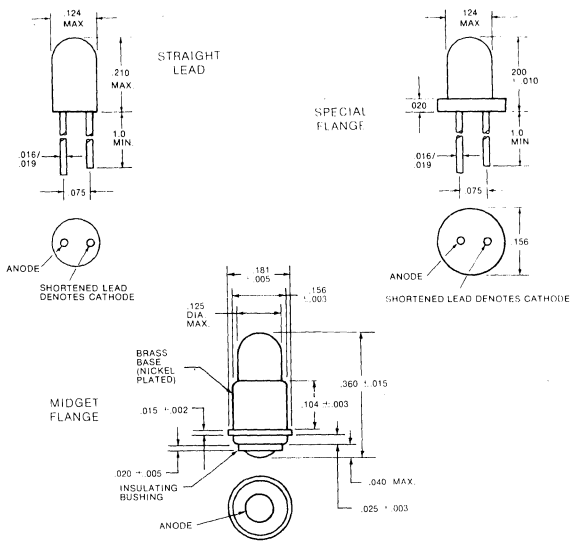
Luminous intensity typically 1.2 mcd at 20 ma.



Lens	Model Numbers Stand-Off Lead	Flange
Red Diffused	LA6501	LA6510
Clear Transparent	LA6502	LA6511
White Diffused	LA6503	LA6512
Red Clear	LA6504	LA6513
	LA6520	LA6525
	LA6530	LA6535
	LA6540	LA6545

LA6600 SERIES

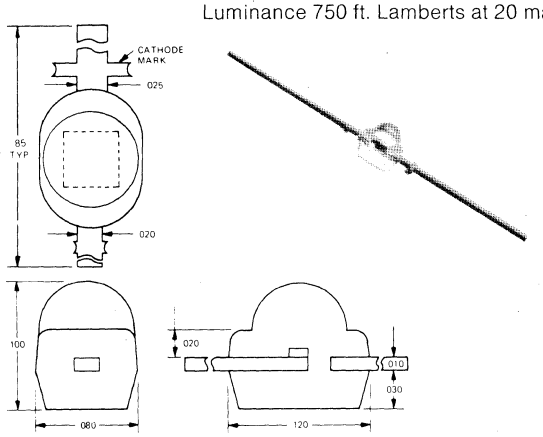
Luminous intensity typically .5 mcd at 20 ma.



Lens	Model Numbers Straight Lead	Special Flange	Midget Flange
Red Clear	LA6600	LA6610	LA6620
White Diffused	LA6601	LA6611	LA6621
Clear Transparent	LA6602	LA6612	LA6622
Red Diffused	LA6603	LA6613	LA6623

LA6300 SERIES

Luminance 750 ft. Lamberts at 20 ma.



Lens	Model Numbers
Clear Transparent	LA6301
Red Clear	LA6302
Red Diffused	LA6303
White Diffused	LA6304

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Leecraft MANUFACTURING CO., INC.

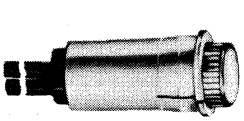
21-16 44th Road, Long Island City, N.Y. 11101 • (212) EXeter 2-8800 • TELEX #12-6977

WRITE FOR PRODUCT LIGHTING GUIDE. PROTOTYPE SAMPLES AVAILABLE ON REQUEST.

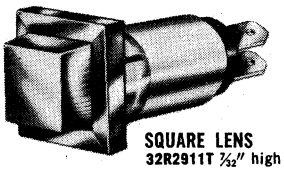
INDICATOR LIGHTS

SNAPLITE INDICATOR LIGHTS

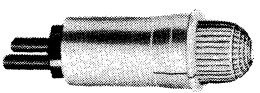
With long-life lamps, high brightness types. Built-in resistors — when neon lamps — to suit applied circuit voltage, provide required lamp life, eliminating replacement need. Features: Snap into place in ½" hole with no additional hardware. Wide variety of lens and housing colors. Tab or solder terminals; or wire leads. AVAILABLE WITH CHROME RINGS. To specify Chrome Rings add R after 1st 2 Digits, i.e., 32-2111 becomes 32R2111.



FLAT CYLINDRICAL LENS
32-2111 3⁄16" high



SQUARE LENS
32R2911T 7⁄32" high



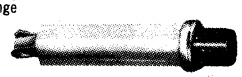
DOME LENS
32-2211 13⁄32" high

TINEON INDICATOR LIGHTS

Long Life, High Brightness Lamps — Press fit into 5/16" hole — For neon types rated 110-250V — Nylon housing in colors (white standard) — Speed nut furnished — Plastic lens in colors — Legends — Built-in Resistor — Insulated Leads.
All Tineons are available with Incandescent Lamp.

3600 Series (with built-in resistor) Available in 3 flange dimensions

4100 Series (with neon less resistor or incandescent)



No. 45R2111T8

TINEONS 45 Series (Blade Terminals)

No. 46N2311

46 Series (Pin Type Terminals)

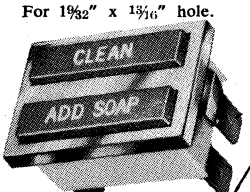
WITH ALUMINUM BEZEL
All Tineons may be furnished with aluminum bezel. Please specify when ordering.

No. 36EN2111 (Hi-Hat red lens) With aluminum bezel

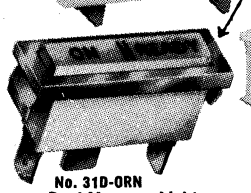
RECTANGULAR INDICATOR LIGHTS

Long Life High Brightness Neon Lamps — Snap into panel securely without additional hardware — Choice of lens colors — Series 3100 has chrome bezel and plastic lens — Series 47 has one-piece plastic lens and body — Complete range of voltages — UL and CSA listed.

DUAL BEZEL
No. 31-ML2
For 1 9⁄32" x 1 3⁄16" hole.

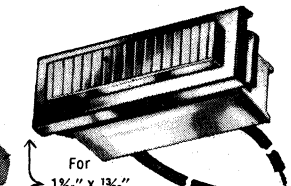


For 1 3⁄32" x 1 3⁄32" hole



No. 31D-ORN
Dual Message Lights

Barrier separates light into two separate message areas. Individual or simultaneous operation.



No. 51-2135T
SLIDELITE™
Pilot Indicator Light, Slide-Switch Combination

Ultra-compact. Simple snap-in installation. Wide voltage range, choice of lights. May be message stamped. Lens colors: red, amber, clear, white, blue, green, others on request. Leads or terminals. 1 25⁄64" x 15⁄32" x 21⁄32". Rating: 125 V. 6 Amps.

LAMPHOLDERS

MIDGET SCREW

16-00 SERIES SOLDER, TERM.

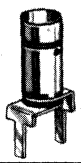
16-200 SERIES WIRE LEADS

16-08

MIDGET GROOVED

25-200 SERIES WIRE LEADS

25-00 SERIES SOLDERING TERMINALS
Used in data processing and automation fields with Lens-End Lamp Nos. 253, 253X, and 261.



25-35

WEDGE BASE

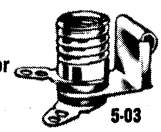
23-00 SERIES | **23-200 SERIES** | **24-00 SERIES**

23-24 | **23-223** | **24-07A**

23-00 SERIES — Molded housing, terminal.
23-200 SERIES — Molded housing with wire leads.
24-00 SERIES — Wafer type terminals.

MINIATURE SCREW

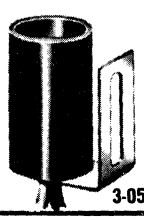
5-00 SERIES SOLDER TERMINALS or WIRE LEADS



5-03

MINIATURE BAYONET

3-00 SERIES

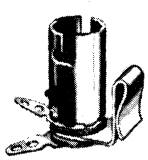


3-05

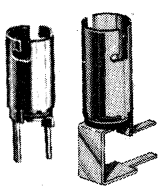
2-00 SERIES

2-15

7-00 SERIES



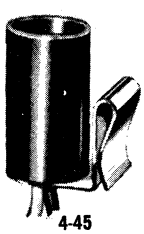
7-01



7-35 **7-35XP11**

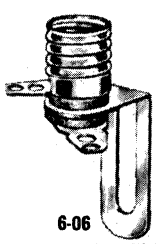
CANDELABRA SCREW

4-00 SERIES



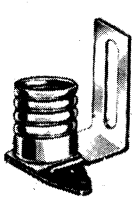
4-45

6-00 SERIES



6-06

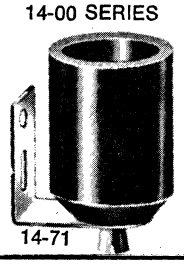
18-00 SERIES



18-79

INTERMEDIATE SCREW

14-00 SERIES

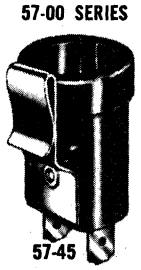


14-71

CANDELABRA BAYONET

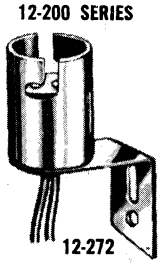
DOUBLE CONTACT

57-00 SERIES



57-45

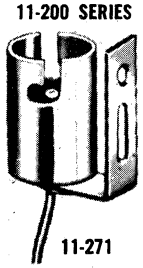
12-200 SERIES



12-272

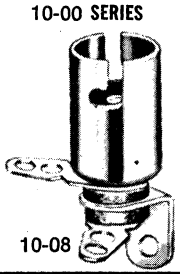
SINGLE CONTACT

11-200 SERIES



11-271

10-00 SERIES

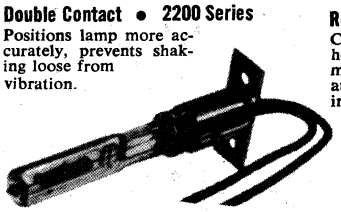


10-08

LAMPHOLDERS FOR SINGLE-ENDED and DOUBLE-ENDED QUARTZ IODINE LAMPS

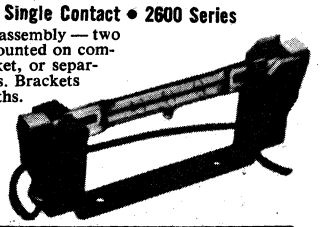
Double Contact • 2200 Series

Positions lamp more accurately, prevents shaking loose from vibration.



Recessed Single Contact • 2600 Series

Complete assembly — two holders mounted on common bracket, or separate sockets. Brackets in all lengths.

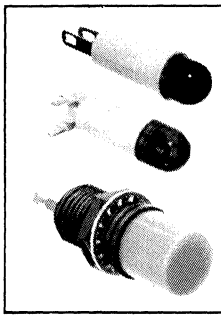


MARCO-OAK

The Marco-Oak indicator light line has been expanded to provide RFI/EMI suppression. Many new models have been added. The low-cost QT indicator series and the new Light-Emitting-Diode (LED) series are of particular interest to the electronics designer. The QT indicator series offers the patented "Marco slide base" which permits front panel relamping. The LED series also offer front panel relamping and wide-angle visibility.

INDICATOR SELECTION GUIDE

T-1 INCANDESCENT INDICATOR

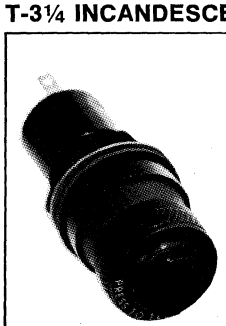


DESCRIPTION	SERIES
General Purpose, Sub-Miniature	99-33180
	99-33081
	99-33080
	99-36980*
	99-36981*
	99-36982
Sub-Miniature, E.M.I. Suppressed	98-36980
	98-36981
	98-36982
Sub-Miniature, Watertight	95-33180

T-1¾ INCANDESCENT INDICATOR

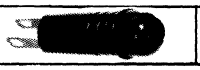
DESCRIPTION	SERIES
General Purpose, Miniature	14-33880
	14-33881
	14-33882
	14-34080
	14-35180
	14-36380
	14-30380
	14-30080
	59-52380
	59-52480
	11-33480*
General Purpose, Miniature, Press-to-Test	59-52280
	03-90980
	03-91080
	01-91180*
Watertight	15-30083
	15-35182
	15-35183
	11-35182*
Watertight, Press-to-Test	05-91182
	05-90880
	05-90881
E.M.I. Suppressed	18-36880*
E.M.I., Press-to-Test	08-83281
E.M.I., Watertight	18-36680
E.M.I., Watertight, Press-to-Test	08-83283

T-3¼ INCANDESCENT INDICATOR



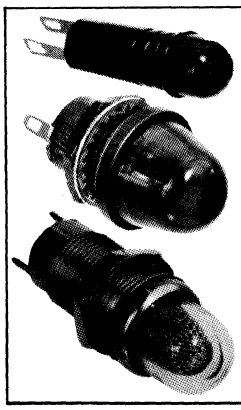
DESCRIPTION	SERIES
General Purpose	13-16080
	13-16180
	13-VM305
	13-VM309
General Purpose, Press-to-Test	04-VM905
	04-VM906
	02-91180*
Watertight	12-16080*
Watertight, Press-to-Test	06-91182
E.M.I. Suppressed	18-83680

T-1 NEON INDICATOR



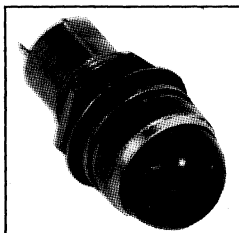
DESCRIPTION	SERIES
Sub-Miniature	99-33080
	99-33081

T-2 NEON INDICATOR



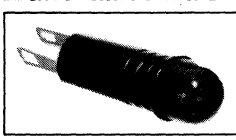
DESCRIPTION	SERIES
General Purpose, Miniature	22-35380
	33-36181
	33-36281
	33-30880
	33-30881
	31-36180*
	31-36280*
Watertight	31-36680*
	31-36681*
E.M.I. Suppressed	38-36180*
	38-36280*
	38-36480
	38-36481

T-3¼ NEON INDICATOR



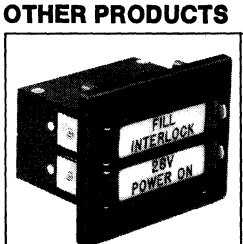
DESCRIPTION	SERIES
General Purpose	35-16080
	35-16081
	35-16180
	35-16181
E.M.I. Suppressed	38-83681
	38-83682
Watertight	32-16080*
	32-16081*

LIGHT EMITTING DIODE (L.E.D.)



DESCRIPTION	SERIES
General Purpose, Miniature	QT/D300
	14-35380

OTHER PRODUCTS

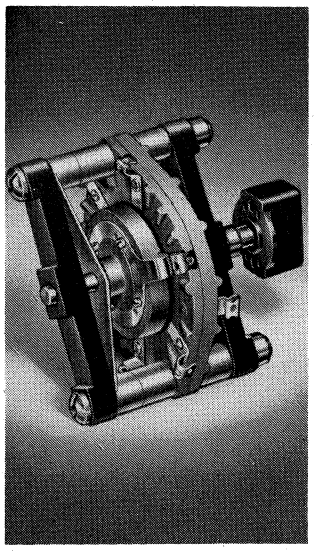


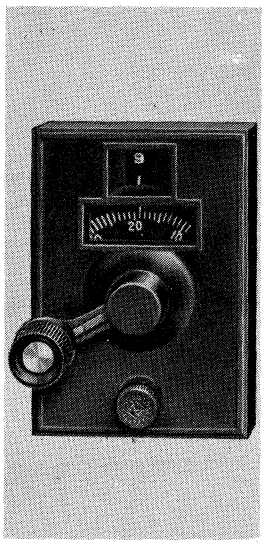
Missilites
Two or more Lamp Displays

*QPL 3661 Listed.

MARCO-OAK
A Subsidiary of OAK Industries Inc.
P.O. Box 4011
207 S. Helena Street, Anaheim, Calif. 92803
Tel. (714) 535-6037 • TWX — 910-591-1185

FOR SWITCHES — SEE MARCO-OAK'S SWITCH SELECTOR GUIDE, EEM **Vol.2•1101**



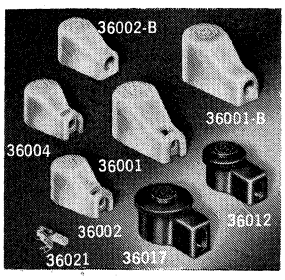


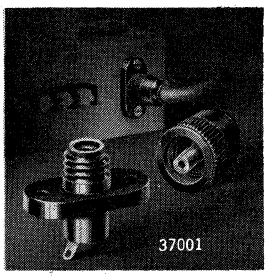
MILLEN NO. 10031 COUNTER DIAL

The **No. 10031 Dial** is a rugged turns counting dial. It has a 0-99 turn digital readout plus a vernier scale calibrated 0-100. The design includes a built-in dial lock. The output coupling is a hub for 1/4" diameter shaft. The crank handle drives any multi-turn device directly. This new small size dial is designed to drive vacuum variable capacitors, rotary tunable inductors, multi-turn potentiometers, permeability tuned inductors and other multi-turn devices. Height: 4⅛". Width: 2⅞". Depth: 1 3/32" behind panel. Bezel and gear case are black molded glass-filled Noryl. Ratio: 1:1. Scales: Black with white numerals.

51000 HIGH VOLTAGE R-F SWITCH

51001: Single Wafer. 1 pole, 2 to 6 positions. 13 KV. D.C. flashover. 20 Amperes.
51001D: Single Wafer. 2 poles, 2 or 3 positions. 9 KV. D.C. flashover. 20 Amperes.
51002: Double Wafer. 2 poles, 2 to 6 positions. 13 KV. D.C. flashover. 20 Amperes.
51002D: Double Wafer. 4 poles, 2 or 3 positions. 9 KV. D.C. flashover. 20 Amperes.



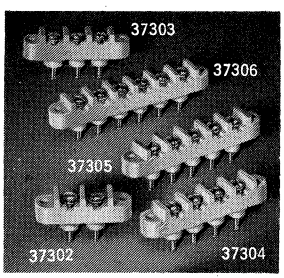


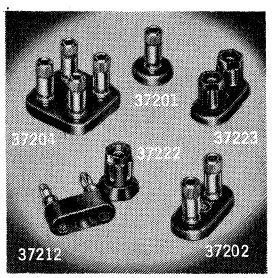
CERAMIC PLATE OR GRID CAPS—Soldering lugs and contact one-piece. Lug ears annealed and solder dipped to facilitate "mechanical plus soldered" connection of cable.
No. 36001—3/16" ..... No. 36002—⅜" ..... No. 36004—¼" .....

SAFETY TERMINAL—Combination high voltage terminal and thru-bushing. Tapered contact pin fits firmly into conical socket providing large area, low resistance connection. Pin is swivel mounted in cap to prevent twisting of lead wire.
No. 37001, Black or Red ..... No. 37501, Low loss .....

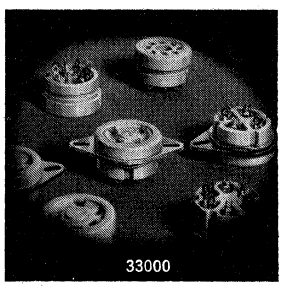
STEATITE TERMINAL STRIPS—Terminal and lug are one piece. Lugs are turret type and are free floating so as not to strain L522 ceramic on wide temperature variations. Easy to mount with series of round holes. 1400 volt and 3500 volt series.

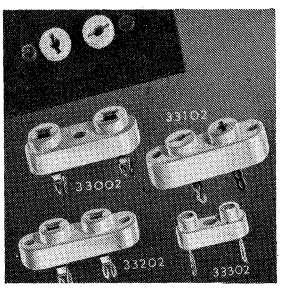
POSTS, PLATES, AND PLUGS—The No. 37200 series, including both insulated and non-insulated binding posts with associated plates and plugs, provide various combinations to meet most requirements. The posts have captive heads and keyed mounting. The No. 37291 on No. 37223 are standard in black or red with other colors on special order. No. 37201, No. 37202, and No. 37204 are available in black, red, or low loss. The No. 37202 is also available in steatite.

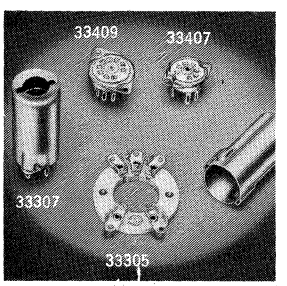


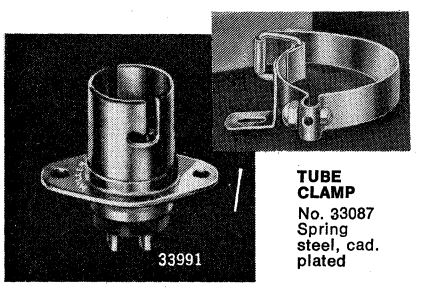


No.	Description	No.	Description
37201	—Single plates, pr.	37204	—Double dual plates, pr. .....
37291	—Single plates (tapered), pr.	37212	—Dual plug .....
		37222	—Non-insulated binding post
37202	—Dual plates, pr.	37223	—Insulated binding post .....









TUBE CLAMP
No. 33087
Spring steel, cad. plated

MILLEN TUBE SOCKETS DESIGNED FOR APPLICATION

Long Flashover path to chassis permits use with transmitting tubes, 866 rectifiers, etc. Long leakage path between contacts. Sockets may be mounted either with or without metal flange. Mounts in standard size chassis hole. All types have barrier between contacts and chassis. All but octal and crystal sockets also have barriers between individual contacts in addition.

Voltage regulator dual contact bayonet socket, 33991 black phenolic insulation and 33992 with low loss mica filled phenolic insulation.

No.	Description	No.	Description
33002	—Crystal Socket ¾" x .125"	33004	—4 Pin Tube Socket
33102	—Crystal Socket .487" x .095"	33005	—5 Pin Tube Socket
33202	—Crystal Socket ½" x .125"		
33302	—Crystal Socket .487" x .050"	33008	—8 Pin Tube Socket
33407	—Miniature Socket only, ceramic	33991	—Socket for 991 .....
33409	—Noval Socket only, ceramic	33992	—Socket for 991 .....
33307	—Miniature Socket, Shield, ceramic	33207	—829 Socket .....
33309	—Noval Socket, Shield, ceramic	33305	—Acorn Socket .....

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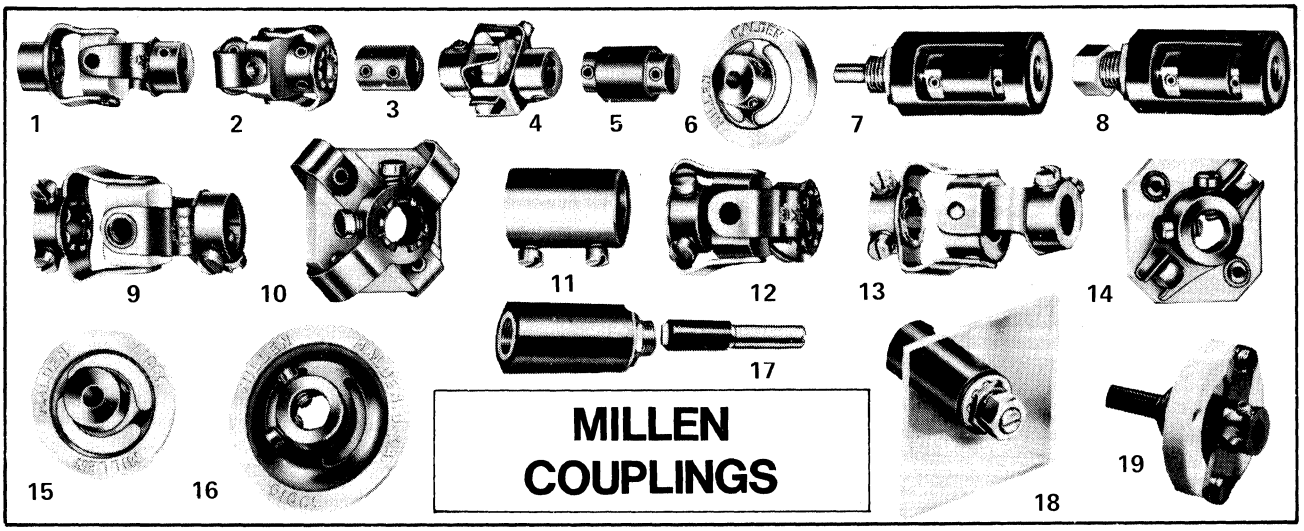


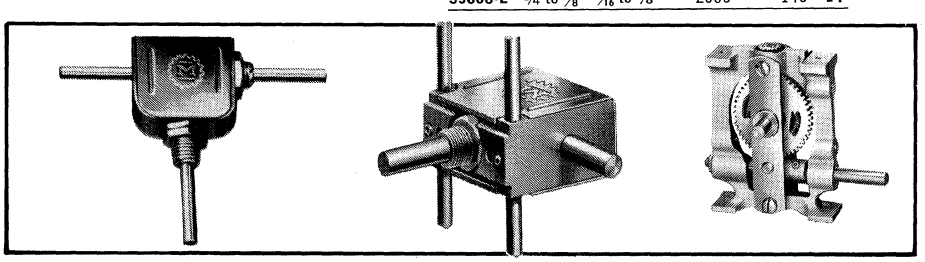
MILLEN COUPLINGS

Millen Number	Hub-to-Hub Shaft Size	Length Inches	Voltage Rating Peak Volts	Max. Torque In.-Oz.	Fig. No.
M001	1/8 to 1/8	1 1/16	2500	—	1
M001-C	1/8 to 1/8	3/4	2500	—	2
M003	1/8 to 1/8	3/8	Non-insulated	Solid	3
M004	1/8 to 1/8	3/4	Non-insulated	—	2
M005	1/8 to 1/8	1 1/16	Non-insulated	—	1
M005-B	1/8 to 1/8	1 1/16	Non-insulated	96	1
M006	1/8 to 1/8	15/16	2500	30	4
M008-A	1/8 to 1/8	39/64	6000	—	5
M017	1/8 to 1/8	17/32	4400	—	6
M017-A	1/8 to 3/32	17/32	4400	—	6
M017-B	1/8 to 3/16	17/32	4400	—	6
M017-C	1/8 to 1/8	17/32	Non-insulated	—	
M017-D	1/8 to 3/32	17/32	Non-insulated	—	
M017-E	1/8 to 3/16	17/32	Non-insulated	—	
M023	1/8 to 1/8	1 9/32	6000	—	7
M024	1/8 to 1/8	1 17/32	6000	—	8

No. M000 Series, Above—Miniature Size
No. 39000 Series, Right—Standard Size

Millen Number	Hub-to-Hub Shaft Size	Length Inches	Voltage Rating Peak Volts	Max. Torque In.-Oz.	Fig. No.
39001	1/4 to 1/4	1 5/16	4000	110	9
39001-A	1/4 to 1/4	1 5/16	4000		9
39001-C	1/4 to 1/4	15/16	4000	110	12
39001-D	1/4 to 1/8	1 5/16	4000		9
39001-E	1/4 to 3/8	1 5/16	4000	110	9
39001-F	1/4 to 1/8	15/16	4000		12
39001-H	1/4 to 3/16	1 5/16	4000	110	9
39002	1/4 to 1/4	1 3/16	3000	48	10
39002-A	1/4 to 1/8	1 3/16	3000	48	10
39002-B	1/4 to 3/16	1 3/16	3000	48	10
39003	1/4 to 1/4	3/4	Non-insulated	Solid	11
39003-B	1/4 to 1/4	3/4	Non-insulated	Solid	
39003-K	1/4 to 1/4	3/4	Non-insulated	Solid	
39004	1/4 to 1/4	15/16	Non-insulated	110	12
39004-B	1/4 to 1/4	1 5/16	Non-insulated	128	12
39004-C	1/4 to 3/16	15/16	Non-insulated	110	12
39004-D	1/4 to 1/8	1 5/16	Non-insulated	110	12
39005	1/4 to 1/4	1 5/16	Non-insulated	110	13
39005-B	1/4 to 1/4	1 5/16	Non-insulated	128	13
39005-C	1/4 to 3/16	1 5/16	Non-insulated	110	13
39005-D	1/4 to 1/8	1 5/16	Non-insulated	110	13
39005-E	1/4 to 3/8	1 5/16	Non-insulated	110	13
39006	1/4 to 1/4	1 1/16 to 7/8	2000	140	14
39006-A	1/4 to 1/8	1 1/16 to 7/8	2000	140	14
39006-B	1/4 to 1/4	1 1/16 to 7/8	Non-insulated	140	14
39006-C	1/4 to 3/16	1 1/16 to 7/8	2000	140	14
39006-E	1/4 to 3/8	1 1/16 to 7/8	2000	140	14

Millen Number	Hub-to-Hub Shaft Size	Length Inches	Voltage Rating Peak Volts	Max. Torque In.-Oz.	Fig. No.
39007	1/4 to 1/4	1 1/16 to 7/8	2000	140	14
39008	1/4 to 1/4	1 1/8	3500	48	
39009	1/4 to 1/4	1 1/8	7000	190	
39009-A	1/4 to 1/4	45/64	6200	250	
39011	1/4 to 1/4	4 1/8	10000	110	
39011-B	1/4 to 1/4	4 1/8	10000	220	
39012	1/4 to 1/4	1 1/16 to 7/8	2000	320	
39012-A	1/4 to 1/8	1 1/16 to 7/8	2000	320	
39012-C	1/4 to 3/16	1 1/16 to 7/8	2000	320	
39013	1/4 to 1/4	1 5/16	1700	96	9
39013-B	1/4 to 1/4	1 5/16	1700	128	9
39013-C	1/4 to 1/4	15/16	1700	96	12
39013-D	1/4 to 1/4	15/16	1700	190	12
39014	1/4 to 1/4	7/8			
39016	1/4 to 1/4	9/16	4400	160	16
39016-A	1/4 to 3/16	9/16	4400	160	16
39016-D	1/4 to 1/4	1/2	Non-insulated	130	
39016-E	1/4 to 1/8	9/16	4400	160	16
39017	3/16 to 3/16	1/2	4400	80	15
39017-A	3/16 to 1/8	1/2	4400	80	15
39017-D	3/16 to 3/16	1/2	Non-insulated	80	
39023	1/4 to 1/4	1 9/32	5500	224	17
39024	1/4 to 1/4	1 9/32	5500	224	18
39027	1/4 to 1/4	1 1/16 to 7/8	Non-insulated	320	
39031	1/4 to 1/4	2 1/8		Solid	
39032-B	1/4 to 1/4		9000	190	19



RIGHT ANGLE DRIVES: Extremely compact, with provisions for many methods of mounting. Ideal for operating potentiometers, switches, etc., that must be located, for short leads, in remote parts of chassis.

No. A012: Miniature right angle drive for 1/8" shafts. Single hole mounting. One to one ratio. 15/32"x3/4"x7/8".

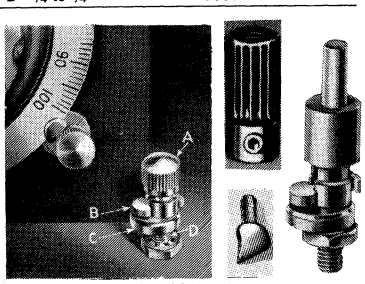
No. 10012: Standard size right angle drive for 1/4" shafts. Provisions for many methods of mounting. One to one ratio.

No. 10012-T: Thru-sleeve right angle drive. Stainless steel sleeve to take 1/4" diameter shaft.

WORM DRIVE UNITS

Cast aluminum frame may be panel or base mounted. Spring loaded split gears to minimize backlash. 3/4"x2 3/8"x3".

No. 10000-A: 16:1 anti-backlash worm drive.
No. 10000-B: 48:1 anti-backlash worm drive.
No. 10000-C: 12:1 anti-backlash worm drive.
No. 10000-D: 36:1 anti-backlash worm drive.



DIAL LOCKS AND INDEX

No. A050: Miniature lock for dials up to 1/16" thick.
No. 10050: Lock for dials up to 3/32" thick.
No. 10050-A: Dial lock with positioning key.
No. 10053: Lock for dial plate behind panel.
No. 10053-A: Behind panel dial lock with key.
No. 10054: Behind panel lock; knurled knob.
No. A021: Miniature metal index for min. dials.
No. 10021: Metal index for standard dials.

MINIATURE KNOBS

For use on 1/8" dia. shaft. All have brass insert.
No. A018: 1/4" Black plastic knob and flange.
No. A019: 1/4" Black plastic knob 9/16" high o.a.

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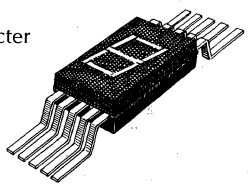
Displays

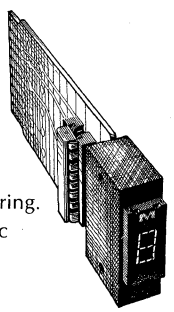
We pioneered the 7-segment display field with the MAN1. We also have the MAN7 and MAN10A—lower cost, brighter than ever.

For smaller character requirements we have the MAN3A, .115" character height, red epoxy lens.

We also have displays with character heights of .127", .190", and .350" and in different package configurations.



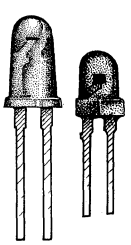
Display Module



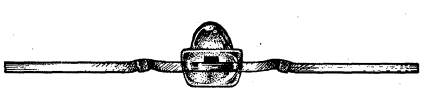
Monsanto display modules, with complete driving circuitry built in, save design time and money. This option provides a clean "building block" approach with minimum engineering.

Available for 7-segment or alpha-numeric displays, in many sizes.

Visible and IR Discretes



The MV5020 series GaAsLITEs feature many lens design configurations and solid state reliability. All come with a snap-in clip for easy panel mounting. Also available—illuminators, diagnostic lamps, red, yellow, and green colors.



The MV50 gives you an extremely bright source in a small package. It can be mounted on 100-mil centers and features long-life and low cost.

We have many more visible GaAsLITES available, as well as a full line of infrared light emitting diodes. They all have Monsanto's experience and dependability behind them.

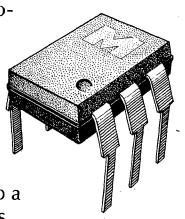
GaAsLITE Update

LITE Heavyweights

Monsanto has produced more GaAsLITE products than all other manufacturers combined. We're pretty proud of that: it means experience, production capability, reliable products. Take a look at some of the LITE Heavyweights available at distributors near you.

Opto-Isolators

Monsanto has a full line of opto-isolators that couple light emitting diodes to photo-transistors, photo-diodes, photo SCR's, and photo-darlingtons. The new MCA2 Photo-darlington coupled pair can be used to replace reed and mercury wetted relays and pulse transformers.



Our MCT2 couples a GaAsLITE emitter to a photo-transistor for use in many business machines, computers, and control applications.

There are many more products in our coupled pair line. Complete information is available in our new catalog.

Arrays

Our custom array product group is available to you for all types of specific array applications. We offer 3½ and 4 digit arrays and multi-diode linear arrays. If you have a requirement, we invite your inquiry.

LITE Heavyweights — on the shelf at our distributors — in quantity. Call today to order or to discuss product applications.

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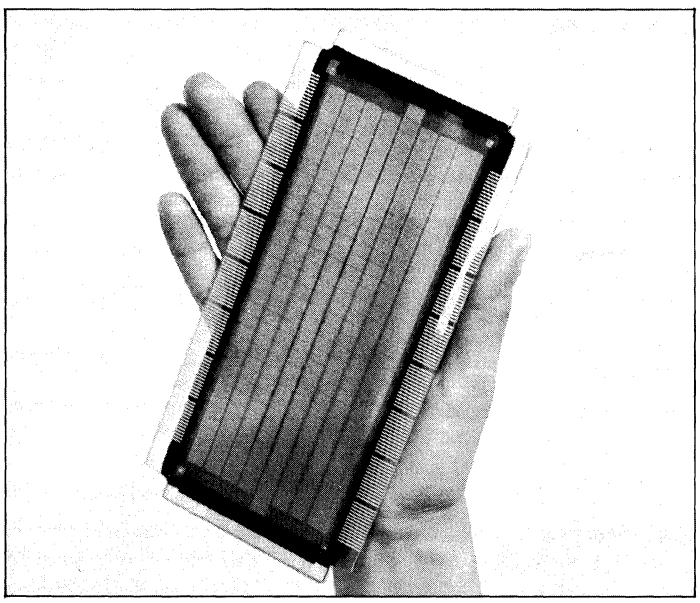
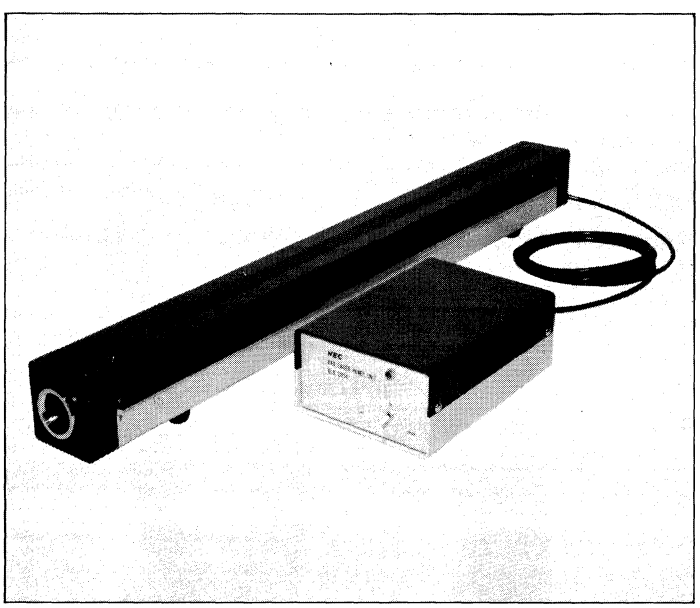
New Directions in Gas Laser and Plasma Display Panel-By NEC



New Type "UTOVUE" Dotmatrix type Plasma Display Panel

Capable of reproducing any letter in the alphabet or any number. The display panel is equipped with a transparent electrode to ensure unusual brightness. It is a decided improvement over conventional types. Featuring a refresh-type operation, this versatile panel can be applied for all kinds of terminal equipment such as computer, data transmission electronic calculators and instrumentation and industrial machines. Sample will be available this fall.



15 mW He-Ne Gas Laser GLG 2040

NEC's new 15 mW He-Ne Gas Laser offers two distinct improvements from conventional ones—greater stability and extra-long operating and shelf life, with no heat run necessary during storage. Output power, for example, is remarkably stable within ±2%/hour after a 30-minute warm-up. Cavity spacers are made of ultra-low-expansion "Neoceram" glass rods. Moreover, the brewster windows are sealed with glass rather than adhesives. That's why NEC guarantees it for the first full year following delivery.

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Nippon Electric Co., Ltd.
Tokyo, Japan

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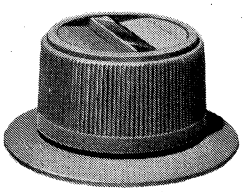
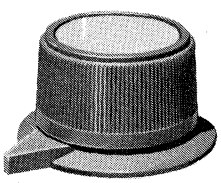
ALPHA SERIES

Cycolac body with aluminum bushing

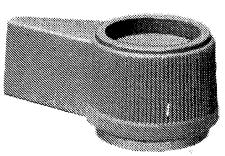
Plain round — Sizes from ⅝" diameter to 1½" diameter



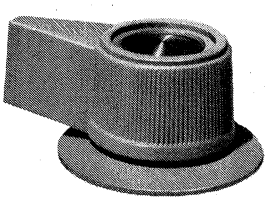
Skirted round — Skirt diameters from 1" to 2"



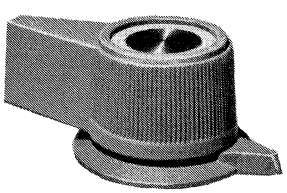
Pointer skirt — Skirted with molded in pointer



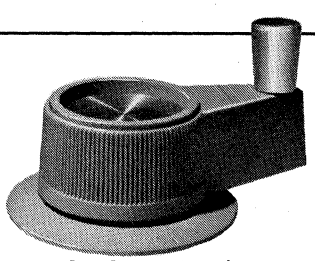
Bar knobs — Three sizes



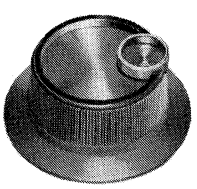
Skirted bar knobs — Skirt diameters from 1.200" to 1.680"



Pointer skirt bar knobs — Three sizes, colored points



Spinner knobs — Crank type in both round and bar



Spinner knobs — Fingertip style

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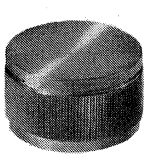
BETA SERIES

Precision machined aluminum knobs



Round — 4 diameters from $\frac{15}{32}$" to 1⅛"

Skirted — 4 sizes, skirt diameters from .800" to 1.500"

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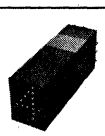
Shelly/Datatron Miniature Indicators

ITEM	DESCRIPTION	SPECIAL FEATURES	BASE TYPE	LAMP (OR LED) TYPE	COLOR COMBINATIONS	CAP STYLES	MTG. HOLES
BRITE-EYE	Microminiature incandescent indicator light	Patented "Easy-Lamp" snap-in base. Just insert indicator in mounting hole and press into position. Terminals are gold plated for corrosion resistance and sure flow of solder. Indicators mount on 0.225 centers and weigh less than ½ gram. Relampable from front panel without tools.	Panel or c rcuit board mounting. Black or white color with or without heatsink.	15 standard T-1 lamps from 1.5 to 28 volts. Life rating to 100,000 hours	Transparent caps in red, green, amber, clear and blue. Translucent caps in red, green, amber, white, yellow.	Seven: Ball End, Lens end, Square, Tubular, Cylindrical, Macrodome and Digicap. Latter inscribed with letter, Numeral or symbol.	.191
TRANS-EYE	Microminiature incandescent indicator light with built-in transistor amplifier	Same features as BRITE-EYE. Plus built-in base transistor compatibility with solid-state circuits. Resistor can be selected for compatibility with input.	Panel Mount TE201 (NPN) or TE202 (PNP). Black unless otherwise specified.	Same as BRITE-EYE	Same as BRITE-EYE	Same as BRITE-EYE	.191
GLO-EYE	Microminiature neon indicator light with built-in resistor	Same features as BRITE-EYE. Incorporates integral resistor which permits preselecting life expectancy. ⅛ watt resistor can be any standard value. 390K used unless otherwise specified. Neon lamp meets MIL-L-15098B specs.	BEPRW (White) BEPRB (Black)	Number 95 neon lamp. USASI A1K type	Same as BRITE-EYE	Same as BRITE-EYE	.191
SIND	Industrial microminiature incandescent indicator light	Same features as BRITE-EYE. Completely assembled with 5V. lamp for low cost indicator for industrial applications.	Panel Mount Black without heatsink	5v @ 60 ma lamp. 50,000 hour life	Four: Translucent cap in red, white, yellow, green.	One: Ball end	.191
SLED	Microminiature LED (Light emitting diode) indicator light	Has "Easy-Lamp" snap-in base. Terminals are gold plated for corrosion resistance and sure flow of solder. SLEDs are supplied with built-in resistor to operate directly from 5, 10 or 15 volts.	Panel Mount Color-Black	LED with built-in resistor for use with 5 or 10v	One: Red	None	.191

Shelly/Datatron Multi-Message Displays and Fiber-optic Readouts

ITEM	DESCRIPTION	SPECIAL FEATURES	LAMP TYPES	RECTICLES	HOUSING	ELECTRONICS MODULES	BEZELS
SRO-90	12 message display maximum message height .438"	Patented rear projection display with front panel replacement lamps and reticles. Six line messages.	T-1 lamps from 3v to 28v unbased	Any picture, symbol, characters, numeral or letter that is photographically reproducable.	Modular	Decode 8-4-2-1 BCD Input codes to 10 line decimal	Snap-on or screw on types. RFI and drip proof
SRO-600	12 message display maximum message height 0.7"	Same features as SRO-90	Based T-1 lamps 5v to 28v	Any picture, symbol, character, numeral or letter that is photographically reproducable.	Modular	Decode 8-4-2-1 BC Input codes to 10 line decimal	Screw-on. RF type. Also RFI and drip types available
FRO- 	Numeric 0-9 Alpha-N, E, S, W, R, L	Single lamp per digit or letter. Arabic characters	T-1 unbased lamps. 5v	N/A	Modular	Decode 8-4-2-1 Input codes	Same as SRO-90

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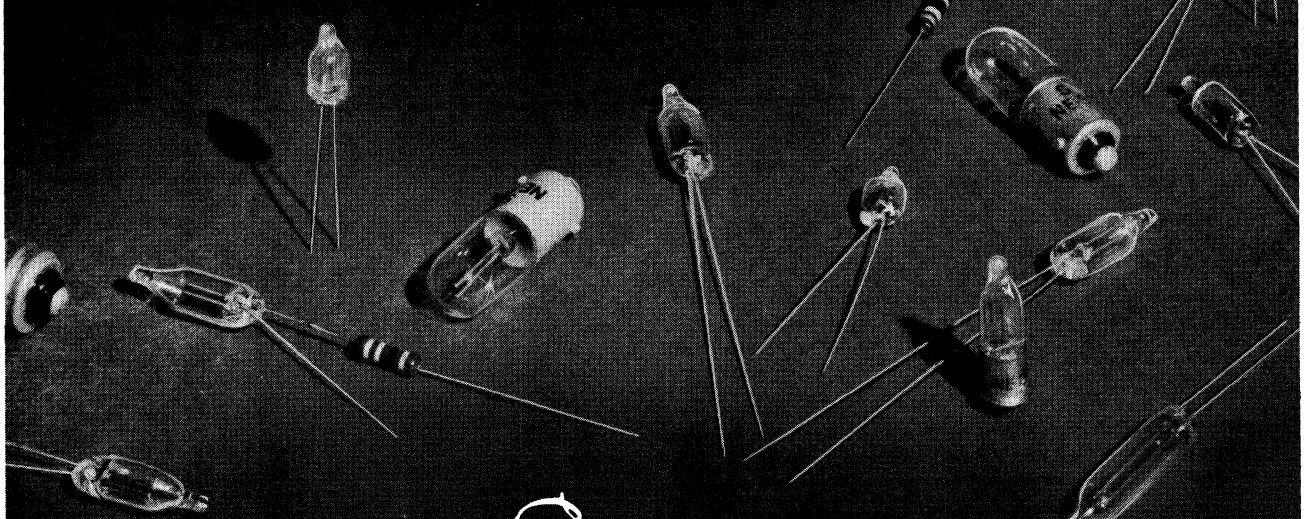

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321

STANDARD BRIGHTNESS INDICATOR LAMPS

SIGNALITE TYPE	ASA #	BREAKDOWN VOLTAGE (MAX.) A.C.	BREAKDOWN VOLTAGE (MAX.) D.C.	RATED LIFE HOURS (AVG.)	SERIES RESISTANCE (OHMS)	CIRCUIT VOLTS	WATTS NOM.	GLASS DIMENSIONS OUTSIDE LENGTH (MAX.)	WIRE TERMINAL LENGTH
A1B	A1B	65	90	25,000	220,000	105-125	1/25	1/2"	1"
T2-20-1	—	65	90	25,000	100,000	105-125	1/15	5/8"	1"
**NE2V	A2B	65	90	25,000	100,000	105-125	1/15	3/4"	2"
T2-24-1	A7A	65	90	25,000	100,000	105-125	1/15	3/4"	1"
T2-24-2 (NE 2E)	A9A	65	90	25,000	100,000	105-125	1/15	3/4"	2"
T2-27-1	A5A	65	90	25,000	100,000	105-125	1/15	27/32"	1"
T2-27-2 (NE 2A)	A3A/A2A	65	90	25,000	100,000	105-125	1/15	27/32"	2"
*T2-32-1	A6A	65	90	25,000	75,000	105-125	1/10	1"	1"
NE-2	A1A	65	90	25,000	150,000	105-125	1/17	1"	1"

NOTES: *Electrodes are 12mm long for longer illuminated length. **NE2V has a small amount of radio active additive to reduce dark effect. Useful life of all standard brightness lamps is considered to be when light output reaches 50% of initial.

HIGH BRIGHTNESS INDICATOR LAMPS

A1C	A1C	95	135	25,000	47,000	105-125	1/7	1/2"	1"
LT2-20-1	—	95	135	25,000	30,000	105-125	1/4	5/8"	1"
LT2-24-1	C3A	95	135	25,000	30,000	105-125	1/4	3/4"	1"
LT2-24-2 (NE 2H)	C2A	95	135	25,000	30,000	105-125	1/4	3/4"	2"
**NE2U	A3C	95	135	25,000	30,000	105-125	1/4	3/4"	2"
LT2-27-1	C4A	95	135	25,000	30,000	105-125	1/4	27/32"	1"
LT2-27-2	C5A	95	135	25,000	30,000	105-125	1/4	27/32"	2"
*LT2-32-1	C6A	95	135	25,000	22,000	105-125	1/3	15/16"	1"

NOTES: *Electrodes are 12mm long for longer illuminated length. **NE2U has a higher amount of radio active additive than the C2A. All high brightness lamps have a small amount of radio active additive to reduce dark effect.

The following notes are common to all standard brightness lamps and high brightness lamps.
Available with different resistor values to meet customer requirements for life and brightness.
May be used on higher voltages in series with proper value rsistor. D.C. life is 60% of A.C. values.
Lamps supplied with cleaned copper finish. May be furnished tinned.

V SERIES VOLTAGE REGULATOR AND REFERENCE TUBES

- temp. coef. less than 15 mv/°C
- life greater than 20,000 hours
- stacking capability for higher voltage regulation

NOTES:
*Limits for less than two volt variation.
**Maximum continuous current without permanent damage to tube.
Equilibrium condition reached within 2 minutes after ignition is common to all Voltage Regulators and Reference Tubes.

SIGNALITE TYPE	BREAKDOWN VOLTAGE Vdc max.	REFERENCE VOLTAGE MEAS. AT Vdc	REFERENCE VOLTAGE MEAS. AT ma	CURRENT RANGE* FOR REGULATOR ma	OPERATING CURRENT ma MAX.**	OPERATING CURRENT ma MIN. AS SHUNT REG.	OPERATING CURRENT ma MIN. IN PARALLEL WITH A CAPACITOR
V83R4	115	83±2	1.5	0.25 — 4.0	6.0	0.25	0.4
V84R2	115	84±2	1.0	0.15 — 2.0	3.0	0.15	0.35
V91R2	125	91±2	1.0	0.1 — 2.0	3.0	0.1	0.3
V103R2	135	103±2	0.8	0.2 — 2.0	3.0	0.2	0.25
V110R4	170	110±2	1.5	0.5 — 4.0	6.0	0.5	0.95
V115R4	155	115±2	0.8	0.15 — 4.0	6.0	0.15	0.3
V116R2	150	116±2	0.6	0.12 — 2.0	3.0	0.15	0.3
V139R1.9	190	139±4	0.5	0.3 — 1.9	3.0	0.3	0.6
V143R1.9	225	143±4	0.5	0.3 — 1.9	3.0	0.3	0.6

Signalite
DIVISION OF GENERAL INSTRUMENT CORPORATION
1933 Heck Ave., Neptune, New Jersey 07753
Area Code 201-775-2490 ■ TWX 201-775-2255

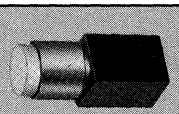
The lamps described are representative of the basic types manufactured by Signalite. For complete information on Neon Glow Lamps for circuit component and/or indicator applications, specifications, or general information contact the factory.

THE SLOAN COMPANY

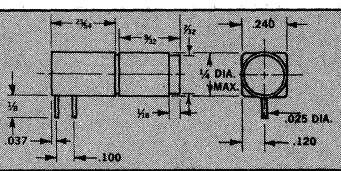
7704 SAN FERNANDO ROAD BOX 367

SERIES

101



LENS BAYONET TYPE
LENS STYLES AVAIL. – DS, DSC, Q, QB



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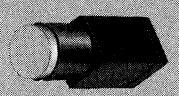

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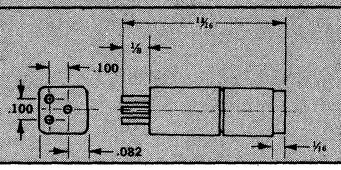
SAME AS 101



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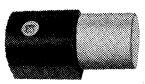
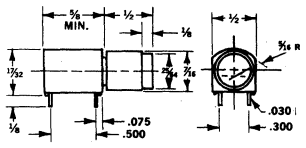
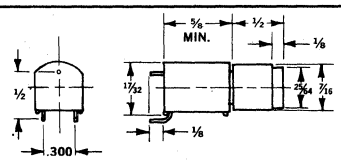


LENS
BAYONET TYPE
LENS STYLES AVAIL. – DS7, DSC7, Q7, QB7
THE SUFFIX (7) IS PERTINENT TO 864 OR 874 SERIES ONLY



874

LENS
BAYONET TYPE
SAME AS 864



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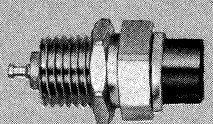
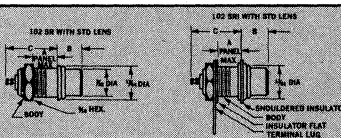


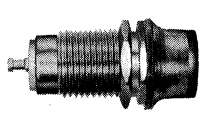
AVAILABLE IN
ALL BODY STYLES

LENS STYLES AVAIL. – STD, DSC, QB, DS, Q



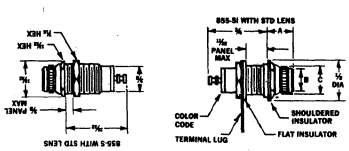
BODY	A	B	C
S	13/64	9/32	13/32
SI	9/32	5/16	3/8
SS	1/4	15/64	7/16
SSI	13/64	17/64	13/32
SK	17/64	15/64	15/32
SKI	7/32	1/4	7/16
SR	9/32	13/64	15/32
SRI	15/64	15/64	29/64

855



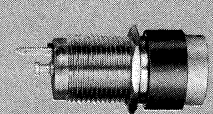
BODY STYLES
AVAILABLE S OR SI

LENS STYLES AVAIL. – STD, DS, DSC, Q, QB, D, M, SE



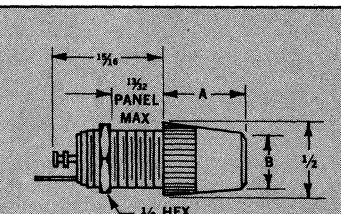
LENS STLYE	A S	A SI	B	C
STD	13/64	21/64	17/64	3/8
D	5/16	11/32	3/8	1/2
DS,DSC,Q,QB	21/64	29/64	3/8	7/16
M	21/32	11/16	3/8	1/2
SE	3/16	3/16		1/2

856



AVAILABLE IN BODY
STYLE S ONLY
(2 TERMINAL BODY ONLY)

LENS STYLES AVAIL. – M, Q, DS, MB, QB, DSC



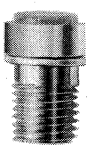
LENS STYLE	A	B
M,MB	5/8	3/8
DS,DSC,Q,QB	3/8	15/32

LENS STYLE

DS

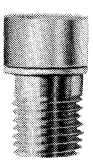
Matte black anodized bezel prevents sidelight emission. Blends with dark colored panels; contrasts with light colored panels. BI-COLOR has the added feature, white when unlighted and colored lighted.

Q



Aluminum anodized bezel (matte silver appearing) allows 180° visibility, blends with light colored panels; contrasts with dark colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

DSC



Aluminum anodized bezel (matte silver appearing) prevents sidelight emission. Blends with light colored panels, contrasts with dark colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

STD

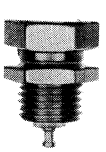
Flat, slightly projected lens gives 180° visibility.
Lens differs on 855 – see drawing.

SE

Edgelight for plastic panels. Small diameter light gasket minimizes wasted panel space. Can be relamped with gloved hands.

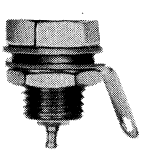
BODY TYPES

S



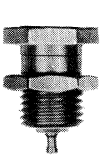
Presents bright metal Hex extending in front of the panel or in front of the shoulder washer on the SI model.

SI



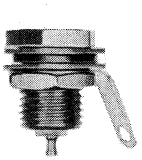
Presents bright metal Hex extending in front of the panel or in front of the shoulder washer.

SS



Presents 5/16" bright metal Hex extends very little in front of the panel or in front of the shoulder washer on the SSI model.

SSI



Presents 5/16" bright metal Hex extends very little in front of the panel or in front of the shoulder washer.

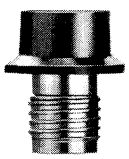
SUN VALLEY, CALIFORNIA 91353 PHONE: (213) 875-1123 TWX: 910-498-2250

LENS STYLE

QB

Matte black anodized bezel. Allows 180° visibility. Blends with dark colored panels; contrasts with light colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

D

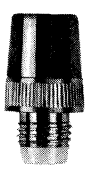


Skirted lens covers metal parts for neat panel appearance. Large lighted surface assures positive indication. BI-COLOR has the added feature, white when unlighted and colored when lighted.

MB

Offers the same features as Type M. Black metal trim. Both accommodate T-1¾ based lamp or T-2 based neon lamp (NE2J or AIH types).

M



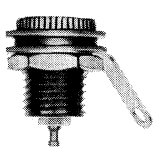
Large lens for maximum visibility from all angles. Engineered to offer the most uniform light distribution. Full 180° visibility.

BODY TYPES

SK

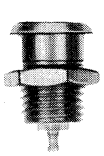
Presents small knurled flange in front of the panel or in front of the shoulder washer on the SKI model.

SKI



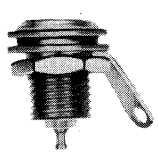
Presents small knurled flange in front of the panel or in front of the shoulder washer.

SR



Presents a small flange in front of the panel or in front of the shoulder washer on the SRI model.

SRI



Presents a small flange in front of the panel or in front of the shoulder washer.

LENS COLOR

TRANSPARENT
- RL — Red
- *BL — Blue
- *GL — Green
- AL — Amber
- CL — Clear

TRANSLUCENT
- RLUC — Red
- WLUC — White
- BLUC — Blue
- GLUC — Green
- ALUC — Amber

*Not recommended for use with neon lamps.

TRANSPARENT
- RL — Red
- *BL — Blue
- *GL — Green
- AL — Amber
- CL — Clear

TRANSLUCENT
- RLUC — Red
- WLUC — White
- BLUC — Blue
- GLUC — Green
- ALUC — Amber

*Not recommended for use with neon lamps.

GENERAL PURPOSE LENS MATERIAL (Translucent except M lens)
- R — Red
- W — White
- B — Blue
- G — Green
- A — Amber
- *C — Clear

LEXAN LENS MATERIAL (Transparent)
- RL — Red
- BL — Blue
- GL — Green
- AL — Amber
- CL — Clear

LEXAN LENS MATERIAL (Translucent)
- RLUC — Red
- WLUC — White
- BLUC — Blue
- GLUC — Green
- ALUC — Amber

GENERAL PURPOSE (Translucent)
- R — Red
- W — White
- B — Blue
- G — Green
- A — Amber

LEXAN LENS MATERIAL (Transparent)
- RL — Red
- BL — Blue
- GL — Green
- AL — Amber
- CL — Clear

LEXAN LENS MATERIAL (Translucent)
- RLUC — Red
- WLUC — White
- BLUC — Blue
- GLUC — Green
- ALUC — Amber

M and MB LENS

TRANSPARENT EXCEPT FOR WHITE
- R — Red
- W — White
- *B — Blue
- *G — Green
- A — Amber
- C — Clear

ALL LENSES EXCEPT M AND MB

TRANSPARENT
- RL — Red
- *BL — Blue
- *GL — Green
- AL — Amber
- CL — Clear

TRANSLUCENT
- RLUC — Red
- WLUC — White
- *BLUC — Blue
- *GLUC — Green
- ALUC — Amber

*Not recommended for use with neon lamps

LAMP TYPE

T-1 INCANDESCENT OR T-1 BASED LED

T-1¾ OR T-2 INCANDESCENT OR T-1¾ BASED LED

T-1¾ INCANDESCENT OR T-1¾ BASED LED

T1¾ AND T2 INCANDESCENT OR T-1¾ BASED LED

HOW TO ORDER

EXAMPLE:

101 (Model No.) RL (Lens Color)

DSC (Lens Style) T-1 Based Lamp (Lamp Type)

EXAMPLE:

864 (Model No.) RL (Lens Color)

DSC (Lens Style) T-1¾ Based Lamp (Lamp Type)

EXAMPLE:

102SI (Body Type) AL (Lens Color)

DSC (Lens Style) T-1 BASED LAMP (Lamp Type)

EXAMPLE:

855SI (Body Type) G (Lens Color) 5 (Color Coding)

D BI-COLOR BASED LAMP (Lens Style) (Lamp Type)

EXAMPLE:

856 (MODEL NO.) RLUC (LENS COLOR)

T-1¾ or T-2 BASED LAMP (LAMP TYPE)

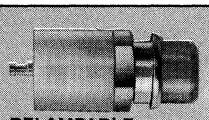
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

THE SLOAN COMPANY

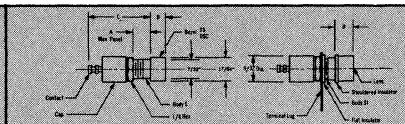
7704 SAN FERNANDO ROAD BOX 367

SERIES

107



REAR RELAMPABLE
LENS STYLES AVAIL. — STD, DS, DSC, Q, QB
BODY STYLES — SI, S



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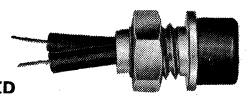
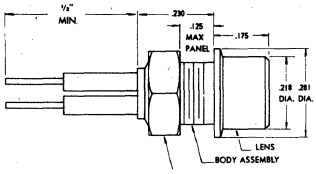


FIXED
LENS STYLES AVAILABLE —
STD DS DSC Q QB



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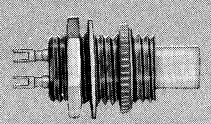
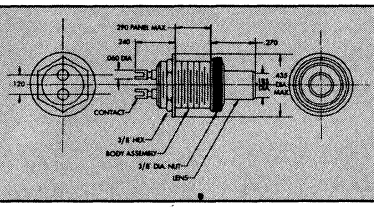


FIXED



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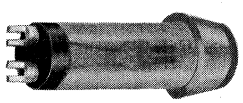
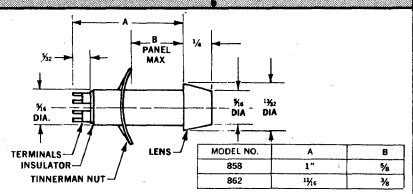
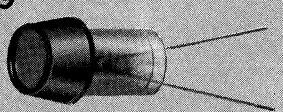


FIXED



MODEL NO.	A	B
858	1"	5/8
862	13/16	3/8

859



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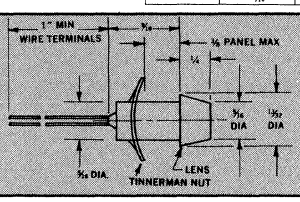


LENS STYLE

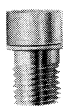
DS

Matte black anodized bezel prevents sidelight emission. Blends with dark colored panels; contrasts with light colored panels. BI-COLOR has the added feature, white when unlighted and colored lighted.

Q

Aluminum anodized bezel (matte silver appearing) allows 180° visibility, blends with light colored panels; contrasts with dark colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

DSC



Aluminum anodized bezel (matte silver appearing) prevents sidelight emission. Blends with light colored panels, contrasts with dark colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

QB

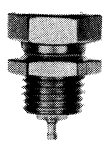
Matte black anodized bezel. Allows 180° visibility. Blends with dark colored panels; contrasts with light colored panels. BI-COLOR has the added feature, white when unlighted and colored when lighted.

STD

Flat, slightly projected lens gives 180° visibility.

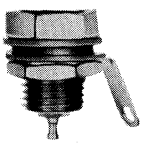
BODY STYLES

S



Presents bright metal Hex extending in front of the panel or in front of the shoulder washer on the SI model.

SI



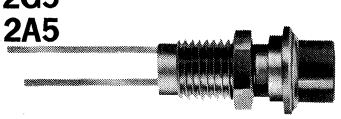
Presents bright metal Hex extending in front of the panel or in front of the shoulder washer.

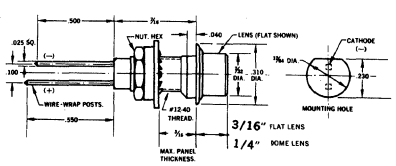
FIXED LED

WE RECOMMEND A TRANSPARENT LENSED LENS TO BE USED FOR APPLICATIONS REQUIRING A BASED LED. IF TRANSLUCENT LENS IS DESIRED WE RECOMMEND NO LENSING IN THE LENS.

SERIES

2L5
2G5
2A5





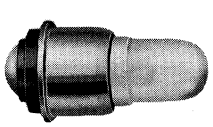
LENS STYLE

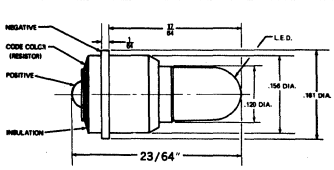
DOME

FLAT

ELECTRICAL DESCRIPTION

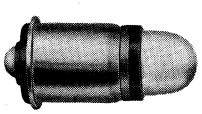
T-1

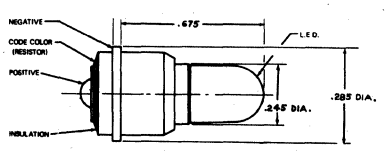




DC Power Dissipation	100 MW
DC Forward Current	50 mA
Peak Forward Current	Mil Std 750
Operating & Storage Temperature	—55°C to +100°C
Light Output	0.8 millicandela typical at 20 mA
Wave Length	655 nm
Speed of Response	15 ns
Capacitance	200 pF
Forward Voltage	1.6 V typical and 2.0 V maximum at 20 mA. Higher voltages and different currents upon request
Reverse Voltage (Breakdown)	3.0 V minimum for $1_R =$ 10 MICRO-AMPS

T-1¾





DC Power Dissipation	225 MW
DC Forward Current	80 mA
Peak Forward Current	Mil Std 750
Operating & Storage Temperature	—55°C to +100°C
Light Output	2.0 millicandela typical at 15mA
Wave Length	690 nm
Speed of Response	15 ns
Capacitance	100 pF
Forward Voltage	2.1V to 2.8V at 20 mA. 5V TTL applications with internal resistor at 15 mA
Reverse Voltage (Breakdown)	4.0 V minimum for $1_R =$ 10 MICRO-AMPS

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SUN VALLEY, CALIFORNIA 91353 PHONE: (213) 875-1123 TWX: 910-498-2250

LENS COLOR	LAMP TYPE	HOW TO ORDER
General Purpose Lens Materials (Translucent): R — Red, W — White, B — Blue, G — Green, A — Amber Lexan Lens Materials (Transparent): RL — Red, BL — Blue, GL — Green, AL — Amber, CL — Clear (Translucent): RLUC — Red, WLUC — White, BLUC — Blue, GLUC — Green, ALUC — Amber	**T-1 BASED LAMP INCANDESCENT OR T-1 BASED LED**	EXAMPLE 107 (Body Type) RLUC (Lens Color) DS (Lens Style) Based Lamp (Lamp Type)
General Purpose Lens Materials (Translucent): R — Red, W — White, B — Blue, G — Green, A — Amber Lexan Lens Materials (Transparent): RL — Red, BL — Blue, GL — Green, AL — Amber, CL — Clear (Translucent): RLUC — Red, WLUC — White, BLUC — Blue, GLUC — Green, ALUC — Amber	**T-1 UNBASED LAMP MIL SPEC OR COMM.**	105S - R - MIL. or COMM. Model No. Lens Color Mil. Spec. or Commercial Bulbs
R — Red, W — White, *B — Blue, *G — Green, A — Amber *Not recommended for use with neon lamps.	**T-1 UNBASED LAMP MIL SPEC OR COMM.**	106S - R - MIL. or COMM. Model No. Lens Color Mil. Spec. or Commercial Bulbs
R — Red, W — White, *B — Blue, *G — Green, A — Amber, C — Clear *Not recommended for use with neon lamps.	**T-1, T-1¾ OR T-2 UNBASED INCANDESCENT OR NEON LAMP**	858 (Model No.) C (Lens Color) AIB (Lamp Type) 220K (*Resistor)
R — Red, W — White, *B — Blue, *G — Green, A — Amber, C — Clear *Not recommended for use with neon lamps.	**T-1, T-1¾ OR T-2 UNBASED INCANDESCENT OR NEON LAMP**	859 (Model No.) C (Lens Color) AIB (Lamp Type) 220K (*Resistor)

LENS COLOR

- Red, White,, and Clear Lens
- Forward Voltage: 5.0± .3V for TTL Logic or Other Low Voltages as Needed
- Resistor Built-In for Voltage Needed (Over 2 Volts)
- Dome or Flat Lens
- Choice of Wire-Wrap* — Solder or Connector Terminals
- Soldering Conditions: 230°C for 5 Seconds Maximum

The versatile T-1 based LED is available in white diffused only. It features forward voltage of 1.6V typical and 2.0V maximum for 20 milliamps. Light output is 0.8 millicandela typical at 20 milliamps. This rugged and dependable unit is just one reason Sloan is known throughout the world as "the indicator light people."

The Sloan T-1 based LED is designed to offer diode reliability as a replaceable unit in T-1 hardware. For example, this versatile device can be installed in a Sloan Pee Cee Unit for circuit board mounting (101 or 111 series). For panel applications, we recommend our popular front replaceable panel mounted (102 series) indicator lights.

The versatile T-1¾ based LED is available in either clear red, white diffused, or red diffused. It features forward voltage of 2.1V typical and 2.8V maximum for 20 milliamps. Light output is 2.0 millicandela typical at 15 miliamps.

The Sloan T-1¾ based LED is designed to offer diode reliability as a replaceable unit in T-1¾ hardware. For example, this versatile device can be installed in a Sloan Pee Cee Unit for circuit board mounting (864 or 874 series). For panel applications, we recommend our popular front replaceable panel mounted (855 series) indicator lights.

HOW TO ORDER

EXAMPLE

2G5 S
2A5 S

Model No. | Terminals: S — Solder, W — Wire-Wrap, C — Connector | Color: R — Red, W — White, C — Clear | RTL -F L | Characteristic: TP — Transparent, TL — Translucent | Style: F — Flat, D — Dome | Lensing: P — Plain, L — Lensed | 5/15 | Voltage: 5 Volts | Current: 25 mA | Omit this callout for 2 volt no resistor.

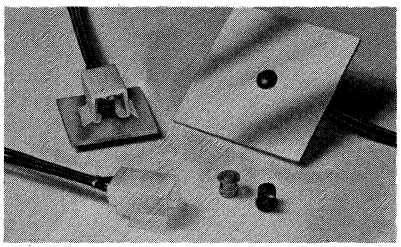
EXAMPLE: 1WDB — 5/15

LED SIZE	OPTICAL CHARACTERISTICS	BASED = VOLTS/CURRENT
1 = T1	WD = White Diffused C = Clear	B = Based OMIT THIS CALL-OUT NO RESISTOR 5/15

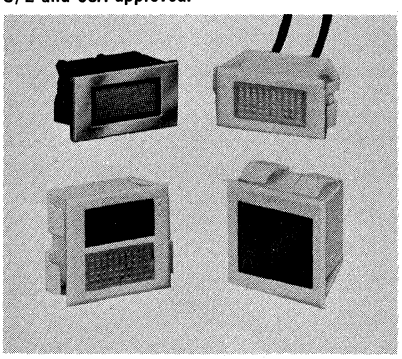
EXAMPLE: 175 WDB — 5/15

LED SIZE	OPTICAL CHARACTERISTICS	BASED = VOLTS/CURRENT
175 = T-1¾	WD = White Diffused C = Clear RD = Red Diffused R = Red	B = Based OMIT THIS CALL-OUT NO RESISTOR 5/15 5/33

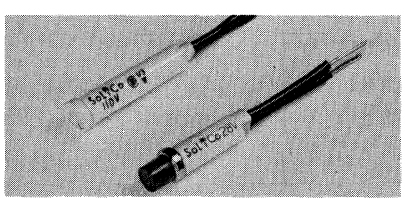
SoLiCo PILOT AND INDICATOR LIGHTS



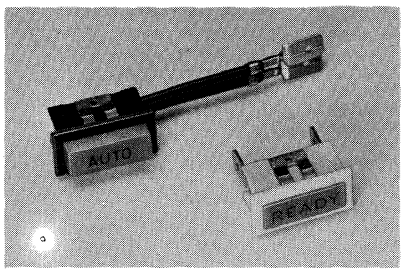
1K14 SERIES
Rear mounts in panel not more than .085" thick. Mounting hole .310" — .320"
LAMP: High brightness neon is standard with complete range of attached resistors available. Miniature incandescent in T-1¾ size available in range of 1.3 volt thru 28 volt.
COLORS: Lens colors are available in complete spectrum both in transparent and translucent material.
Recognized under the component program of U/L and CSA approved.



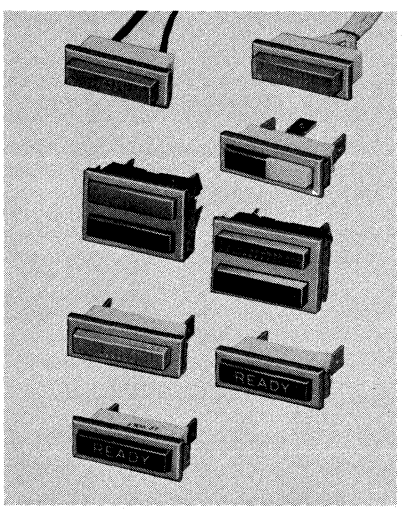
"L" SERIES
Molded from DuPont Zytel 101. Standard colors are black or white, custom colors available upon request.
Optional: When ordering metal bezel, stainless steel is standard. Consult factory for other finishes.
Recognized under the component program of U/L and CSA approved.



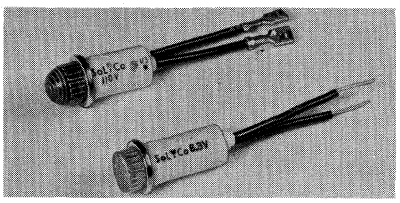
3L SERIES (with built-in resistor)
3S SERIES (resistor in lead)
These compact lights snapfit in a 5/16" hole. No additional hardware is necessary. Extended portion is .350 diameter by .110 inch high, while body length below shoulder is 1.420" long on 3L and .940" long on 3S.
Recognized under the component program of U/L and CSA approved. High brightness neon lamps with appropriate resistors to assure long life while achieving desired brightness. Complete range of incandescent lamps also available.
LENS: F4 and F5* lens is offered in a variety of colors and available in nylon or lexan. Decorative bezel with various finishes upon request. Chrome is standard.
BODY COLORS: White is standard although body can be molded in any color.
LEADS: Same as 5S.



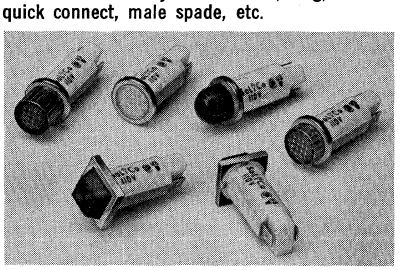
"M" SERIES
These compact units snap securely without additional hardware into .940 by .440 inch opening. Material thickness .031" — .093".
LENS: M Series with "H" lens features a .855 by .315 inch lens face — .170" high offering excellent raised lighting characteristics with a choice of colors. (Imprinting available).
M Series with "F" lens affords a full .860 by .315 inch lighting face ideal for hot stamping legends, even two lines if desired.
BODY COLORS: white or black available.
LEADS: Black plastic 105°C leads 6" long ends stripped ½" and tinned are standard. Any desired length and colored leads can be readily supplied. In addition, these leads can be provided with a variety of terminations — ring, female flag, etc. M series can be supplied with .250" or .187" male spades.



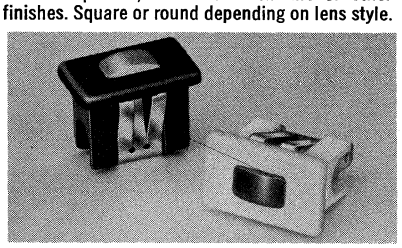
"R" SERIES
These rectangular lights snap in securely (without additional hardware) into 1.312 or 1.280 by .375 inch opening. Material thickness range .030/.080 inch. 2R requires 1.280" by .812 inch mounting hole.
Recognized under the component program of U/L and CSA approved. High brightness neon lamps with appropriate built-in resistors to assure long life while achieving desired brightness. Complete range of incandescent lamps also available.
LENS: Ideal for vertical or horizontal hot stamp legends. These 1.150 by .250 inch lenses are offered in a variety of colors (nylon or lexan). Split lens variations also available (2R and 4R Series).
BEZEL: Decorative bezel in various finishes available (black, bright brass, etc.) Chrome plate is standard.
LEADS: Same as M SERIES.



5S AND 5L SERIES
These stylish round body lights with chrome plated bezel mount into ½" hole and are secured by snapfit feature. The overall body length below the bezel is .900" on the 5S and 1.120" on the 5L.
Recognized under the component program of U/L and CSA approved. High brightness neon lamps with appropriate resistors to assure long life while achieving desired brightness. Complete range of incandescent lamps also available.
LENS: A choice of lens styles and colors available. Nylon or Lexan material.
BEZEL: Decorative bezels in various finishes available (chrome plated is standard).
LEADS: Black plastic 105°C leads 6" long, ends stripped ½" and tinned are standard. Any desired length and color leads can readily be supplied. In addition, these leads can be provided with a variety of terminals, ring, female quick connect, male spade, etc.



5T SERIES
HOUSING: Zytel 101, White is standard. However, Black, Red and other colors are available. Fits in ½" mounting hole (snap fit).
RATING: Same as 5S — 5L SERIES
LAMP: High brightness neon is standard with complete range of attached resistors available. Miniature incandescent in T-1¾ size available in range of 1.3 volt thru 28 volt.
LENS: Various styles with internal facets for maximum light refraction. Available in Lexan and Nylon.
COLORS: Lens colors are available in complete spectrum both in transparent and translucent material.
BEZEL: Optional, available in chrome or other finishes. Square or round depending on lens style.



S222 SERIES
These lights snap securely without additional hardware into a rectangular opening 1.200 by .640 inch. Material thickness .045 to .065 inch.
LENS: Choice of colors available (nylon and acrylic). Red, white, amber, clear.
LEADS: S222 Series provided with screw terminals, S222-A with wire leads. S222-B provided with .250 male spade terminals.

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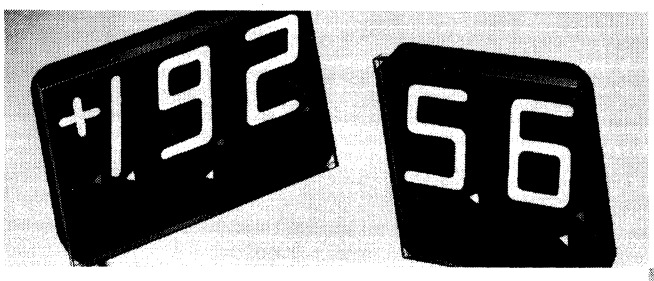
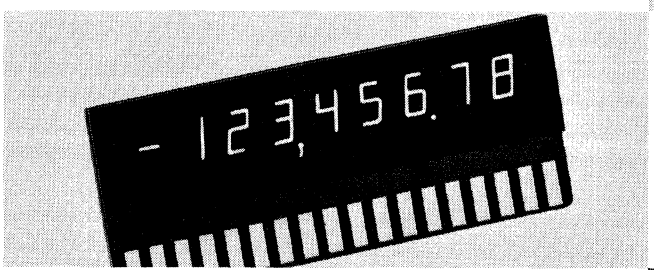


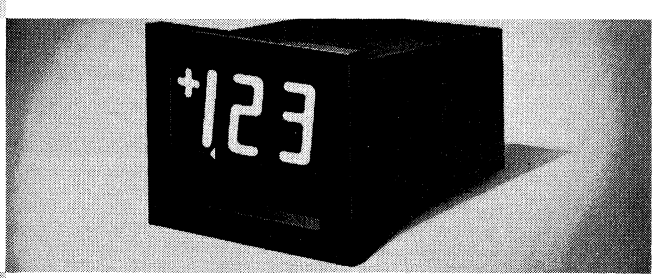
◀VERSATILE SPERRY PLANAR DISPLAYS
Unique Sperry SP-300 and SP-700 Series seven-segment displays appear as continuous characters and can be read in direct sunlight. Both ⅓" and ½" character heights offer 130° viewing angle, accurate viewing up to 40', low power requirements, proven reliability, and low, low cost. Units designed for multiplexing operation and MOS/LSI interface available. 1½, 2, 3, and 2½ digit units, horizontally stackable, are offered.

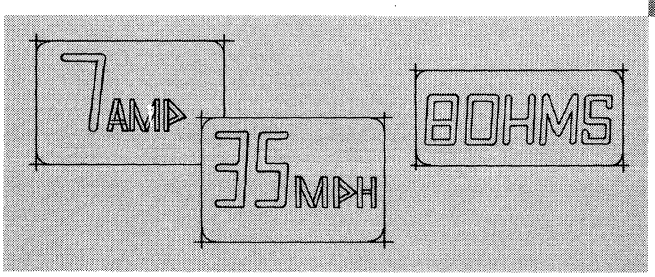
SPERRY CLOCK DISPLAY▶
SP-100 Series is specifically designed for 12-hour and 24-hour clock applications. Units can be used in all dc and multiplexed applications and interface with MOS/LSI clock chips. Digits are ½" high, 12-hour unit includes AM and PM alpha read-outs. Natural color is an eye appealing orange. Red is available with filters. Cost is below $1.75 per digit in 1,000 unit quantity.



◀SPERRY PANEL DISPLAY
This nine-digit unit, the SP-400 Series, has a character height of ¼" and is designed for hand-held and desk calculators as well as other multi-digit equipment applications. Unit is designed for multiplex operation and interfaces directly with MOS/LSI circuits. A decimal point/comma is provided with each digit. Cost is below $1.75 per digit in 1,000 unit quantity.

SPERRY DISPLAY MODULE▶
The SP-800 Series display module is available in 1½, 2, 2½, and 3 digits and is horizontally stackable. Digit height is ½". The module contains the display, monolithic decoder/drivers, latch and optional counter all pre-wired ready for simple installation and hook-up. Standard units are orange. Red filtered units are optional.





◀SPERRY CUSTOM UNITS
Sperry has a proven capability to design and produce custom displays for unique applications. Alpha readouts such as OHMS, VOLTS, AMPS, MPH, GPM and others can be combined with NUMERIC digits for special displays. You are invited to discuss your custom requirements with Sperry.

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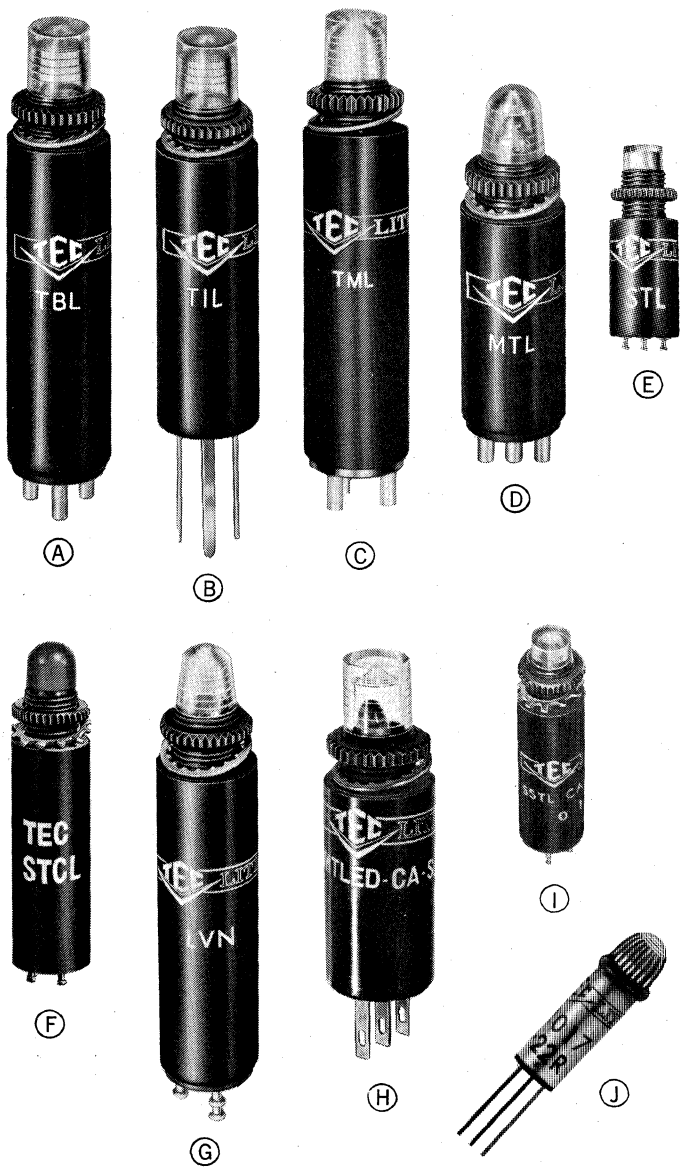
• SWITCHES • INDICATORS • LAMPS • READOUTS • DISPLAY PANELS AND SYSTEMS

TEC-LITE offers you one-stop service for all your display/control needs with a multitude of highly reliable, economically priced devices. Choose from a wide variety of body styles, terminals, lens colors, mounting options, operating ranges, switch types, plus other options such as RFI shielding. Many products are also available on 24-hour delivery; write for Cat. No. 955.

And if what you need isn't in our inventory we'll custom build it for you at a surprisingly low cost. TEC has over 8,000 special designs on file — both electrical and mechanical — so let us help you with your unique requirements. Write for detailed specifications on items listed on these TEC-LITE pages, plus information on complete line of display and control products.



All devices on this page shown approx. actual size

TRANSISTOR CONTROLLED SWITCHES AND INDICATORS

A. TBL Series. Switch/indicator with permanently wired neon lamp and N.O. or N.C. SPST or N.O. & N.C. SPDT momentary switch with contact rating of 100 mA @ 120 VAC. Mounts in 3/8" hole on 5/8" centers.

B. TIB/TIL Series. TIB is switch/indicator as above, but with replaceable incandescent lamp. TIL is indicator only, controlled by signals as low as 3 mA.

C. TML Series. An indicator with memory that turns on with signals as low as 2 μs @ 0.5 mA. Has replaceable incandescent lamp and 5 indicator-switch options: no switch; N.O. SPST; N.C. SPST; N.O. & N.C. SPDT-DB; and reset/press-test. Switch contact rating is 100 mA @ 120 VAC. Mounts in 3/8" hole on 5/8" centers.

D. MTL Series. Miniature indicator with permanently wired neon lamp controlled from signals as low as 1.5 volts. Mounts in 3/8" hole on 5/8" centers.

E. STL Series. Subminiature indicator with permanently wired neon or incandescent lamp controlled by signals as low as 1 mA. Mounts in 1/4" hole on 3/8" centers.

All of the above devices are also available as IC-compatible units designed to operate from the low-level outputs of DTL and TTL IC modules. Write for Cat. No. 571, "Transistor Controlled Indicators & Readouts for IC's."

F. STCL Series. Subminiature indicator with replaceable incandescent lamp cartridge that plugs into logic section. Mounts in 1/4" hole on 3/8" centers.

G. LVB/LVN Series. LVB is switch/indicator with permanently wired neon lamp and N.O. or N.C. SPST or N.O. & N.C. SPDT-DB momentary switch with contact rating of 100 mA @ 120 VAC. LVN is indicator only, operating from supply as low as 2 volts. Mounts in 3/8" hole on 5/8" centers.

H. MTLED Series. Indicator with rugged, long life, high brightness red or green LED. Interfaces directly with DTL and TTL IC logic. Supply is 5 VDC. Mounts in 3/8" hole on 5/8" centers.

I. SSTL Series. Subminiature version of MTLED above with the same characteristics. Red LED only, but can accommodate green or yellow LED by adding external resistor. Mounts in 1/4" hole on 3/8" centers.

J. L-1017 Series. Cartridge indicator with DTL and TTL interface and red or green LED. Supply is 5 VDC. Mounts in .290" hole on 1/2" centers with spring steel clip.

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TEC LITE

YOUR COMPLETE SOURCE FOR

INDICATING DEVICES

SWITCHES AND INDICATORS

A. S-501 Series. Bounce-free buffered logic switch with momentary contact eliminates bounce inherent in any mechanical switch. Mounts in 3/8" hole on 5/8" centers.

B. PBL/PBS Series. PBL is alternate or momentary action switch/indicator with 3 switch capacities: 5 amp, 15 amp, and 100 mA. Replaceable incandescent, neon or LED lamp. PBS is switch only. Mounts in 3/8" hole on 5/8" centers (5 amp, 100 mA models) or 3/4" centers (15 amp model).

C. PTL Series. Indicator with replaceable incandescent or neon lamp and press-to-test feature. Mounts in 3/8" hole on 7/16" centers.

D. MBL/MBS Series. MBL is miniature switch/indicator with N.O. or N.C. momentary contact and permanent incandescent or neon lamp. MBS is switch only with N.O., N.C. or N.O. & N.C. contact. Mounts same as PTL above.

E. MDL Series. Miniature indicator with permanent incandescent or neon lamp. Mounts same as PTL above.

F. SBL/SBS/SIL Series. Subminiature devices. SBL is a switch/indicator with N.O. SPST momentary contact and permanent incandescent or neon lamp. SBS is switch only; SIL indicator only. Mounts in 1/4" hole on 3/8" centers.

G. S3L Series. Subminiature tri-lite indicator offers 3 information display capabilities in 1 unit. Houses 3 incandescent lamps with red, green and amber color filters. Mounts in 1/4" hole on 3/8" centers.

H. FML Series. Miniature front-mounting indicator with permanently wired incandescent or neon lamp. Mounts in 3/8" hole on 1/2" centers.

I. RBL Series. Switch/indicator with replaceable incandescent or neon lamp; 1 amp, 2.5 amp and 100 mA switch capacities; and 4 momentary contact switch types. Mounts in 3/8" hole on 7/16" centers.

J. RDL Series. Indicator with replaceable incandescent or neon lamp in a variety of models: front and rear mounting; with or without bezel; and lens with diameter of .332" (as shown) or .468". Mounts in 3/8" hole on 7/16" centers or 15/32" hole on 11/16" centers.

K. SDL Series. Ultraminiature indicator with incandescent or neon lamp. Mounts in 13/64" hole on 1/4" centers.

L. S-1001 Series. PCB-mounted, 4-position, N.O. maintained rotary switch for computers, amplifiers, tachometers, etc.

M. RCL Series. Replaceable indicator light with incandescent lamp in 3 lens styles. Mounts in RCL cartridge holder or on panel with spring steel clip.

N. S-105 Series. Combines attractive panel appearance and large pushbutton surface with a variety of TEC-LITE indicators and switch/indicators — 8 different models with various operating ranges and switch/terminal options. Mounts in .785" x .882" hole on 1" centers.

O. MCL Series. Miniature cartridge light with incandescent or neon lamp and square or round lens. Mounts in 5/16" hole on 1/2" centers with spring steel clip.

All devices on this page shown approx. actual size

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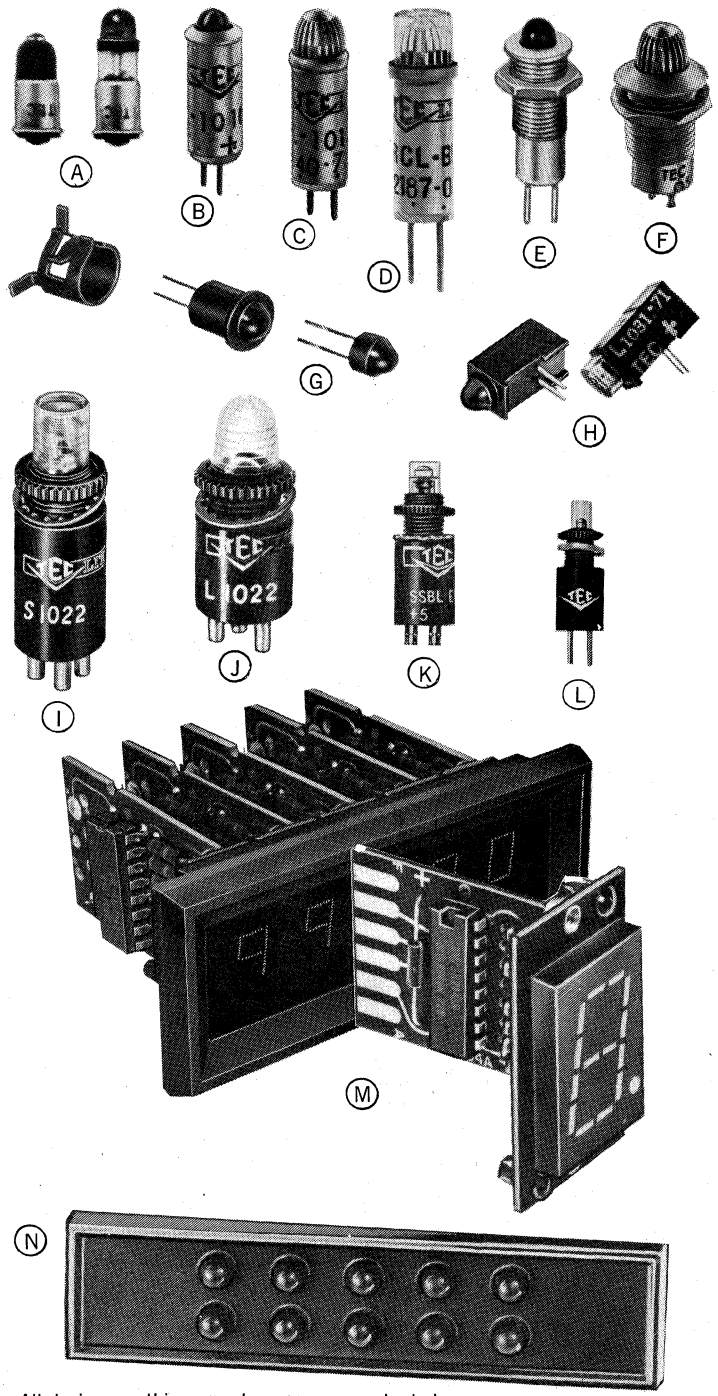
LED's: LAMPS • INDICATORS • SWITCH/INDICATORS • DIGITAL READOUTS • DISPLAY PANELS



All devices on this page shown approx. actual size

A. LS/LL Series. Direct replacements for flange-based T1¾ incandescent or neon lamps. Internal resistors adapt units for 5 to 28 VDC operation. Red or green LED.

Indicators B through F have the following common features: black or clear anodized aluminum bodies; red or green LED's; and internal resistors that adapt units for 2 to 28 VDC operation (L-1016 and L-1021) or 5 to 28 VDC (L-1010, L-1015 and L-1020).

B. L-1010 Series. Mounts in .290″ hole on ½″ centers in solderless cartridge holder or with spring steel clip.

C. L-1015 Series. Has flat top or spherical lens in red, green or clear. Same mounting as above.

D. L-1016 Series. Same as L-1015 above, but with .025″ square wire-wrap terminals.

E. L-1020 Series. Mounts in 5/16″ hole on 5/8″ centers in cartridge holder or lead wire connectors.

F. L-1021 Series. Flat top or spherical lens in clear, red or green. Mounts in 3/8″ hole on 11/16″ centers.

G. L-1025 Series. Panel-mounted, super-miniature indicator is only 21/64″ long. Red diffusing LED appears black in "off" state. Mounts in ¼″ hole with clip provided.

H. L-1030/L-1031 Series. Compact, PCB-mounted indicators solder directly to board in 1/32″ holes. L-1030 has same LED as L-1025 above. L-1031 has red, green or yellow LED with a red, green, yellow or clear lens.

I. S-1022 Series. Switch/indicator with red or green LED and momentary N.O. or N.C. switch. Operates from 2 to 28 VDC supply. Mounts in 3/8″ hole on 3/16″ centers.

J. L-1022 Series. Indicator with red or green LED, 2 to 28 VDC supply. Mounts in 3/8″ hole on 3/16″ centers.

K. SSBL/SSIL Series. Subminiature devices available with red, green or yellow LED's and red, green, yellow or clear lenses. SSBL has SPST-N.O.-DB switch and uses 5 VDC supply. SSIL is indicator only and uses 5 to 28 VDC supply. Mounts in ¼″ hole on 3/8″ centers.

L. L-1040 Series. Ultraminiature indicator with red LED and clear or red lens. Uses 5 to 28 VDC supply. Matching switch (S-1040) has momentary N.O., N.C., or N.O. & N.C. contact with rating of 100 mA @ 28 VAC. Mounts in .170″ hole on centers as close as .300″.

M. SSR Series. IC-compatible digital readouts with character heights of .270″, .334″, .600″ and .770″. All models have 7-segment decoder/driver with memory option and accept 1, 2, 4, 8 BCD inputs. Units include lamp test, non-driven decimal point, automatic blanking provision.

N. L-1050/L-1051 Series. Display assemblies consisting of LED's mounted in chrome-finished bezels. Red diffusing LED's appear black in "off" state. L-1050 (shown) holds up to 10 LED's; L-1051 holds up to 20 LED's.

NOTE: All devices with green or yellow LED's are available only with 5-volt rating.

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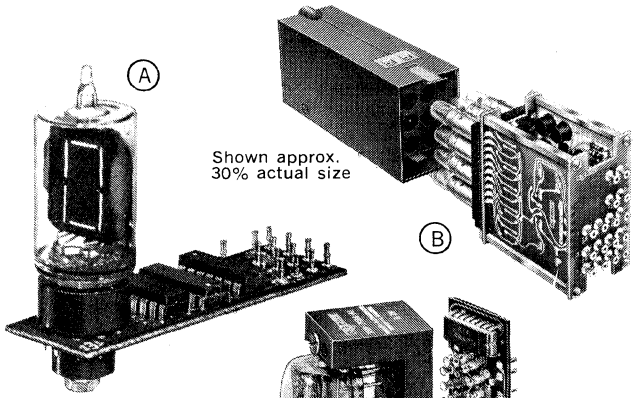
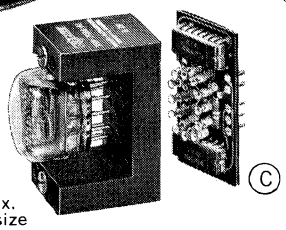
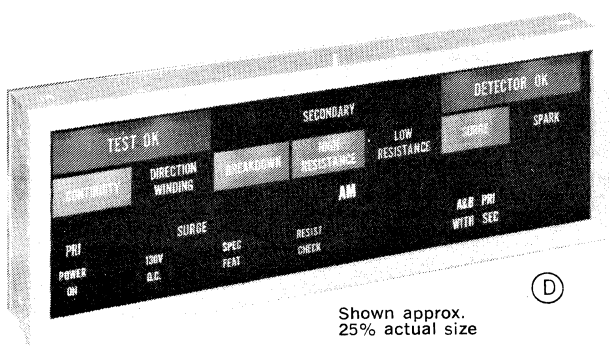




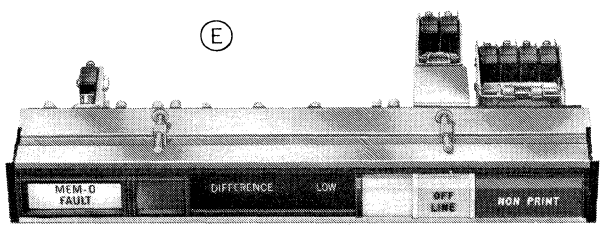


TRANSISTORIZED READOUTS AND DISPLAY DRIVER

A. TSR-71 Series. Incandescent segmented readout with IC logic control uses RCA Numitron tube for bright 7000 ft/L, wide-angle, single-plane display. MSI/IC logic provides BCD decoder / driver plus counter and buffer memory options. Driven decimal point or nonsignificant zero blanking (or ripple blanking for intensity control) are also offered. Display tube has 7-bar matrix .610" high. Mounts on .90" centers.

B. TPD Series. Solid state lamp control module designed for IEE Series 10 and 120H high-brightness projection readouts. Controls 6, 12 or 28 VDC incandescents from logic levels as low as 1 mA. Other lamp supply voltages can be accommodated on special order. Also available as MTPD Series — designed to operate from low level outputs of DTL and TTL IC modules.

C. TNR-70 Series. UL listed, ultracompact readout with rugged, low-power neon NIXIE® tube offers 2 logic level options and 4 logic function options. Accepts 1, 2, 4, 8 BCD inputs and is available with memory and/or decade counter. Characters are .610" high. Mounts with just 2 screws on 1" centers.



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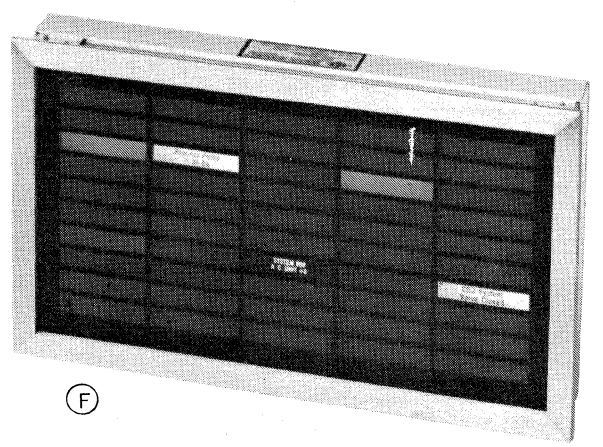
DISPLAY SYSTEMS

D. DATA•PANEL® Display Systems. These integrated displays cost less per point than individual indicators and cut installation work by 50% or more. Messages and symbols are brilliantly and colorfully conveyed in a single viewing plane, and optimum use of IC's lowers cost and increases reliability. A DATA•PANEL Display System easily interfaces with **your** system, particularly if a computer is involved, and may be installed in consoles, racks or walls. Just a few applications are: data processing, communications, materials handling and dispatch. Size limitation is 3 feet square.

E. DATA-LINE Display Modules. Combine switches, indicators and message displays in an in-line modular package that complements basic DATA•PANEL Display System design. Gives designers a new, completely modular information display device for computers, industrial control and guidance systems, peripheral equipment, instruments, etc. Modules can be gang-mounted and are available in lengths up to 4 feet.

F. DATA-MONITOR™ Annunciator Systems. A natural extension of our DATA•PANEL Display Systems, these systems with memory logic provide high-density alarm displays at 1/3 the cost and 1/9 the space of conventional annunciators. Compact device is only 6½" high by 11½" wide and combines flashing alarm with audible alarm.



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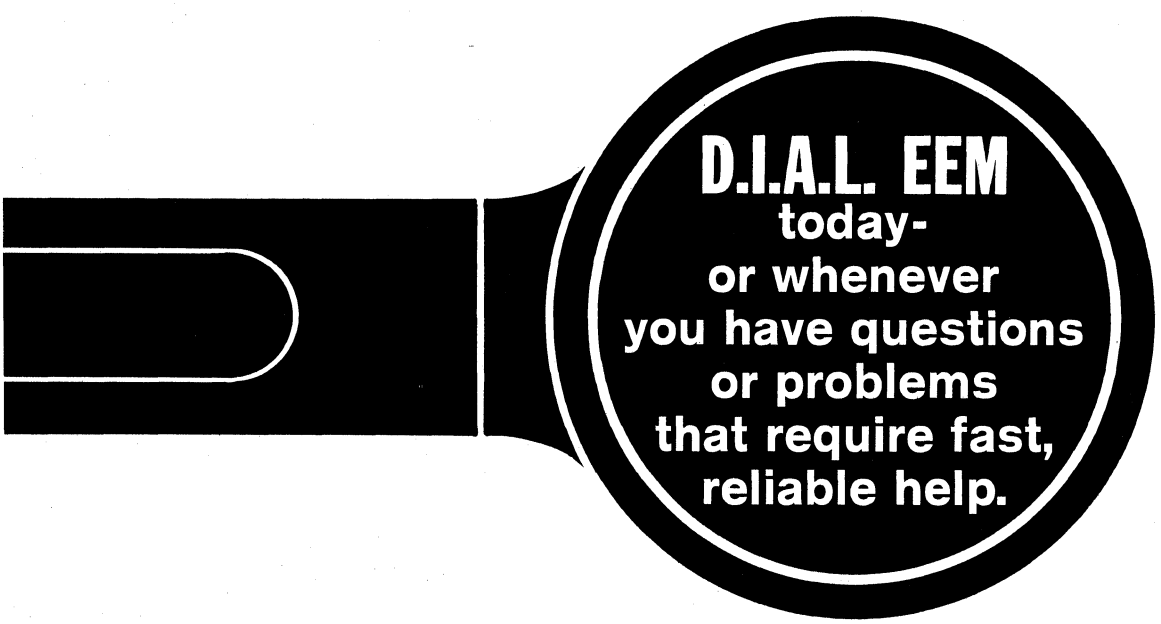

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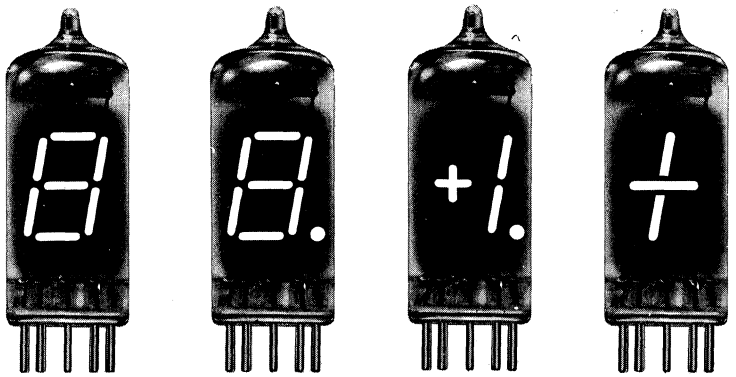
TUNG-SOL® DIGITAL AND ALPHANUMERIC DISPLAYS

VACUUM TYPES

DIGIVAC S/G™ VACUUM FLUORESCENT DISPLAYS



DT1704C
Numerals 0 to 9
and 14 letters

DT1705E
with
decimal point

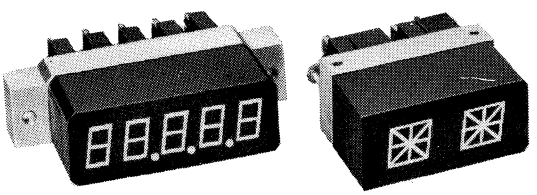
DT1707C
plus/minus
one, decimal

DT1719A
plus/minus

This Tung-Sol development, which created a whole new set of digital display standards, is now made in a narrower configuration that reduces the space required for array applications. Low voltage, low power drain (25 V and 1.6 V) is ideal for low signal level requirements, especially battery-operated equipment. Digivac S/G displays meet MIL specs. They employ standard miniature tube bases and have inexpensive logic/driver requirements. Display is single plane with space-age-type segmented characters. Solderable-lead option provides for circuit board mounting. Common filters provide unlimited color selection for identification, or to heighten contrast. Illustrated types are standard. Other symbols on special order.

INCANDESCENT TYPES

7 Segments, 16 Segments, Stacked, Integrated, Status Indicators



Designed to provide optimum contrast under ambient light conditions. Light shades are not needed. Tung-Sol displays function in extreme environmental conditions. The 20 mA and 70 mA lamp banks are mechanically interchangeable.

7 Segments—Display 0 through 9.

16 Segments—Full alphanumeric display.

Integrated—Monolithic construction requires less width per character. Individually replaceable lamp blocks, or individually replaceable lamps.

Status Indicators—Fixed messages, or symbols, to specification. Supplied readable when off, or completely blank.

TYPICAL CONFIGURATIONS

TUNG-SOL DIVISION / Wagner Electric Corporation
630 W. Mt. Pleasant Avenue, Livingston, N.J. 07039 / TWX: 710-994-4865 Phone: (201) 992-1100; (212) 732-5426

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TUNG-SOL® SUBMINIATURE LAMPS

All base and bulb types for read-out and indicator applications

SPECIFICATIONS: T-1 3/4 LAMPS

ELECTRICAL CHARACTERISTICS					PHYSICAL CHARACTERISTICS					
Lamp No.	Design Volts	Design Current	Nominal Light Output	Average Rated Life	Midget Base Style	Max. Bulb Diam.	MOL	Filament Type	LCL	Application
331	1.35	.06	.02 CP	500	Flange	.230	.625	S-2	.375	Indicator(4)
440	1.5	.05	.012 CP	Indef.	Flange	.230	.625	C-2R	.375	Indicator
1769	2.5	.20	.20 CP	500	Screw	.230	.718	C-2R	.500	Indicator
1767	2.5	.20	.20 CP	500	Screw	.230	.625	C-2R	.500	Indicator(4)
*364	2.5	.40	.28 CP	5000	Flange	.230	.625	C-2R	.375	Indicator
4(1)	2.5	.40	800 ft.-cd(5)	Indef.	Groove	.240	.813	C-2R		Read-out
4S(1)	2.5	.40	1250 ft.-cd(6)	Indef.	Groove	.240	.813	C-2R		Read-out
1748(1)(2)	2.5	.40	800 ft.-cd(5)	Indef.	3/4" Leads	.240	.718	C-2R		Read-out
1748S(1)(2)	2.5	.40	1250 ft.-cd(6)	Indef.	3/4" Leads	.240	.718	C-2R		Read-out
*2169(2)	2.5	.35	.21 CP	10,000	5/8" Leads	.230	.520	C-2R		Indicator
1738(2)	2.7	.06	.04 CP	6000	3/4" Leads	.230	.520	C-2R		Indicator
338	2.7	.06	.04 CP	6000	Flange	.230	.625	C-2R	.375	Indicator
342	6	.04	.03 CP	10,000	Screw	.230	.718	C-2V	.500	Indicator
345	6	.04	.03 CP	10,000	Flange	.230	.625	C-2V	.375	Indicator(4)
328	6	.20	.60 CP	1000	Flange	.230	.625	C-2R	.375	Indicator(4)
337	6	.20	.60 CP	1000	Groove	.230	.625	C-2R	.375	Indicator
1768	6	.20	.60 CP	1000	Screw	.230	.625	C-2R	.500	Indicator(4)
1730(2)	6	.04	.03 CP	10,000	1" Leads	.230	.520	C-2V		Indicator
.2134(2)	6	.04	.03 CP	10,000	1 3/4" Leads	.230	.520	C-2V		Indicator
1784(2)	6	.20	.60 CP	1000	5/8" Leads	.230	.520	C-2R		Indicator
*380	6.3	.040	.02 CP	50,000	Flange	.230	.625	C-2V	.375	Indicator
1739(2)	6.3	.075	.25 CP	1000	5/8" Leads	.230	.520	C-2R		Indicator
1775	6.3	.075	.25 CP	1000	Screw	.230	.625	C-2R	.500	Indicator(4)
350	6.3	.15	.45 CP	3000	Flange	.230	.625	C-2R	.375	Indicator(4)
349	6.3	.20	.50 CP	5000	Flange	.230	.625	C-2R	.375	Indicator
*379	6.3	.20	.40 CP	50,000	Groove	.230	.625	C-2V	.375	Indicator
*381	6.3	.20	.40 CP	50,000	Flange	.230	.625	C-2V	.375	Indicator
2112(2)	6.3	.20	.50 CP	5000	5/8" Leads	.230	.520	C-2R		Indicator
*2181(2)	6.3	.20	.40 CP	50,000	5/8" Leads	.230	.520	C-2V		Indicator
344	10	.014	.002 CP	5000+	Flange	.230	.625	C-2F	.375	Indicator(4)
367	10	.04	.10 CP	Indef.	Flange	.230	.625	C-2V	.375	Indicator
374	10	.014	.006 CP	5000	Flange	.230	.625	C-2F	.375	Indicator
1869(2)	10	.014	.002 CP	5000+	5/8" Leads	.230	.520	C-2F		Indicator
1917(2)	10	.014	.006 CP	5000	5/8" Leads	.230	.520	C-2F		Indicator
2107(2)	10	.04	.10 CP	Indef.	5/8" Leads	.230	.625	C-2V		Indicator
*2207	10	.04	.10 CP	20,000	Groove	.230	.625	C-2V	.375	Indicator
384	11	.025	.05 CP	2000	Flange	.230	.625	C-2F	.375	Indicator
1916(2)	12	.019	.012 CP	Indef.	5/8" Leads	.230	.520	C-2V		Indicator
*336	14	.08	.50 CP	750	Groove	.230	.625	C-2F	.375	Indicator
*373	14	.08	.50 CP	750	Screw	.230	.718	C-2F	.500	Indicator
382	14	.08	.30 CP	50,000	Flange	.230	.625	C-2F	.375	Indicator
386	14	.08	.30 CP	50,000	Groove	.230	.625	C-2F	.375	Indicator
330	14	.08	.50 CP	750	Flange	.230	.625	C-2F	.375	Indicator(4)
1705(2)	14	.08	.50 CP	750	1" Leads	.230	.520	C-2F		Indicator
2182(2)	14	.08	.30 CP	50,000	5/8" Leads	.230	.520	C-2F		Indicator
346	18	.04	.25 CP	1000	Groove	.230	.625	C-2F	.375	Indicator
*370	18	.04	.25 CP	1000	Flange	.230	.625	C-2F	.375	Indicator
*457	22	.04	.30 CP	2000	Groove	.230	625	C-2F	.375	Indicator
327	28	.04	.34 CP	1000	Flange	.230	.625	C-2F	.375	Indicator(4)
327X	28	.046	.34 CP	2500	Flange	.230	.625	C-2F	.375	Indicator(4)
334	28	.04	.34 CP	1000	Groove	.230	.625	C-2F	.375	Indicator(4)
335	28	.04	.34 CP	1000	Screw	.230	.718	C-2F	.500	Indicator
340(3)	28	.04	.34 CP	1000	Flange	.230	.625	C-2F	.375	Indicator(4)
*369	28	.04	.34 CP	1000	Screw	.230	.593	C-2F	.500	Indicator
1762(2)	28	.04	.34 CP	1000	5/8" Leads	.230	.520	C-2F		Indicator(4)
387	28	.04	.30 CP	25,000	Flange	.230	.625	C-2F	.375	Indicator
*388	28	.04	.30 CP	25,000	Groove	.230	.625	C-2F	.375	Indicator
2187(2)	28	.04	.30 CP	25,000	5/8" Leads	.230	.520	C-2F		Indicator
1764(2)	28	.04	.34 CP	1000	1" Leads	.230	.520	C-2F		Indicator
1860(2)	28	.04	.34 CP	1000	1" Tinned Leads	.230	.520	C-2F		Indicator
1762X(2)	28	.046	.34 CP	2500	5/8" Leads	.230	.520	C-2F		Indicator

These lamps are normally supplied in clear glass. Colored bulbs will be made on special order. Unless otherwise specified, all lamps have metal bases.

*Made to order only

SPECIFICATIONS: T-3/4 LAMPS

Lamp No.	Design Volts	Design Current	Nominal Light Output	Average Rated Life	Midget Base Style	Max. Bulb Diam.	MOL	Filament Type	LCL	Application
30	4.5 DC	.0215	.0175	5000.	1-3/16" Tinned leads	.102	.230	C-2R		Digital

Reference Notes Indef.—Life over 5000 hours. (1) Lens end. (2) Wire leads. (3) High temperature solder. (4) Application in aircraft service. (5) Through 3/16" min. dia. window at 3/8" from lamp tip. (6) Through 1/8" min. dia. window at 3/8" from lamp tip.

Wire Lamp Types Not Shown—Type F. 2264—2129—2176—2183—2119—2201—2265 and 2002.

TUNG-SOL DIVISION/Wagner Electric Corporation

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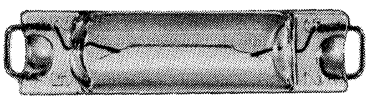
TUNG-SOL® MOLDED BASE LAMPS AND BASELESS CARTRIDGE LAMPS

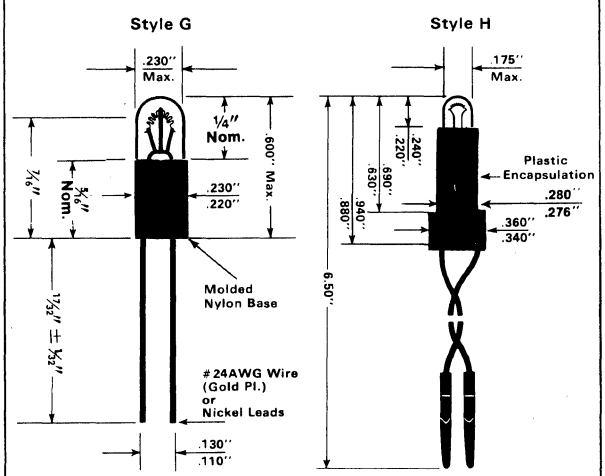
BASELESS CARTRIDGE LAMPS

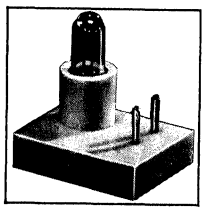


ELECTRICAL CHARACTERISTICS

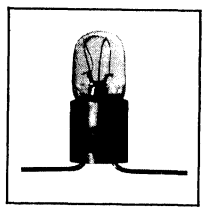
Lamp Type	Design Volts	Design Amps	Design C.P.	Life Hours
561	12.8	.97	12	600 @ 12.8V
562	13.5	.74	6	2000 @ 14V
563	13.5	.52	4	1000 @ 14V
564	14.0	.44	2	Indef. long @ 14V
565	28.0	.38	4.5	Indef. long @ 28V
566	14.0	.36	1.0	Indef. long @ 14V

These lamps may be mounted on a variety of simplified terminals. AMP Inc., Harrisburg, Pa., makes several types.





Plug-in module activates photo-electric sensor in high speed check sorter.



Molded base permits bending lead wires at acute angles.

The molded base lamp provides important advantages that simplify production and contribute added reliability to the end product. The molded base is permanently bonded to the bulb. It replaces the previously cemented-on metal base. The former receptacle that had to be wired into the circuit is completely eliminated. The molded base lamp is self-mounting. In fact, the Tu-Pin lamp can be applied with automated equipment.

The molded base technique makes it possible to provide a wide variety of lamp packages—built-in key ways, plug-in types, unusual positioning of the leads and multi-purpose configurations.

Strip-mounted, grain-size, 21-mil lamps snap into molded plastic holder to form a condition monitor for computer circuit boards. Lamp sockets are numbered to correspond to individual circuits. Space for test probe contacts is provided. Units can be operated in either normally "on" or "off" condition and can be wired to a door switch or test push button.

TUNG-SOL®

TUNG-SOL DIVISION

Wagner Electric Corporation

630 W. Mt. Pleasant Avenue, Livingston, N. J. 07039
TWX: 710-994-4865 Phone: (201) 992-1100; (212) 732-5426
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ELECTRICAL CHARACTERISTICS / PHYSICAL CHARACTERISTICS

Lamp No.	Style	Design Volts	Design Current	Nominal Light Output	Average Rated Life	Midget Base Style	Max. Bulb Diam.	MOL	Filament Type	Indicator Base Color
2301	G	**1.35**	.06	.02	500	Tu-Pin Molded	.230	.600	S-2	White
2302	G	**2.5**	.20	.20	500	Tu-Pin Molded	.230	.600	C-2R	Brown
2303	G	**2.7**	.06	.04	500	Tu-Pin Molded	.230	.600	C-2R	Lt. Grn.
2304	G	**3.0**	.30	.34	1500	Tu-Pin Molded	.230	.600	C-2R	Black
2305	G	**6.0**	.04	.03	10,000	Tu-Pin Molded	.230	.600	C-2V	Aluminum
2306	G	**6.0**	.20	.60	1000	Tu-Pin Molded	.230	.600	C-2R	Orange
2307	G	**6.3**	.20	.50	5000	Tu-Pin Molded	.230	.600	C-2R	Dk. Blue
***2319**	G	**6.3**	.20	.40	50,000	Tu-Pin Molded	.230	.600	C-2F	Lt. Brown
2308	G	**10.0**	.014	.006	5000	Tu-Pin Molded	.230	.600	C-2F	Pink
2309	G	**10.0**	.04	.10	5000	Tu-Pin Molded	.230	.600	C-2V	Lt. Blue
2310	G	**14.0**	.08	.50	750	Tu-Pin Molded	.230	.600	C-2F	Yellow
***2339**	G	**24.0**	.05	.50	1000	Tu-Pin Molded	.230	.600	C-2F	Black
2311	G	**18.0**	.04	.25	1000	Tu-Pin Molded	.230	.600	C-2F	Dk. Grn.
***2318**	G	**24.0**	.080	.50	20,000	Tu-Pin Molded	.230	.600	C-2F	Lt. Blue
2312	G	**28.0**	.04	.34	1000	Tu-Pin Molded	.230	.600	C-2F	Red
***2329**	G	**28.0**	.046	.34	2500	Tu-Pin Molded	.230	.600	C-2F	Gray
2334	G	**6.3**	.075	.25	1000	Tu-Pin Molded	.230	.600	C-2R	Red
EN1748†	H	**2.5**	.400	800 ft.-cd[5]	Indef.	Encapsulated	.175	.940	C-2R	Gray
EN1748S†	H	**2.5**	.400	1250 ft.-cd[6]	Indef.	Encapsulated	.175	.940	C-2R	Red

†Various lead lengths are available *Made to order only

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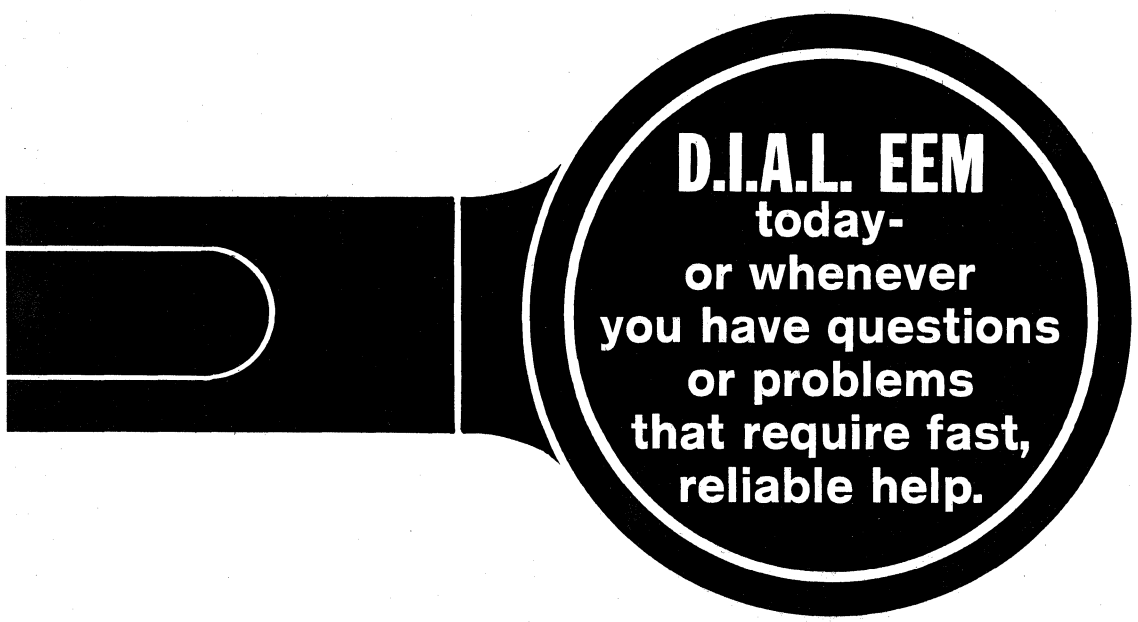

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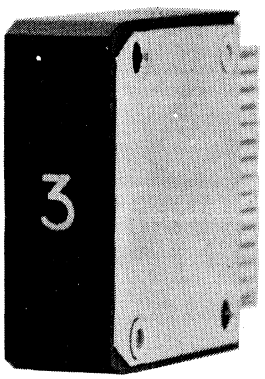
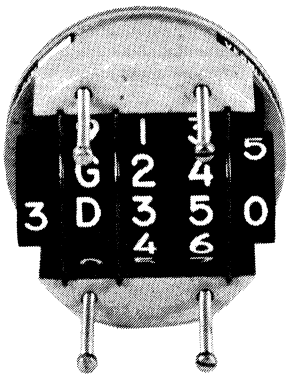
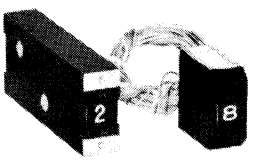
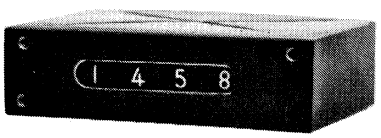


VERNIDEX STANDARD
½ x 1½ x 1½







VERNIDEX MINIATURE

Part No.	Volts D.C.	No. of Char.	Size of Char.	Pulse Mode	No. of Leads or Term.
06VEA-0022	10	11	.156 x .156	1-1-1-1	12 L
06VBA-0048	10	10	.156 x .156	1-2-1-2	6 T
06VBD-1105 3 Position Flag	10	3	.187 x .187	Return to Flag with Power off	3 T
12VBB-1002	6	10	.281 x .250	Polarity Reversal	6 P/C
12VAC-0015	6	11	.250 x .156	1-1-1-1	12 P/C

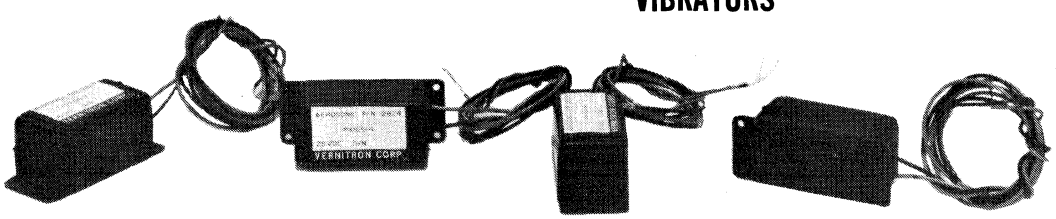
Write or phone today for detailed bulletin and stock list.

Vernitech has fully qualified hermetically sealed units to military specs with regard to:

Altitude	Shock	Fungus	Radio Interference
Temperature	Salt Spray	Explosion	Life
Vibration	Sand/Dust	Acceleration	Fogging

ALL MODELS AVAILABLE WITH FULL LOGIC SELF-CONTAINED—ACCEPTS BCD INPUT

VIBRATORS



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Consult the factory for either standard or custom-made designs.

Part No.	Input Voltage	Input Current	Peak G's	Size (Inches)	Weight
PX 10014	28 VDC	50 ma	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10018	13-15 VDC	25 ma max. @ 13V	.75 - 2.0	1.6 x .67 x .65	28 grams
PX 10021	21-28 VDC	25 ma @ 21V 30 ma @ 28V	.75 - 2.0	1.0 x .725 x .65	24 grams
PX 10036	14-28 VDC	30 ma max.	.25	.75 x .725 x .65	22 grams

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DIVISION OF VERNITRON CORPORATION
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ALLEN AVIONICS, INC.
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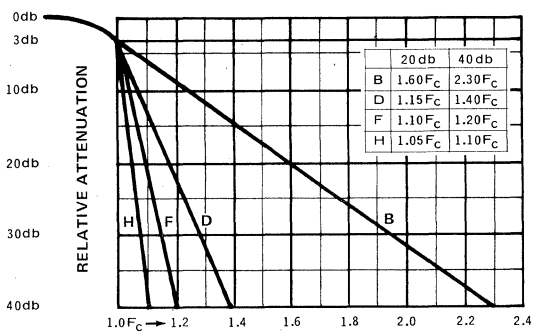
SEE OUR PAGES UNDER
DELAY LINES
SECTION 2350
WRITE FOR CATALOG

CUSTOM-BUILT LOWPASS & HIGHPASS L-C FILTERS

PROTOTYPES CAN OFTEN BE DELIVERED IN LESS THAN 3 DAYS

Types: Butterworth, Tchebycheff, Gaussian, Bessel and Elliptic Function.
Frequency Range: 200 Hz to 100 MHz.
Construction: Epoxy encapsulated or sealed in metal can.
The Lowpass and Highpass Filters listed below are typical units that we build. We do manufacture units with shape factors and cut-off frequencies in-between those listed.

LOW PASS FILTERS



	20db	40db
B	1.60Fc	2.30Fc
D	1.15Fc	1.40Fc
F	1.10Fc	1.20Fc
H	1.05Fc	1.10Fc

SIZE (INCHES)

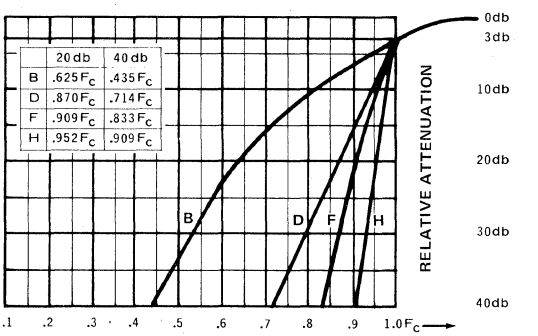
Sealed in Metal Can with B.N.C. Connectors:

L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

S — 1.25 x .875 x .625
U — 2.00 x 1.125 x .750
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

HIGH PASS FILTERS



	20db	40db
B	.625Fc	.435Fc
D	.870Fc	.714Fc
F	.909Fc	.833Fc
H	.952Fc	.909Fc

1 db MAXIMUM RIPPLE — 2 db MAXIMUM INSERTION LOSS

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
200 Hz	500-1500	B	Z
		D	Z
400 Hz	500-3K	B	Y
		D	Z
1 kHz	500-10K	B	Y
		D	Z
		F	Z
2.5 kHz	500-20K	B	Y
		D	Z
		F	Z
5 kHz	50-20K	B	Y
		D	Z
	150-20K	F	Z
7.5 kHz	50-20K	B	Y
		D	Z
	150-20K	F	Z
10 kHz	50-10K	B	X
		D	Z
	150-10K	F	Z
25 kHz	50-10K	B	X
		D	Z
	150-10K	F	Z
50 kHz	50-10K	B	X
		D	Z
	150-10K	F	Y
		H	Z
75 kHz	50-10K	B	W
		D	Y
	150-10K	F	Y
		H	Z
100 kHz	50-10K	B	W
		D	Y
		F	Y
		H	Z
200 kHz	50-10K	B	U
		D	W
	50-5K	F	Y
		H	Z
300 kHz	50-5K	B	U
		D	W
	50-5K	F	Y
		H	Z

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
400 kHz	50-5K	B	U
		D	W
		F	Y
		H	Z
500 kHz	50-5K	B	U
		D	W
		F	Y
		H	Z
600 kHz	50-2.5K	B	U
		D	W
	50-2K	F	Y
		H	Z
700 kHz	50-2.5K	B	U
		D	W
	50-2.0K	F	Y
		H	Z
800 kHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	Z
900 kHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	Y
1 MHz	50-1.5K	B	U
		D	W
	50-1.0K	F	X
		H	O
2 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
3 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
4 MHz	50-250	B	U
		D	W
	50-200	F	X
		H	O
5 MHz	50-250	B	S
		D	W
	50-100	F	X
		H	O
6 MHz	50-100	B	S
		D	U
		F	X
		H	O

Cut-Off (Fc) Frequency 3 db Max.	Impedance Range (Ohms)	Shape Factor (See Graph)	Size
7 MHz	50-100	B	S
		D	U
		F	M
		H	O
8 MHz	50-100	B	S
		D	U
		F	M
		H	O
9 MHz	50-100	B	S
		D	U
		F	M
		H	N
10 MHz	50-100	B	S
		D	S
		F	M
		H	N
15 MHz	50-100	B	S
		D	S
		F	M
		H	N
20 MHz	50-100	B	S
		D	S
	50	F	M
		H	N
25 MHz	50	B	S
		D	S
		F	M
		H	N
30 MHz	50	B	S
		D	S
		F	M
35 MHz	50	B	L
		D	M
		F	M
40 MHz	50	B	L
		D	M
		F	M
50 MHz	50	B	L
		D	M
		F	N
75 MHz	50	B	M
		D	N

ALLEN AVIONICS, INC.
224 EAST SECOND STREET • MINEOLA, NEW YORK 11501 • PHONES: (516) 248-8080 OR (516) 747-5450

CUSTOM-BUILT BANDPASS L-C FILTERS

PROTOTYPES OFTEN DELIVERED IN LESS THAN 3 DAYS

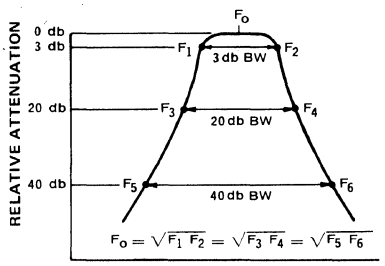
Types: Butterworth, Tchebycheff, and Elliptic Function.

Frequency Range: 400 Hz to 30 MHz.

Impedance Range: 50 ohms to 10K ohms.

Construction: Epoxy encapsulated or sealed in metal can.

The bandpass filters listed below are typical units that we build. We do manufacture filters with cut-off frequencies in-between those listed. We also deliver bandpass designs with better shape factors than those listed below.



1 db MAXIMUM RIPPLE

Shape Factor	20 db BW / 3 db BW	40 db BW / 3 db BW
A	2.70	5.70
B	1.60	2.50
C	1.45	1.85

SIZE (INCHES)

Sealed in Metal Can with B.N.C. Connectors:

L — 2.00 x 1.625 x 1.125
M — 3.00 x 1.625 x 1.125
N — 4.00 x 1.500 x 1.250
O — 5.00 x 1.500 x 1.250

Encapsulated in Epoxy Container:

T — 1.25 x 1.250 x .875
U — 2.00 x 1.125 x .750
V — 1.75 x 1.750 x .875
W — 2.50 x 1.125 x .750
X — 3.00 x 1.500 x 1.000
Y — 4.00 x 1.500 x 1.125
Z — 4.50 x 2.500 x 1.375

Center Frequency (F_o)	Q Range F_o / 3db BW	Impedance Range (Ohms)	Shape Factor	Insertion Loss	Size
400Hz	1–5	1K-5K	A	3-10db	Y
1KHz	1–10	1K-5K	A	3-10db	Y
5KHz	1–25	500-10K	A	2-10db	X & Y
	1–15	500-10K	B	3-10db	Y & Z
10KHz	1–50	100-10K	A	2-10db	X & Y
	1–25	100-10K	B	3-10db	Y & Z
	1–15	100-10K	C	4-10db	Y & Z
25KHz	1–50	100-10K	A	2-10db	W to Y
	1–25	100-10K	B	3-10db	Y & Z
	1–15	100-10K	C	3-10db	Y & Z
50KHz	1–50	100-5K	A	2-10db	W to Y
	1–25	100-5K	B	3-10db	X to Z
	1–15	100-5K	C	3-10db	Y & Z
75KHz	1–50	100-5K	A	1-10db	W to Y
	1–25	100-5K	B	2-10db	X to Z
	1–15	100-5K	C	3-10db	Y & Z
100KHz	1–50	100-5K	A	1-10db	W to Y
	1–25	100-5K	B	2-10db	W to Z
	1–15	100-5K	C	3-10db	Y & Z
200KHz	1–50	50-5K	A	1-10db	V to Y
	1–25	50-5K	B	2-10db	W to Z
	1–15	50-5K	C	3-10db	Y & Z
300KHz	1–50	50-5K	A	1-10db	U to Y
	1–25	50-5K	B	2-10db	V to Z
	1–10	50-2K	C	3-10db	X to Z
400KHz	1–50	50-5K	A	1-10db	U to Y
	1–25	50-5K	B	2-10db	V to Z
	1–10	50-2K	C	3-10db	X to Z
500KHz	1–50	50-5K	A	1-10db	U to Y
	1–25	50-5K	B	2-10db	V to Z
	1–10	50-2K	C	3-10db	X to Z

CALL OR WRITE FOR OUR COMPLETE FILTER CATALOG

Our Engineering Staff will be happy to help you with your design problems.

Center Frequency (F_o)	Q Range F_o / 3db BW	Impedance Range (Ohms)	Shape Factor	Insertion Loss	Size
750KHz	1–40	50-5K	A	1-10db	U to Y
	1–25	50-5K	B	2-10db	V to Z
	1–10	50-2K	C	3-10db	X to Z
1MHz	1–30	50-5K	A	1-10db	T to Y
	1–20	50-5K	B	2-10db	U to Z
	1–10	50-1K	C	3-10db	X to Z
2MHz	1–25	50-500	A	1-10db	T to Y
	1–15	50-500	B	2-10db	T to Z
	1–10	50-500	C	3-10db	X to Z
3MHz	1–25	50-500	A	1-10db	T to Y
	1–15	50-500	B	2-10db	T to Z
	1–10	50-500	C	3-10db	X to Z
4MHz	1–25	50-200	A	1-10db	T to Y
	1–15	50-100	B	2-10db	T to Y
	1–10	50-100	C	3-10db	T to Z
5MHz	1–20	50-100	A	2-10db	T to Y
	1–15	50	B	3-10db	T to Y
	1–10	50	C	4-10db	T to Z
7.5MHz	1–20	50-100	A	2-10db	T to Y
	1–10	50	B	3-10db	M to Z
	1–5	50	C	4-10db	N to Z
10MHz	1–20	50	A	2-10db	M to Y
	1–10	50	B	3-10db	N to Y
	1–5	50	C	4-10db	N to Z
15MHz	1–15	50	A	3-10db	L to O
	1–10	50	B	3-10db	L to O
	1–5	50	C	4-10db	L to O
20MHz	1–15	50	A	3-10db	L to O
	1–8	50	B	4-10db	L to O
	1–5	50	C	4-10db	L to O
25MHz	1–10	50	A	3-10db	L to O
	1–8	50	B	4-10db	L to O
	1–5	50	C	4-10db	L to O
30MHz	1–10	50	A	3-10db	L to O
	1–5	50	B	4-10db	L to O

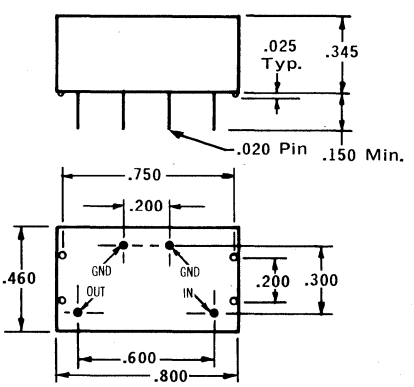
CUSTOM-BUILT DIP L-C FILTERS

PROTOTYPE UNITS CAN OFTEN BE SHIPPED WITHIN 3 DAYS

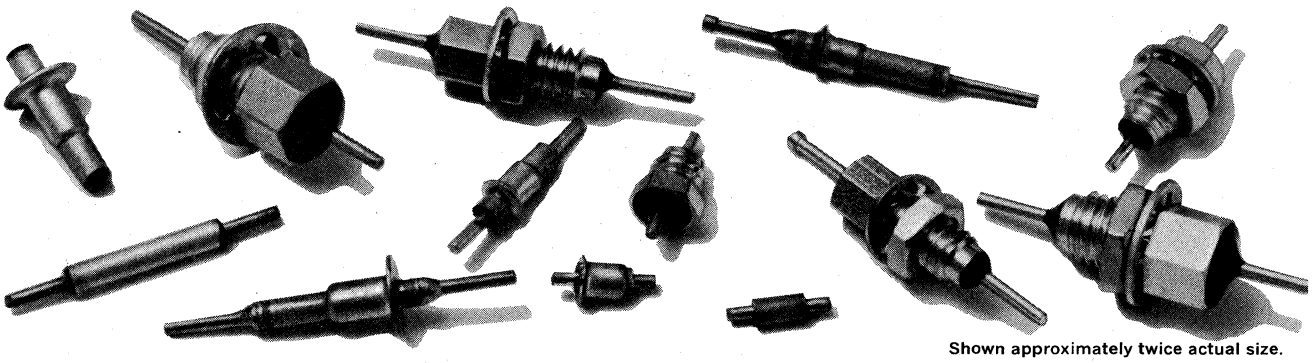
Lowpass Shape Factor	Impedance Range (ohms)	Cut-Off (F_c) Frequency	Highpass Shape Factor	Impedance Range (ohms)
A	500-5K	500 kHz	A	500-5K
B	1K		B	5K
A	500-2K	1 MHz	A	200-2K
B	500		B	5K
A	200-1K	2 MHz	A	100-1K
B	200		B	2K
A	100-1K	3 MHz	A	100-500
B	100		B	1K
A	100-1K	4 MHz	A	50-500
B	100		C	50-100
A	50-500	5 MHz	A	50-200
B	100		C	50-100
A	50-200	10 MHz	A	50-200
C			C	50-100
A	50-100	20 MHz	A	50-100
C			C	50
A	50-100	30 MHz	A	50
C			C	

Allen Avionics offers a wide range of LC Filters in a dip package. Any "in-between frequency" can be manufactured.

Lowpass		Shape Factor	Highpass	
20 db	40 db	—	20 db	40 db
2.5 F_c	5.25 F_c	A	.400 F_c	.190 F_c
2.3 F_c	3.75 F_c	B	.434 F_c	.266 F_c
1.6 F_c	2.30 F_c	C	.625 F_c	.434 F_c



Want a low-pass RFI/EMI filter with small size? See AMP.



Shown approximately twice actual size.

You'll find exactly the one you're looking for among a wide variety of rugged, single-piece, center-conductor RFI/EMI low-pass filters with solder or bolt-in mountings.

Features.

- Three sizes (standard, miniature and subminiature) suitable for a wide variety of applications.
- Standard or low-capacitance versions accommodate a wide range of cutoff frequencies.
- High insertion loss performance versus size.
- Rugged, single-piece construction offers excellent resistance to shock and vibration.

Environmental and physical specifications.

Salt Spray: MIL-STD-202, Method 101, Cond. A; 96 hrs. (salt solution 20%)
Temperature Cycling: MIL-STD-202, Method 102. Cond. D; except −55°C to +125°C
Immersion Test: MIL-STD-202, Method 104, Cond. A
Barometric Pressure: MIL-STD-202, Method 105, Cond. B
Moisture Resistance: MIL-STD-202, Method 106; 50 VDC applied
Vibration: MIL-STD-202, Method 204, Cond. D
Resistance to Soldering Heat: MIL-STD-202, Method 210, Cond. B
Shock: MIL-STD-202, Method 213, Cond. C
Terminal Strength: MIL-STD-202, Method 211, Cond. A 5 lb. pull test
Temperature range: −55°C to +125°C, without voltage derating.
Note. The following military standards and specifications are applicable to all series filters. MIL-STD-202, MIL-STD-220, and MIL-F-15733

Electrical specifications.

Standard-size 4000 pf filters (Series 55).

Maximum voltage rating (to +125°C, 60-400 Hz): 200 VDC; 125 VAC.
Maximum current rating: 15A (load); .5A (RF).
Minimum capacitance (either terminal-to case): 4000 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage (either terminal-to case): 500 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 2 MHz 50 db @ 100 MHz
10 db @ 10 MHz 90 db @ 300 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals (except filter P/N 859550-3): .002 ohms @ +25°C.

Miniature 3000 pf filters (Series 25).

Maximum voltage rating (to +125°C, 60-400 Hz): 50 VDC; 35 VAC.
Maximum current rating: 15A (load); .3A (RF).
Minimum capacitance (either terminal-to case): 3000 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage (either terminal-to case): 150 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
10 db @ 10 MHz 55 db @ 300 MHz
30 db @ 100 MHz 65 db @ 500 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals: .002 ohms @ +25°C.

Subminiature 1500 pf filters (Series 25).

Maximum voltage rating (to +125°C, 60-400 Hz): 50 VDC; 35 VAC.
Maximum current rating: 15A (load); .3A (RF).
Minimum capacitance (either terminal-to case): 1500 pf @ 1 KHz (rms) @ +25°C.
Dielectric withstanding voltage: (either terminal-to case): 150 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
5 db @ 10 MHz 40 db @ 500 MHz
20 db @ 100 MHz 50 db @ 1000 MHz to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals: .002 ohms @ +25°C.

Standard-size, low-capacitance filters (Series 45).

Maximum voltage rating (to +125°C, 60-400 Hz): 200 VDC; 125 VAC.
Maximum current rating: 15A (load); .5A (RF).
Maximum capacitance (either terminal-to case): 300 pf @ 1 KHz (rms) @ +25°C; 390 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage: (either terminal-to case): 500 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 25 MHz 45 db @ 1 GHz
35 db @ 500 MHz 70 db @ 5 to 18 GHz.
Minimum insulation resistance (either terminal-to case): 500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals (except filter P/N 859604): .002 ohms @ +25°C.

Miniature low-capacitance filters (Series 15).

Maximum voltage rating (to +125°C, 60-400 Hz):
50 VDC; 35 VAC.
Maximum current rating: 15A (load); .3A (RF).
Maximum capacitance (either terminal-to case):
225 pf @ 1 KHz (rms) @ +25°C;
280 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage (either terminal-to case):
150 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220 @ +25°C):
3 db @ 50 MHz
25 db @ 500 MHz
35 db @ 1.0 GHz
55 db @ 5.0 to 18 GHz.
Minimum insulation resistance (either terminal-to case):
500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals:
.002 ohms @ +25°C.

Subminiature low-capacitance filters (Series 15).

Maximum voltage rating (to +125°C, 60-400 Hz):
50 VDC; 35 VAC.
Maximum current rating: 15A (load); .3A (RF).
Maximum capacitance (either terminal-to case):
130 pf @ 1 KHz (rms) @ +25°C;
170 pf @ 1 KHz (rms) @ +125°C.
Dielectric withstanding voltage (either terminal-to case):
150 VDC for 5 sec.
Minimum no-load insertion loss (per MIL-STD-220):
3 db @ 150 MHz
16 db @ 1.0 GHz
35 db @ 5.0 GHz
42 db @ 10 GHz to 18 GHz
Maximum insulation resistance (either terminal-to case):
500 megohms @ 100 VDC and +25°C.
Maximum DC resistance between in/out terminals:
.002 ohms @ +25°C.

Mechanical specifications.

Standard-size filters (Series 55 & 45).

Series 55 Part No.	Series 45 Part No.	Weight in grams	Suggested mounting hole diameter	Recommended mounting torque	Thread size
859550-1	859604-1	.50	.140	—	—
*859550-2	*859604-2	.35	.125	—	—
859550-3	859604-3	.25	.125	—	—
859550-4	859604-4	.35	.125	—	—
859550-5	859604-5	.45	.125	—	—
859551-1	—	2.00	.203	8 in-lb.	10-32 UNF-2A
*859551-2	—	2.00	.203	8 in-lb.	10-32 UNF-2A
859552-1	859606-1	.35	.094	—	—
*859552-2	*859606-2	.35	.094	—	—
859555-1	859605-1	1.5	.177	8 in-lb.	8-32 UNC-2A
*859555-2	*859605-2	1.5	.177	8 in-lb.	8-32 UNC-2A
859554-1	—	2.70	.228	8 in-lb.	12-32 UNEF-2A
*859554-2	—	2.70	.228	8 in-lb.	12-32 UNEF-2A

NOTES:
All filters listed are tin-plated.
All threaded versions supplied with lock washer and nut.
*These part numbers have a turret head terminal, .060" dia. by .030".

Miniature filters (Series 25 and 15).

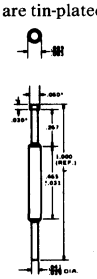
Series 25 Part No.	Series 15 Part No.	Weight in grams	Suggested mounting hole diameter	Recommended mounting torque	Thread size
859249-1	859603-1	1.2	.177	5 in-lb.	8-32 UNC-2A
*859249-2	*859603-2	1.2	.177	5 in-lb.	8-32 UNC-2A
1-859249-1	859603-3	.3	.125	—	—
*1-859249-2	*859603-4	.3	.125	—	—
1-859249-3	859603-5	.4	.125	—	—
2-859249-1	859603-6	.25	.094	—	—
*2-859249-2	*859603-7	.25	.094	—	—

NOTES:
All filters listed are tin-plated.
All threaded versions supplied with lock washer and nut.
*These part numbers have a turret head terminal, .060" x .030".

Subminiature filters (Series 25 and 15).

Series 25 Part No.	Series 15 Part No.	Weight in grams	Suggested mounting hole diameter	Recommended mounting torque	Thread size
859259-2	859602-1	.40	8-32 UNC-2A Thread	4 in-lb.	8-32 UNC-2A
859259-3	859602-3	.20	.125	—	—
859259-4	859602-5	.15	.094	—	—
859259-6	859602-2	.40	8-32 UNC-2A Thread	4 in-lb.	8-32 UNC-2A
859259-8	859602-4	.20	.125	—	—

NOTES:
All filters listed are tin-plated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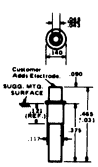
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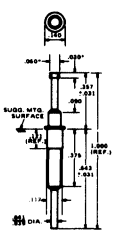
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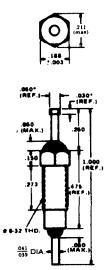
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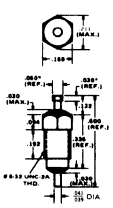
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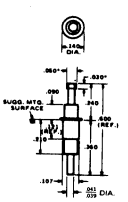
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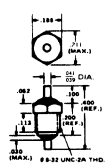
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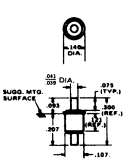
859259-3
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AMP
INCORPORATED

For more information, write AMP Capitron Division, Elizabethtown, Pa. 17022.
Note: Data subject to change without notice.

All-tronics Inc.

RADIO INTERFERENCE FILTERS

FOLLOW THESE EASY STEPS

1. DETERMINE CURRENT AND VOLTAGE OF CIRCUIT WHERE THIS FILTER WILL BE USED.
2. OBTAIN BASIC PART NUMBER FROM TABLE BELOW BASED ON SUPPRESSION REQUIREMENTS.
3. SELECT MOUNTING STYLE AND TERMINAL TYPE FROM FACING PAGE.
4. BUILD UP PART NUMBER THIS WAY →

70 D 6.3 G P 11

BASIC PART NUMBER — MOUNTING STYLE — TERMINAL TYPE

RECTANGULAR TYPES EFFECTIVE TO 400 MEGAHERTZ

Amperes	Case Size			0-70 Volts DC Series		400 VDC/150 VAC 0-70 Hertz Series		150 VAC 50-1000 Hertz Series		600 VDC/250 VAC 0-70 Hertz Series		250 VAC 50-1000 Hertz Series	
	a	b	c	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db
0.40	1 1/8	1	11/16	70D0.4E	48	400D0.4E	24	400A0.4E	24	*	*	*	*
	1 3/4	1 1/4	7/8	70D0.4F	60	400D0.4F	47	400A0.4F	47	600D0.4F	42	600A0.4F	42
	2	1 3/4	1 1/8	70D0.4G	90	400D0.4G	90	400A0.4G	90	600D0.4G	90	600A0.4G	90
0.63	1 1/8	1	11/16	70D0.6E	48	*	*	*	*	*	*	*	*
	1 3/4	1 1/4	7/8	70D0.6F	56	400D0.6F	40	400A0.6F	40	600D0.6F	35	600A0.6F	35
	2	1 3/4	1 1/8	70D0.6G	90	400D0.6G	85	400A0.6G	92	600D0.6G	83	600A0.6G	87
1.0	1 1/8	1	11/16	70D1.0E	47	*	*	*	*	*	*	*	*
	1 3/4	1 1/4	7/8	70D1.0F	53	400D1.0F	30	400A1.0F	30	600D1.0F	30	600A1.0F	30
	2	1 3/4	1 1/8	70D1.0G	87	400D1.0G	74	400A1.0G	87	600D1.0G	75	600A1.0G	80
2.5	2	1 3/4	1 1/8	70D2.5G	75	400D2.5G	57	400A2.5G	60	600D2.5G	59	600A2.5G	64
	2	2	1 1/4	70D2.5H	80	400D2.5H	63	400A2.5H	67	600D2.5H	69	600A2.5H	70
4.0	2	1 3/4	1 1/8	70D4.0G	72	400D4.0G	48	400A4.0G	52	600D4.0G	50	600A4.0G	52
	2	2	1 1/4	70D4.0H	82	400D4.0H	68	400A4.0H	68	600D4.0H	62	600A4.0H	62
6.3	2	1 3/4	1 1/8	70D6.3G	72	400D6.3G	43	400A6.3G	45	600D6.3G	44	600A6.3G	47
	2	2	1 1/4	70D6.3H	80	400D6.3H	60	400A6.3H	60	600D6.3H	55	600A6.3H	55
	3 1/16	2 7/8	1 5/8	*	*	400D6.3J	88	400A6.3J	90	600D6.3J	75	600A6.3J	75
10	2	1 3/4	1 1/8	70D10G	60	400D10G	40	400A10G	43	600D10G	27	600A10G	30
	2	2	1 1/4	70D10H	72	400D10H	50	400A10H	54	600D10H	35	600A10H	35
	3 1/16	2 7/8	1 5/8	70D10J	90	400D10J	72	400A10J	75	600D10J	63	600A10J	66
16	3 1/16	2 7/8	1 5/8	70D16J	77	400D16J	65	400A16J	65	600D16J	49	600A16J	55
25	3 1/16	2 7/8	1 5/8	70D25J	70	400D25J	55	400A25J	55	600D25J	44	600A25J	48
	3 1/16	2 7/8	2 1/8	70D25K	84	400D25K	60	400A25K	65	600D25K	55	600A25K	60
40	3 1/16	2 7/8	1 5/8	70D40J	50	400D40J	20	400A40J	23	600D40J	35	600A40J	35
	3 1/16	2 7/8	2 1/8	70D40K	75	400D40K	50	400A40K	50	600D40K	45	600A40K	45
63	3 1/16	2 7/8	1 5/8	70D63J	50	400D63J	19	400A63J	22	600D63J	35	600A63J	35
	3 1/16	2 7/8	2 1/8	70D63K	55	400D63K	50	400A63K	50	600D63K	40	600A63K	45
	3 1/2	3 1/2	2 1/2	70D63L	80	400D63L	60	400A63L	60	600D63L	45	600A63L	54
100	3 1/16	2 7/8	2 1/8	70D100K	55	400D100K	50	400A100K	50	600D100K	40	600A100K	45
	3 1/2	3 1/2	2 1/2	70D100L	60	400D100L	55	400A100L	55	600D100L	45	600A100L	50

TUBULAR TYPES EFFECTIVE TO 10 GIGAHERTZ

Amperes	Case Size		0-70 Volts DC Series		400 VDC/150 VAC 0-500 Hertz Series		600 VDC/150 VAC 0-500 Hertz Series	
	Dia.	Length	Basic Part No.	db	Basic Part No.	db	Basic Part No.	db
1.0	1	2 1/2	70R1.0M	75	400R1.0M	70	600R1.0M	55
	1	4	70R1.0P	90	400R1.0P	85	600R1.0P	70
2.5	1	2 1/2	70R2.5M	75	400R2.5M	60	*	*
	1	4	70R2.5P	88	400R2.5P	70	600R2.5P	55
	1 3/8	4 1/8	*	*	400R2.5R	90	600R2.5R	75
4.0	1	4	70R4.0P	75	400R4.0P	65	600R4.0P	45
	1 3/8	4 1/8	70R4.0R	90	400R4.0R	85	600R4.0R	70
6.3	1	4	70R6.3P	70	*	*	*	*
	1 3/8	4 1/8	70R6.3R	85	400R6.3R	65	600R6.3R	45
	1 1/2	4 3/8	*	*	400R6.3S	90	600R6.3S	75
10	1	4	70R10P	60	*	*	*	*
	1 3/8	4 1/8	70R10R	80	400R10R	65	600R10R	45
	1 1/2	4 3/8	*	*	400R10S	80	600R10S	60
16	1 3/8	4 1/8	70R16R	70	400R16R	55	600R16R	35
	1 1/2	4 3/8	70R16S	85	400R16S	70	600R16S	50
20	1 1/2	4 3/8	70R20S	70	400R20S	60	600R20S	40

All-tronics Inc.
45 BOND STREET. WESTBURY. L. I., N. Y. 11590 • (516) 333-3090

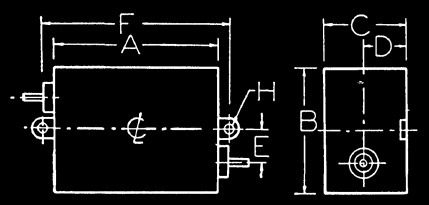
All-tronics, inc.

RADIO INTERFERENCE FILTERS

STYLES & DIMENSIONS STANDARD MOUNTING

RECTANGULAR TYPES

STYLE P

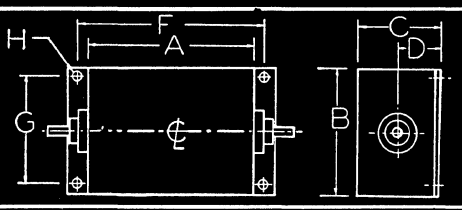


IF BASIC PART NUMBER ENDS WITH THIS LETTER

STYLE P DIMENSIONS ARE

	A	B	C	D	E	F	H
E	1 1/8	1	11/16	11/32	1/4	1 7/16	5/32
F	1 3/4	1 1/4	7/8	7/16	1/4	2 1/8	3/16
G	2	1 3/4	1 1/8	9/16	1/2	2 3/8	3/16
H	2	2	1 1/4	5/8	5/8	2 3/8	3/16

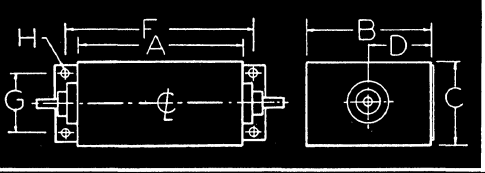
STYLE P



STYLE P DIMENSIONS ARE

	A	B	C	D	F	G	H
J	3 1/16	2 7/8	1 5/8	13/16	3 5/8	2 1/8	.195
K	3 1/16	2 7/8	2 1/8	1 1/16	3 5/8	2 1/8	.195
L	3 1/2	3 1/2	2 1/2	1 1/4	4 1/2	2	.195

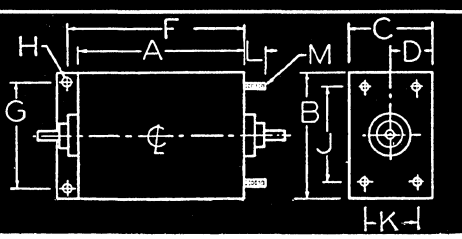
STYLE R



STYLE R DIMENSIONS ARE

	A	B	C	D	F	G	H
J	3 1/16	2 7/8	1 5/8	1 7/16	3 5/8	7/8	.195
K	3 1/16	2 7/8	2 1/8	1 7/16	3 5/8	1 3/8	.195
L	3 1/2	3 1/2	2 1/2	1 3/4	4 1/2	1 3/4	.195

STYLE S

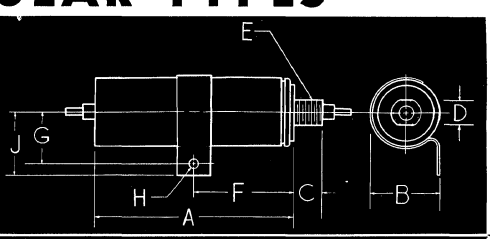


STYLE S DIMENSIONS ARE

	A	B	C	D	F	G	H	J	K	L	M
J	3 1/16	2 7/8	1 5/8	13/16	3 3/8	2 1/8	.195	2	7/8	15/32	10-32
K	3 1/16	2 7/8	2 1/8	1 1/16	3 3/8	2 1/8	.195	2	1 3/8	15/32	10-32
L	3 1/2	3 1/2	2 1/2	1 1/4	4	2	.195	2 1/4	1 3/4	15/32	10-32

TUBULAR TYPES

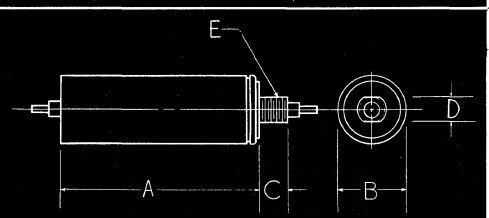
STYLE L



STYLE L DIMENSIONS ARE

	A	B	C	D	E	F	G	H	J
M	2 1/2	1	7/16	3/8	7/16-20NF	1 1/4	3/4	.156	15/16
P	4	1	7/16	3/8	7/16-20NF	2	3/4	.156	15/16
R	4 1/8	1 3/8	5/8	17/32	5/8-24NF	2 1/16	1	.195	1 1/4
S	4 3/8	1 1/2	5/8	17/32	5/8-24NF	2 3/16	1 1/8	.195	1 3/8

STYLE M



STYLE M DIMENSIONS ARE

	A	B	C	D	E
M	2 1/2	1	7/16	3/8	7/16-20NF
P	4	1	7/16	3/8	7/16-20NF
R	4 1/8	1 3/8	5/8	17/32	5/8-24NF
S	4 3/8	1 1/2	5/8	17/32	5/8-24NF

SELECT TERMINALS FROM FOLLOWING PAGE →

All-tronics, inc.
45 BOND STREET, WESTBURY, L. I., N. Y. 11590 • (516) 333-3090

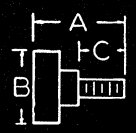
All-tronics, inc.

RADIO INTERFERENCE FILTERS

TERMINALS

IF BASIC PART NUMBER ENDS WITH ONE OF THESE LETTERS → **USE TERMINAL TYPE** → **FOR THIS CURRENT RANGE**

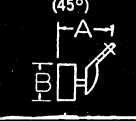
THREADED TERMINAL



Supplied with Nut and Lockwasher.

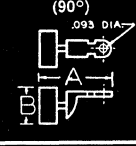
		AMP.	THREAD SIZE	A	B	C
EFGHMP	10	0-2.5	4-40	1/2	5/16	3/16
FGHRS	11	0-10	6-32	5/8	7/16	9/32
FGHJRS	12	0-16	8-32	5/8	7/16	5/16
JKL	13	4-25	10-32	13/16	1	5/16
JKL	14	10-63	1/4-20	1	1	3/8
JKL	15	25-100	3/8-16	1 1/4	1 1/2	9/16

SOLDER TERMINAL (45°)



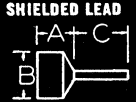
EFGHJ	16	0-16	—	13/32	5/16	—

SOLDER TERMINAL (90°)



EFGHJMP	17	0-16	—	1/2	5/16	—
RS	31	0-20	—	1/2	15/32	—

SHIELDED LEAD



EFGH	19	0-2.5	—	5/16	5/16	12
EFGH	22	0-2.5	—	5/16	5/16	36
FGHRS	24	2.5-16	—	5/16	13/32	11
FGHRS	26	2.5-16	—	5/16	13/32	36
MP	28	0-4	—	5/16	5/16	12
MP	30	0-4	—	5/16	5/16	32

INSERTION LOSS

The column marked **db** in the table of basic part numbers is the insertion loss at a frequency of 150 kilohertz. Insertion loss is a measure of the effectiveness of a filter at a particular frequency. The insertion loss is the logarithmically adjusted ratio of signal input to signal output measured in a standard circuit of 50 ohms input and output impedance. The larger the number of **db** the greater is the signal reducing ability of the filter.

All the **db** figures in the chart represent the insertion loss for each filter at 150 kilohertz. A complete description of insertion loss requires a graph or a tabular chart showing a number of **db** readings at frequencies spread throughout the useful range of the filter. The filters in this catalog have a useful range from below 150 kilohertz to above 250 megahertz. They have been designed to maintain approximately the stated level of insertion loss in the frequency range of 150 kilohertz to about 10 megahertz and then to follow a gently sloping reduction maintaining effective levels of insertion loss to between 250 and 400 megahertz. This corresponds to the normal frequency distribution of radio interference generated by most electrical machinery, electromechanical devices and a great deal of electronic equipment.

The tubular filters are designed for more severe requirements and will maintain the stated level of insertion loss from 150 kilohertz to greater than 10,000 megahertz.

CURRENT & VOLTAGE RATINGS

Filters are rated for continuous use at a maximum ambient temperature of 85°C (185°F). They are made to withstand occasional momentary surges for normal motor starting, etc. If you have an intermitten duty problem contact factory for a suitable rating.

The filters are rated for continuous use at the specified voltage at temperatures up to 85°C (185°F). Filters with a dual voltage rating (e.g. 400 VDC/150 VAC) are rated for the higher voltage only in direct current applications. The rating drops to the lower value for alternating current applications. Any filter may be used at a lower voltage than its rating.

All filters are designed to have a voltage drop of low value so that they will not interfere with proper operation of the equipment in which they are installed. The 70 volts D.C. series has a maximum drop of 0.3 volt when operated at full rated current. The 400 VDC/150 VAC and the 600 VDC/250 VAC have a drop of less than one percent of the AC rating when carrying full rated current.

ALL-TRONICS RFI/EMI TESTING LABORATORY

In addition to manufacturing the Standardized Filters shown on these pages and the additional lines described below, ALL-TRONICS also maintains a complete laboratory facility especially for RFI-EMI testing. Large modern RFI shielded rooms, the latest interference and field intensity meters and top level know-how provides a testing service that covers all the latest requirements and compliance with FCC regulations and/or military specifications including MIL-STD-220A, MIL-STD-461A, MIL-I-6181D, MIL-STD-826A and MIL-I-16910C. In addition to RFI/EMI interference levels caused by your equipment ALL-TRONICS can also perform susceptibility tests to determine the effects of RFI/EMI emissions on your product. Test plans per MIL-STD-831 and consultation on test methods for your products are also available.

ALL-TRONICS is for ALL your RFI/EMI needs.

All-Tronics, Inc. reserves the right to improve design specifications or withdraw items from this catalog in the light of new technological advances.

OTHER FILTER TYPES FROM ALL-TRONICS

- **POWERLINE FILTERS**
  - 5 AMPS thru 400 AMPS • 100 db from 14 KHz to 10 GHz measured per MIL-STD-220A **WITH EXTENDED RANGE BUFFER NETWORKS** • Single circuit to 3ϕ 4 wire circuits in external metal cases.
- **RF FILTERED & SHIELDED CIRCUIT BREAKER PANELBOARDS**
  - 50 AMPS thru 200 AMPS • 100 db from 14 KHz to 10 GHz measured per MIL-STD-220A **WITH EXTENDED RANGE BUFFER NETWORKS** • METAL CASES complete with Shielded Circuit Breakers • In accordance with DCA CIR 300-175-1 and all RED/BLACK Criteria.
- **SECURE COMMUNICATIONS & SIGNAL LINE FILTERS**
  - Complete Modular Cases pre-wired with any desired combination of TELEPHONE, TELETYPE, SIGNAL, LIGHT and VOICE FILTERS to meet the requirements of RED/BLACK Criteria.
- **GENERAL PURPOSE TUBULAR & RECTANGULAR RFI/EMI FILTERS**
- **U/L & CSA APPROVED FILTERS**
  - For Computer and Peripheral Equipment.
- **CUSTOM-DESIGN** capabilities for SPECIAL requirements.

All-tronics, inc.
45 BOND STREET, WESTBURY, L. I., N. Y. 11590 • (516) 333-3090

Active Electronic Filters

Analyze your requirements with our variable frequency instruments and select our low cost fixed frequency modules accordingly.

Applications: Communication, Data Transmission, Control, Vibration testing, Biomedicine, Military Engineering, Increased Instrument Sensitivity through noise elimination.

PORTABLE VARIABLE FREQUENCY FILTERS

These variable filters permit the setting of cut-off frequencies continuously and are available in a variety of versions as shown in the table below.
Low Weight, Unity gain in passband, 24 DB/octave skirt, max. attenuation 80 DB, input impedance 1 Megohm, output impedance less than 5 ohm.
Battery or A.C. line operation. Up to 4 model APV series or two model AP 200 series can be supplied on a standard 19" rack, 5¼" high, as shown on Fig. C. Add $20 for 110 V-A.C., and $30 for 220 V A.C. Supplies.

Model * *	Low Pass	High Pass	Band Pass	Band Reject	Tuning Range	Price
						Battery Operated
APVL–41-4	✓				0.2Hz–2KHz	315.-
APVL–42-4	✓				2Hz–20KHz	315.-
APVL–43-5	✓				0.02Hz–2KHz	350.-
APVL–44-5	✓				0.2Hz–20KHz	350.-
APVL–1	✓				1 Decade †	220.-
APVH–41-4		✓			0.2Hz–2KHz	315.-
APVH–42-4		✓			2Hz–20KHz	315.-
APVH–43-5		✓			0.02Hz–2KHz	350.-
APVH–44-5		✓			0.2Hz–20KHz	350.-
APVH–1		✓			1 Decade †	220.-
APVLH–41-5	✓	✓			0.2Hz–20KHz	430.-
APVLH–44-5	✓	✓			2.0Hz–20KHz	430.-
AP–200-1			✓		1 Decade †	420.-
AP–240-5			✓		0.02Hz–2KHz	580.-
AP–245-4			✓		0.2Hz–2KHz	520.-
AP–250-5			✓		0.2Hz–20KHz	580.-
AP–255-4			✓		2.0Hz–20KHz	520.-
AP–230-4	✓	✓	✓		2Hz–20KHz	540.-
AP–235-5	✓	✓	✓		0.02Hz–2KHz	680.-
AP–240-4	✓	✓	✓		0.2Hz–2KHz	580.-
AP–245-5	✓	✓	✓		0.2Hz–20KHz	680.-
AP–250-4	✓	✓	✓	✓	0.2Hz–2KHz	650.-
AP–255-5	✓	✓	✓	✓	0.2Hz–20KHz	700.-
AP–260-5	✓	✓	✓	✓	0.1Hz–10KHz	750.-
AP–265-5	✓	✓	✓	✓	0.02Hz–2KHz	750.-
AP–270-4	✓	✓	✓	✓	2.0Hz–20KHz	560.-
AP–280-5	✓	✓	✓	✓	2.0Hz–200KHz	590.-*
AP–220-5	✓	✓	✓	✓	20Hz–2MHz	770.-*

* *Price includes 110 V A.C. Supply.*
** *Last Digit indicates Number of Decades covered.*
† *Available ranges 0.1–1.0, 0.2–2.0, 0.5–5.0 and multiples of 10^{1} to 10^{5}*

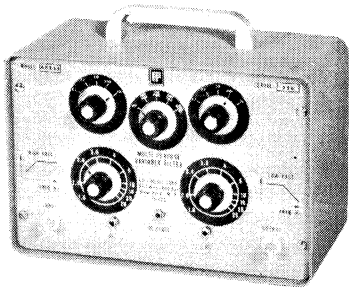


FIG. A
AP 200 SERIES
5.5 lbs. 3 kg

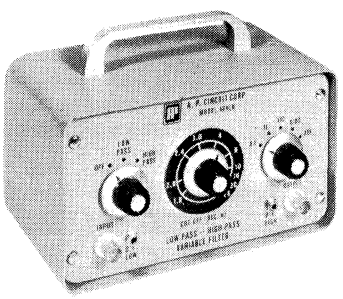


FIG. B
APV 40 SERIES
2.5 lbs. 1.5 kg

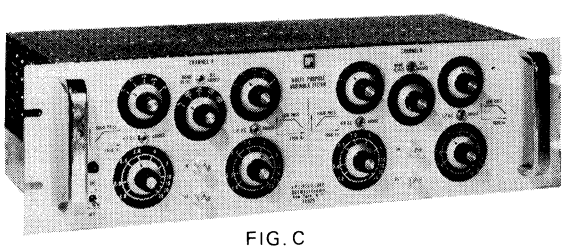


FIG. C
DUAL CHANNEL RACK MOUNT
12 lbs. 6 kg.

FIXED FREQUENCY FILTERS

All units feature: Unity gain in Passband; max. attenuation 80 DB, input impedance 1 Megohm, output impedance less than 10 ohm.

NOTCH FILTERS High Q narrow bandwidth. These filters are available in a number of standard frequencies, for P.C. mounting (Fig. E) or with Octal Base (Fig. D).
Model APN 60 reduces 60 Hz content to less than 1% of input voltage but passes all other frequencies from D.C. to 200 KHz. The rejection bandwidth can be narrowed to 1 Hz. Q's up to 100 can be obtained by an external adjustment. A matching power supply is available. Higher or lower notch frequencies available.
APPLICATION NOTE
UPON REQUEST.

PRICE $155.00

QUANTITY
DISCOUNTS

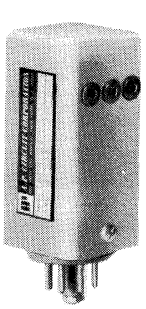


FIG. D

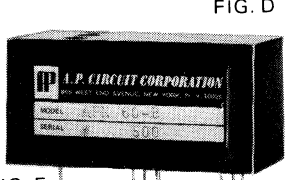


FIG. E

LOW COST MODULES (FIG. F)

24 Db/Octave (4 pole) Low or High Pass ... $ 53.00

48 Db/Octave (8 pole) Low or High Pass ... $109.00

24 Db/Octave (8 pole) Band Pass $109.00

Phase matching to your specification.

Prices for 1.0 Hz to 10 KHz Range.

Ask for detailed literature.

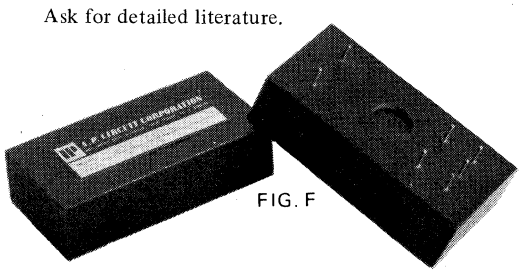


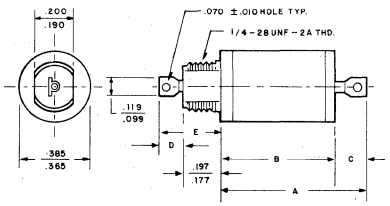
FIG. F

For Additional Information, Quantity Discount and additional Products write to Dept. P.

A.P. CIRCUIT CORPORATION
865 WEST END AVENUE, NEW YORK, N. Y. 10025 • TEL: 212 - 222-0876

AVX CERAMICS

SUBMINIATURE CERAMIC FILTERS



BROADBAND MINIATURE LOW PASS EMI FILTERS — L NETWORKS .375 DIAMETER

L9 Working Voltage 100VDC −55°C to 125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)			Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFL2C1111T	0.25	0.4	500	1000	6	34	43	58	70	70	70
AFL211111T	1.0	0.2	500	1000	—	30	38	57	70	70	70
AFL231111T	3.0	0.05	500	1000	—	24	30	48	70	70	70
AFL251111T	5.0	0.03	500	1000	—	20	28	38	70	70	70
AFL261111T	10.0	0.007	500	1000	—	18	27	36	54	70	70

OPERATING TEMPERATURE RANGE:	−55°C to +125°C
FLASH TEST VOLTAGE:	2 times rated 50 Ma charging current max.
LIFE TEST VOLTAGE:	1.4 times rated voltage @125°C and 1000 hours
INSERTION LOSS:	Measured in 50 ohm system per MIL-STD-220A full load
TORQUE:	10 lbs. inch max.
HOUSING (HERMETICALLY SEALED):	Tin plated brass or steel can be supplied with silver (S) or gold (G) plating. Change letter T at the end of the part no. to S or G for desired finish
MARKING:	AVX Ceramics part no. and indentification, voltage current, circuitry and Date Code

BROADBAND MINIATURE LOW PASS EMI FILTERS Pi NETWORK .375 DIAMETER

Pi6 Working Voltage 100VDC −55°C to +125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)	Peak Transient Voltage	Min. I.R. Megohms	Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFP2C1111T	0.25	0.4	500	1000		58	70	70	70	70	70
AFP211111T	1.0	0.2	500	1000		47	66	70	70	70	70
AFP231111T	3.0	0.05	500	1000		36	55	70	70	70	70
AFP251111T	5.0	0.03	500	1000		14	42	64	70	70	70
AFP261111T	10.0	0.007	500	1000		22	28	40	70	70	70

BROADBAND MINIATURE LOW PASS EMI FILTERS — T NETWORKS .375 DIAMETER

T6 Working Voltage 100VDC −55°C to +125°C

Part Number	Max. DC Current (amps)	Max. DC Resistance (ohms)	Peak Transient Voltage	Min. I.R. Megohms	Minimum Insertion Loss db Full Load						
					30 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
AFT2C1311T	.25	.8	400	1000	20	54	70	70	70	70	70
AFT211311T	1.0	.4	400	1000		30	60	70	70	70	70
AFT231311T	3.0	.1	400	1000		12	40	67	70	70	70
AFT251311T	5.0	.06	400	1000			20	50	70	70	70

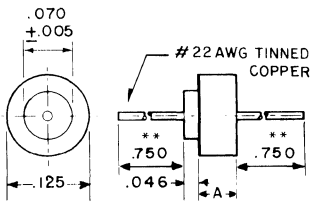
THESE PRODUCTS AVAILABLE FROM AVX CERAMICS FRANCHISED INDUSTRIAL DISTRIBUTORS

AVX CERAMICS, P.O. Box 867, MYRTLE BEACH, SOUTH CAROLINA 29577, Telephone: (803) 448-3191, TWX: 810-661-2252

AVX CERAMICS

SUBMINIATURE CERAMIC FILTERS

EYELET-TYPE BROADBAND LOW PASS EMI FILTERS — C NETWORK



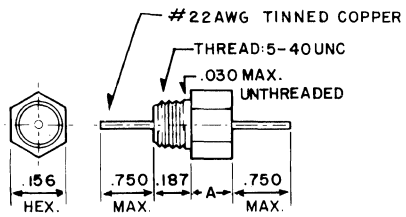
.125 Diameter—Eyelet 8 Amp

Working Voltage over the temperature range of −55°C to +125°C

Part Number	A	Cap GMV MFD	Working Voltage DC	Min. Insertion Loss dB								
				30 KHZ	50 KHZ	100 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
6EC83T-1	.187	.18	50*		1	7	11	17	27	45	50	65
6EC83T-2	.115	.09	50*			1	5	11	21	38	45	65
6EC11T-1	.187	.1	50			2	6	12	22	40	45	65
6EC11T-2	.115	.05	50					6	16	34	45	65
6EC21T-1	.187	.05	100					6	16	34	45	65
6EC21T-2	.115	.025	100						10	28	40	60
6EC31T-1	.187	.026	150						10	28	40	60
6EC31T-2	.115	.013	150						4	22	40	60
6EC41T-1	.187	.014	200						4	22	35	60
6EC41T-2	.115	.007	200							16	35	60

* Working voltage −55°C to +85°C 50VDC, −55°C to +125°C 28VDC

AVheX BROADBAND MINIATURE LOW PASS EMI FILTERS — C AND Pi NETWORKS



5/32 Hex .156

8 Amps C Network

Working Voltage over the temperature range of −55°C to +125°C

Part Number	A	Cap GMV MFD	Working Voltage DC	Min. Insertion Loss dB								
				30 KHZ	50 KHZ	100 KHZ	150 KHZ	300 KHZ	1 MHZ	10 MHZ	100 MHZ	1 GHZ
1HC83T-1	.230	.40	50*	3	8	14	18	24	34	52	60	65
1HC83T-2	.130	.20	50*		2	8	12	18	28	46	55	65
1HC11T-1	.230	.20	50		2	8	12	18	28	46	55	65
1HC11T-2	.130	.10	50			2	6	12	22	40	50	65
1HC21T-1	.230	.12	100			3	7	13	23	42	50	65
1HC21T-2	.130	.06	100					7	17	36	45	65
1HC31T-1	.230	.06	150					7	17	36	45	65
1HC31T-2	.130	.03	150						11	31	40	60
1HC41T-1	.230	.03	200						11	31	40	60
1HC41T-2	.130	.015	200						5	25	35	55

* Working voltage −55°C to +85°C 50VDC, −55°C to +125°C 28VDC

OPERATING TEMPERATURE RANGE:	−55°C to +125°C
INSULATION RESISTANCE:	1000 megohms minimum
FLASH TEST VOLTAGE:	2 times rated 50 Ma charging current max.
LIFE TEST VOLTAGE:	1.4 times rated voltage @125°C and 1000 hours
INSERTION LOSS:	Measured in 50 ohm system per MIL-STD-220A full load
TORQUE:	10 lbs. inch max.
HOUSING (HERMETICALLY SEALED):	Tin plated brass or steel can be supplied with silver (S) or gold (G) plating. Change letter T at the end of the part no. to S or G for desired finish
MARKING:	AVX Ceramics part no. and identification

THIS IS ONLY A REPRESENTATIVE LISTING OF AVX'S WIDE LINE OF FILTERS. FOR COMPLETE INFORMATION REQUEST AVX CATALOG FC-73.

THESE PRODUCTS AVAILABLE FROM AVX CERAMICS FRANCHISED INDUSTRIAL DISTRIBUTORS

AVX CERAMICS, P.O. Box 867, MYRTLE BEACH, SOUTH CAROLINA 29577, Telephone: (803) 448-3191, TWX: 810-661-2252

BULOVA LC FILTERS/MAGNETIC COMPONENTS

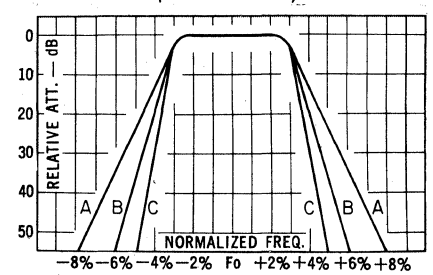
Computer Designed for Maximum Performance—To Your Spec—DC to 80MHz

Pioneers in Time/frequency product design, Bulova has developed a diversified L C Filter product line that features ● Computer programmed performance characteristics ● Competitive pricing ● Custom product sophistication ● High-use, long-life reliability

A continuing effort in L C filter design for the selection and shaping of frequencies has culminated in the development of a unique series of filters, particularly engineered for spectrum analysers.

Filters With Excellent Shape Factor

High frequency filters with 45db/3db shape factors between 1.5/1 and 2.3/1. They are designed to operate between 100 ohm impedances and exhibit excellent temperature stability.



Comb Filters

Useful for such applications as spectrum analysis and available as standard items in contiguous banks from 10 Hz to 10 MHz.

IRIG BANDPASS FILTERS—Available from 400 Hz to 165 kHz with attenuation at ±7.5% of center frequency within 3 db in 21 channels. Eight other standard channels are available in frequency from 22 kHz to 165 kHz at ±15% 3 db points.

IRIG LOW PASS FILTERS—Low Pass and Linear Phase Low Pass filters are available in IRIG frequencies. The low pass are intended to attenuate the 2nd and higher harmonics of the incoming signal. Bulova's linear phase low pass filters attenuate the higher harmonics and provide minimum phase distortion and therefore low transient response. These filters are for 10k ohms terminating impedances.

TONE CHANNEL FILTERS—Designed for data transmission systems, Bulova offers a wide selection of special (and standard) tone filters (band pass and low pass) featuring high stability, small package size, a wide variety of center frequencies and shape factors, phase linearity, etc. Range: 10 Hz to 10 kHz; Stability: better than .1%; Bandwidth: as narrow as 1% can be supplied.

TUNABLE, MULTI-FREQUENCY TONE TRANSFORMERS—Tone Transformers are ideal components for communication equipment, using tones to accomplish signaling functions. To cover a wide range of applications, these transformers are available with 4 to 10 terminals, suitable for printed circuit mounting.

BAND REJECT FILTERS—Some of the outstanding features of Bulova LC Band Reject Filters are their high discrimination and stability. This type of filter is available in a wide range of frequencies and shape factors . . . Bulova also specializes in LC and RC Notch Filters.

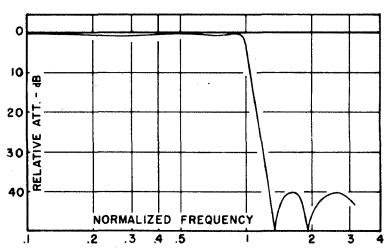
LUMPED CONSTANT DELAY LINES—Bulova custom designs Delay Lines to cover any practical impedance range. Keeping physical dimensions at a minimum, these networks feature low signal attenuation, excellent thermal stability, low pulse distortion and extended band width, achieving high delay-to-rise-time ratio.

EQUALIZERS—Maintaining narrow tolerances, a wide selection of custom designed Amplitude and Phase (Delay) Equalizers have been developed to be used with transmission lines, amplifier networks etc. Bulova's engineering staff is always available to consult with you on design problems. Additional information on all networks is available upon request.

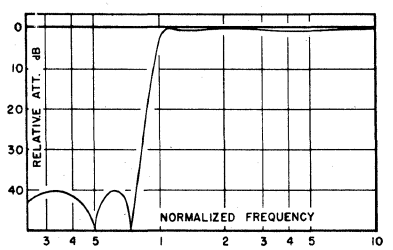
90-150 HZ DUAL BAND PASS FILTERS FOR AVIONIC SYSTEMS—Designated Series 3300, the units are designed for application in Instrument Landing Systems. The primary features of the Bulova Band Pass Filters include high frequency stability over temperature (−10°C to +50°C) and exceptionally accurate output tracking (within .1 db over temperature range).

INTERSTAGE FILTERS—60 Hz to 20 kHz

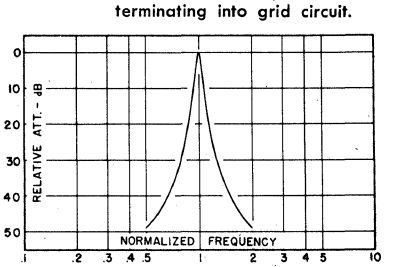
Low Pass
Available up to 30 MHz



High Pass
Available in impedance from 50 ohms to 10 K ohms



Band Pass
Standard filters available with 600 ohm and 10 K ohm terminations. All have provision for terminating into grid circuit.



From Bulova Electronics Division: Frequency Control Components • Crystal Oscillators • Crystal Filters • LC Filters • Fork Oscillators • Coils • Servo D.C. Amplifiers • Optical Devices • Time Period Generators • Time of Day Systems • Inverters • Frequency Changers • Frequency Deviation Counters

BULOVA fcp **BULOVA** FREQUENCY CONTROL PRODUCTS

ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.

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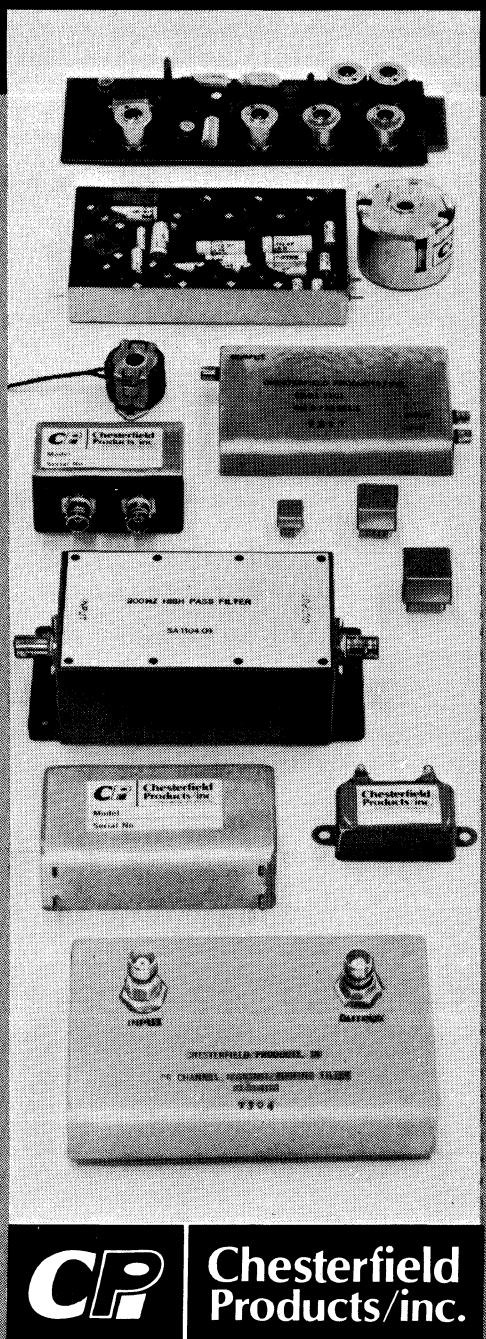
WOODSIDE, N. Y. 11377 • 212 335-6000

LC FILTERS



LOW PASS - HIGH PASS
BAND STOP - BAND PASS
EQUALIZERS
ROOFING FILTERS

GUARANTEED TECHNICAL PERFORMANCE

- **FAST QUOTATIONS**
- **FAST DELIVERY**
- **LOW PRICES**

LC filters from 10 Hz to 50 MHz designed to commercial or Mil Specs. Our competent staff of filter engineers has made us a top rated supplier in the instrumentations, Communications, Telemetering, and Computer fields.

Call or write and let us know your filter requirements. No order too small. If you need one or one thousand units, **we will be happy to quote.**

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Audio, RF and Microwave

Here are 19 good reasons to remember CIR-Q-TEL when you need high performance filters:

1. Widest range of bandpass, highpass and lowpass models in the top performance league.
2. Bandpass filters from 5 KHz to 12.4 GHz center frequencies; 1 to 16 resonators.
3. Highpass filters from 5 KHz to 1 GHz cutoff frequencies, with 3, 5, 7, 9 . . . to 25 elements.
4. Lowpass filters from 5 KHz to 12 GHz cutoff frequencies, with 3, 5, 7, 9 . . . to 25 elements.
5. Smallest filter types available to date —as tiny as ¼" diameter.
6. Wide selection of bandwidths in a single body size to simplify your packaging tasks.
7. Tubular shape permits easy mounting . . . compact, lightweight.
8. Special folded designs allow even more compactness, with *no* performance degradation.
9. Unique synthesis techniques permit diplexing all filter types.
10. Unusually sharp roll-off; steep attenuation slopes.
11. Essentially spurious-response-free performance.
12. High power capacity; units can be built to handle up to 10-15 KW peaks.
13. A high degree of unit-to-unit repeatability.
14. Special linear phase and phase tracking filters for critical applications. Superb time and frequency domain characteristics to handle complex waveforms without distortion.
15. Ruggedly built to meet stringent Mil and NASA environmental specs.
16. Computer design of over *one million* sets of performance combinations usually allows quoting exact specs over the phone.
17. Complete engineering/consulting service to help guarantee top performance in your application.
18. Most dependable delivery in the industry.
19. Fair prices. Not cheap . . . but *fair.*

SERIES/0.2

¼"

Actual Size

A breakthrough in miniaturization with virtually no sacrifice in performance. Cutoff and center frequencies from 130 MHz to over 12 GHz.

SERIES/2

½"

CIR-Q-TEL's best all-around performers, and often the most economical. Cutoff and center frequencies from 40 MHz to 6 GHz.

NOMINAL SPECIFICATIONS
(all types pictured)

Impedance Level	50, 70*, 93*, 600* & 1200* ohms
VSWR	1.5:1 (or less*)
Ripple	less than ± 0.2 dB
Shock	greater than 20G in 11 m.s.; up to 2000G*
Vibration	up to 60Gs sinusoidal or transient .02-2000 cps.*
Temperature Range	
Operating	−55 to +125°C (most models)
Storage	−65 to +135°C (most models)
Pressure and Altitude	Most are rated for space applications
Relative Humidity	0 - 98% *
Salt Spray	per mil std. 202, method b*

* when quoted by the factory.

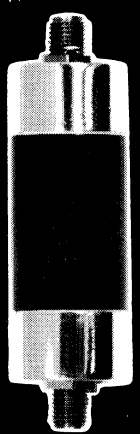
NOTE: Most are available in lowpass, highpass and bandpass models. For example, the lowpass designation for Series/7 is Type FLT/7, while the highpass and bandpass versions are designated Types FHT/7 and FBT/7 respectively.

All types of connectors are available from CIR-Q-TEL, plus complete mounting hardware for both regular and high-shock applications.

Filters: BANDPASS • HIGHPASS • LOWPASS

SERIES/5

←— ¾" —→



Medium power filters with comparatively low cutoff and center frequencies (30 to 3000 MHz).

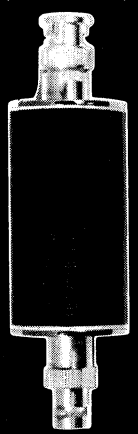
SERIES/20

→| 1⅛" |←

Larger filters providing maximum power capacity, lowest insertion loss, and low cutoff and center frequencies (20 to 2500 MHz).

SERIES/21

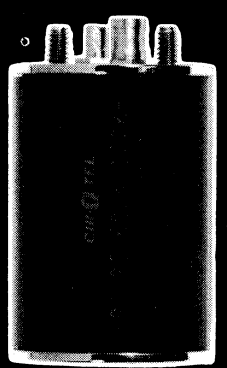
←1⅛" →|



LF filters custom-designed to specific requirements; center and cutoff frequencies from 10 KHz to over 100 MHz. Also Series/7 RF-VHF filters, ultra-light and compact (7/8" dia.) for 5 MHz to over 300 MHz range.

SERIES/22

←—— 2½" ——→

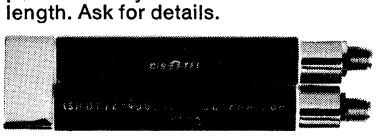


To filter even lower frequencies than Series/21; completely custom-designed; center and cutoff frequencies from 500 Hz to over 1 MHz.

OTHER MAJOR CIR-Q-TEL PRODUCTS

SPECIAL FILTERS

Folded Designs: You get all the performance you need in half the length. Ask for details.



Linear Phase/Phase Match: Filters for superior time and frequency domain performance. Minimum ringing, $< \pm 3°$ phase tracking, $< \pm 3°$ linearity. Highpass, lowpass and bandpass designs, 1 KHz to 10 GHz.

Low-Cost Tunable: Bandpass filters, tunable over a range of 50 KHz to 2 GHz; bandwidth (3dB) from 1% to 5% nominal. Standard models are 1%, 3% and 5%.

Absorptive Filters: Lowpass and highpass filters that absorb energy in the reject band instead of reflecting it. Cutoff frequencies from 500 Hz to 2 GHz; may be absorptive at filter's input, output or both. Designed to eliminate sensitivities of drive source or load to reactive (reject band) terminations.

Coaxial Cavity Filters: Types FBC/8 and FBC/16 provide extremely high Q factors at 0.5 to 6 GHz in a small, rugged package.

Diplexers, Multiplexers: Custom-designed to your requirements.

Special Designs: We can supply Bessel, LaGendre, Gaussian, equal ripple phase, Butterworth, Chebishev, elliptic or Zolotarev response characteristics with bandwidths from 0.5% to over 195% (arithmetic) for passband widths.

ATTENUATORS

AFT/0.025 Fixed Tubular Attenuators are low-cost, reliable units for general use in the DC to 2500 MHz range.

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We have probably already solved your filter problem, and we'll gladly discuss your needs and quote specs—and delivery dates—by phone. Product literature is yours for the asking.

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Setting the pace in filter technology for over 11 years!

CIRQTEL INCORPORATED

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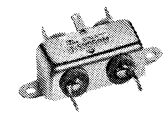
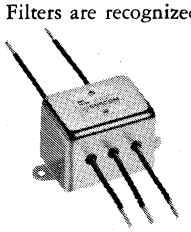
RFI Powerline Filters

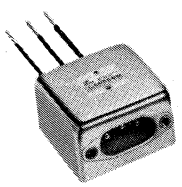
B Series These powerline filters effectively provide RFI control of both line to ground and equipment generated noise in a small size at low cost. All are recognized by UL. **K Series** These powerline filters are similar to the B Series. They have the added feature of being extremely effective in the control of line to line as well as line to ground RFI interference. They are particularly suited to applications where pulsed, continuous and/or intermittent RFI interference is present. All are recognized by UL. **EF International Series** These filters incorporate the special IEC (International Electrotechnical Commission) connector which complies with all requirements for equipment where a detachable powerline is part of the equipment design. Pin configuration in the connector conforms to proposed European specification of 4 mm. minimum. All electrical specifications are in accordance with IEC, BSI, CSA, VDE and American Standards Association specifications. **R Series** These dual T section RFI powerline filters provide premium performance at moderate cost and are well suited for low impedance loads. At frequencies as low as 150 KHz, the R Series has an insertion loss as high as 45 DB. They control pulsed, continuous and/or intermittent interference, insuring protection of equipment from powerline noise in addition to protecting the line from equipment noise. The dual T type provides extremely low leakage yet without deterioration of insertion loss characteristics. All B, K, EF and R Series Filters are recognized by UL.

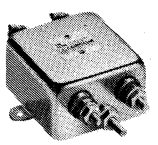

CASE STYLE B1 and K1

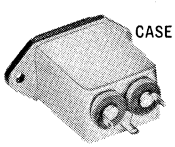
CASE STYLE B2 and K2

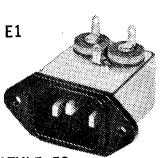

CASE STYLE B3 and K3

CASE STYLE B4 and K4

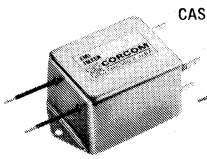

CASE STYLE B5 and K5

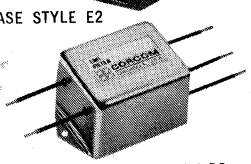

CASE STYLE B6 and K6

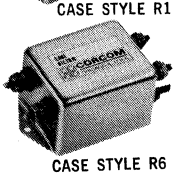

CASE STYLE E1

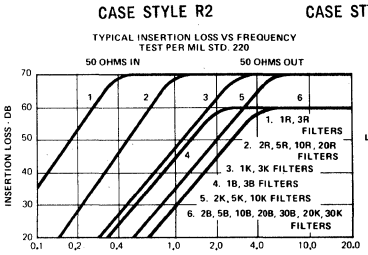

CASE STYLE E2

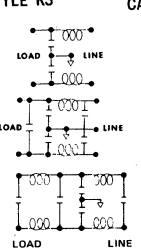
CASE STYLE R1


CASE STYLE R2


CASE STYLE R3


CASE STYLE R6





specifications	B & K Series	EF Series	R Series
Rated Voltage	115/250 VAC	115/250 VAC	115/250 VAC
Maximum leakage current, each line to ground @ 115 VAC 60 Hz	.5 MA	.25 MA	.5 MA
Capacitance line to ground	10,000 pfd	5,000 pfd	10,000 pfd
Operating Frequency	50-400 Hz	50-400 Hz	50-400 Hz
High Pot Test	2,100 VDC	2,100 VDC	2,100 VDC

Model No.	Case Style	Size L x W x H	Maximum Line Current	List Price
1B1	B1	2.50 x 2.25 x .65″	1 amp	$5.85
1B2	B2	2.50 x 1.56 x .65″	1 amp	5.95
1B3	B3	2.50 x .94 x .65″	1 amp	6.05
1B4	B4	2.00 x 2.50 x .75″	1 amp	6.70
1B5	B5	2.00 x 1.85 x .75″	1 amp	6.80
2B1	B1	2.50 x 2.25 x .65″	2 amp	5.30
2B2	B2	2.50 x 1.56 x .65″	2 amp	5.35
2B3	B3	2.50 x .94 x .65″	2 amp	5.40
2B4	B4	2.00 x 2.50 x .75″	2 amp	6.05
2B5	B5	2.00 x 1.85 x .75″	2 amp	6.15
3B1	B1	2.50 x 2.60 x .75″	3 amp	6.05
3B2	B2	2.50 x 1.94 x .75″	3 amp	6.15
3B3	B3	2.50 x 1.31 x .75″	3 amp	6.40
3B4	B4	2.00 x 2.75 x .75″	3 amp	6.95
3B5	B5	2.00 x 2.06 x .75″	3 amp	7.05
5B1	B1	2.50 x 2.60 x .75″	5 amp	5.40
5B2	B2	2.50 x 1.94 x .75″	5 amp	5.55
5B3	B3	2.50 x 1.31 x .75″	5 amp	5.70
5B4	B4	2.00 x 2.75 x .75″	5 amp	6.30
5B5	B5	2.00 x 2.06 x .75″	5 amp	6.40
10B1	B1	2.50 x 2.60 x 1.13″	10 amp	5.95
10B2	B2	2.50 x 1.94 x 1.13″	10 amp	6.05
10B3	B3	2.50 x 1.31 x 1.13″	10 amp	6.15
10B4	B4	2.00 x 2.75 x 1.13″	10 amp	6.80
10B5	B5	2.00 x 2.16 x 1.13″	10 amp	6.95
10B6	B6	2.50 x 2.57 x 1.13″	10 amp	7.25
20B1	B1	2.78 x 3.35 x 1.13″	20 amp	10.00
20B6	B6	2.78 x 3.38 x 1.13″	20 amp	11.25
30B6	B6	4.12 x 5.13 x 1.50″	30 amp	20.00
1K1	K1	2.78 x 3.13 x .875″	1 amp	$6.85
1K2	K2	2.78 x 2.47 x .875″	1 amp	6.95
1K3	K3	2.78 x 1.81 x .875″	1 amp	7.05
1K4	K4	2.00 x 2.75 x .875″	1 amp	7.70
1K5	K5	2.00 x 2.06 x .875″	1 amp	7.80
2K1	K1	2.78 x 3.13 x .875″	2 amp	6.30
2K2	K2	2.78 x 2.47 x .875″	2 amp	6.35
2K3	K3	2.78 x 1.81 x .875″	2 amp	6.40
2K4	K4	2.00 x 2.75 x .875″	2 amp	7.05
2K5	K5	2.00 x 2.06 x .875″	2 amp	7.15
3K1	K1	2.78 x 3.13 x 1.13″	3 amp	7.05
3K2	K2	2.78 x 2.47 x 1.13″	3 amp	7.15
3K3	K3	2.78 x 1.81 x 1.13″	3 amp	7.40
3K4	K4	2.00 x 2.75 x 1.13″	3 amp	7.95
3K5	K5	2.00 x 2.06 x 1.13″	3 amp	8.05
5K1	K1	2.78 x 3.13 x 1.13″	5 amp	6.40
5K2	K2	2.78 x 2.47 x 1.13″	5 amp	6.55
5K3	K3	2.78 x 1.81 x 1.13″	5 amp	6.70
5K4	K4	2.00 x 2.75 x 1.13″	5 amp	7.30
5K5	K5	2.00 x 2.06 x 1.13″	5 amp	7.40
10K1	K1	2.78 x 3.38 x 1.13″	10 amp	6.95
10K2	K2	2.78 x 2.72 x 1.13″	10 amp	7.05
10K3	K3	2.78 x 2.06 x 1.13″	10 amp	7.15
10K6	K6	2.78 x 3.25 x 1.13″	10 amp	8.25
20K6	K6	3.32 x 3.38 x 1.55″	20 amp	12.25
30K6	K6	4.12 x 5.13 x 1.50″	30 amp	21.00
1EF1	E1	1.97 x 1.97 x .79″	1 amp	$9.75
3EF1	E1	1.97 x 1.97 x .79″	3 amp	9.00
6EF1	E1	1.97 x 1.97 x .79″	6 amp	8.25
1EF2	E2	1.97 x 1.55 x 1.31″	1 amp	9.75
3EF2	E2	1.97 x 1.55 x 1.31″	3 amp	9.00
6EF2	E2	1.97 x 1.55 x 1.31″	6 amp	8.25
1R1	R1	3.38 x 1.75 x 1.13″	1 amp	$10.80
1R2	R2	3.06 x 1.75 x 1.13″	1 amp	10.90
1R3	R3	2.75 x 1.75 x 1.13″	1 amp	11.00
2R1	R1	3.38 x 1.75 x 1.13″	2 amp	10.25
2R2	R2	3.06 x 1.75 x 1.13″	2 amp	10.35
2R3	R3	2.75 x 1.75 x 1.13″	2 amp	10.45
3R1	R1	3.88 x 2.00 x 1.13″	3 amp	11.00
3R2	R2	3.56 x 2.00 x 1.13″	3 amp	11.10
3R3	R3	3.32 x 2.00 x 1.13″	3 amp	11.30
5R1	R1	3.88 x 2.00 x 1.13″	5 amp	10.35
5R2	R2	3.56 x 2.00 x 1.13″	5 amp	10.45
5R3	R3	3.32 x 2.00 x 1.13″	5 amp	10.65
10R1	R1	3.88 x 2.00 x 1.50″	10 amp	10.90
10R2	R2	3.56 x 2.00 x 1.50″	10 amp	11.00
10R3	R3	3.32 x 2.00 x 1.50″	10 amp	11.10
10R6	R6	3.75 x 2.00 x 1.50″	10 amp	12.10
20R1	R1	3.88 x 2.00 x 1.50″	20 amp	22.75
20R6	R6	5.13 x 4.12 x 1.50″	20 amp	24.00

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CDE CORNELL-DUBILIER

EMI Filters and Services

EMI/EMC SYSTEMS ENGINEERING SERVICES

Test facilities are available in New Bedford, Mass., and Venice, Calif., which provide all aspects of EMI/EMC systems engineering services to customers. Included in these programs are the following services, required to execute an effective EMI/EMC systems implementation:

- **Preparation of EMI/EMC Control Plans.**
- **Establishment of administrative channels for EMI/EMC implementation required to coordinate the EMC requirement within larger programs.**
- **Design Review Service and Recommendations to assure that proper design considerations are incorporated in the equipment.**
- **Test plans to document the design and test methods required for system EMC.**
- **Development and Qualification Test programs designed to provide factual evaluation of compliance with design goals and/or compliance with:**

MIL-STD-461A/462/463	*FCC Rules*
MIL-STD-826A	*MIL-I-6181D*
VDE0875/8:66	*MIL-I-16910C*
VDE0875/7:71	*MIL-I-26600*
BRITISH STD 800:1954	*Other Source Documents*

FIELD SERVICES:
In addition to the systems test services within the shielded test facilities of CDE, field test and engineering services are available to provide evaluation and validation of actual installations. Applications for field test services have included in-flight, ground, shipboard and facility Electromagnetic Compatibility tests; R. F. Field Patterns; Field Ambient Surveys; Shielding Efficiency Validation of shielded enclosures, and certification/evaluation of Industrial-Scientific and Medical (ISM) facilities (and equipment) to the FCC Rules and Regulations.

CORNELL DUBILIER
EMI/EMC Test Facilities and Engineering Services are available at:
1605 Rodney French Blvd.,
New Bedford, Mass. 02744
(617) 996-8561
and
13376 Beach Avenue
Venice, Calif. 90291
(213) 821-5001

For additional Filter engineering literature, write to Filter Manager, Cornell-Dubilier, 150 Avenue L, Newark, New Jersey 07101.

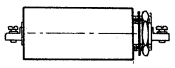
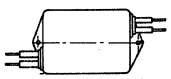
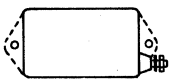
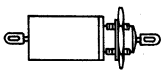
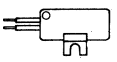
CDE CORNELL-DUBILIER **150 Avenue L, Newark, N. J. 07101**

CDE CORNELL-DUBILIER

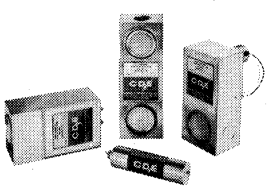
EMI Filters and Services

In many applications, standard filters may be used to suppress interference and achieve electromagnetic compatibility. For other applications, custom designed filters can be supplied.

In all instances, compliance with EMC specification requirements should be verified by suppression testing.

					
	NFR-A	**NF10431 Series**	**NF**	**NFT**	**IF Series**
Current Range	1 thru 50 Amp	2 x 3.5 Amp 2 x 3.9 Amp	1 thru 10 Amp	10, 15 Amp	Various
Circuit Configuration	Pi	Pi, L	Pi	Feed-thru	Various
Voltage Rating	250 VAC 600 VDC	280 VAC/DC	250 VAC 600 VDC	100 VDCW 600 VDCW	277 VAC 115 VAC
Line Frequency	60Hz	60 Hz	60Hz	—	—
Typical Insertion Loss		(NF10431-12)			
@ 150KHz	60db	10db	50db	—	—
@ .6MHz	75db	34db	60db	—	—
@ 1.0MHz	80+db	46db	60db	—	—
@ 100MHz	80+db	—	60db	—	—
@ 1GHz	80+db	—	60db	—	—
UL Listed	Yes	Yes	No	No	Yes
CDE Catalog Class Number	220.40	220.10	220.50	220.30	220.05

COMMUNICATION & SIGNAL LINE FILTERS



Cornell-Dubilier Communication and Signal Line Filters are designed for use in telephone, teletype, and digital communication networks for the purpose of making possible secure communication installations in accordance with the security requirements of DCA RED/BLACK ENGINEERING — INSTALLATION CRITERIA (U) per DCA CIR C175-6A.

Through the application of the SDS 940 computer system in conjunction with unique network synthesis and analysis capabilities Cornell-Dubilier Electronics is able to offer a product line consistent with minimum cost and optimum size and electrical characteristics.

Due to the vast number of different applications, each having unique physical and electrical requirements, only a few of the many types of security communication filters have been shown.

Notes:

1. The CDFS Series is a high reliability filter designed to meet the applicable portions of MIL-F-17533/MIL-F-18327 for metal encased, hermetically sealed units.
2. Exterior finish is fused electro-tin-plate.
3. Operating temperature range is rated at —55°C to 85°C.
4. Case temperature rise is less than 20°C.
5. Insulation resistance is in excess of the requirements of paragraph 3.11 of MIL-F-15733E.
6. Dielectric withstanding voltage may be tested in accordance with paragraph 4.6.5 of MIL-F-15733E.

Listing of Model Numbers

CDE No.	Cut-off Freq. (kHz)	Impedance (ohms)	Circuit	Attenuation (db)			Current (Amps) Max.	Voltage VDC	Voltage Drop Max.
				14kHz	150kHz	1MHz			
CDFS1001	4	300	Single	60	—	—	.15	600	4
CDFS1002	4	300	Single	60	—	—	.15	600	4
CDFS1003	18	600	Balanced	—	70	—	.5	400	3
CDFS1004	3	600	Balanced	100	—	—	.5	400	6
CDFS1005	5	600	Balanced	—	100	—	.5	400	5
CDFS1006	18	600	Balanced	—	70	—	.5	400	3
CDFS1007	3	600	Balanced	100	—	—	.5	400	6
CDFS1008	5	600	Balanced	—	100	—	.5	400	5
CDFS1009	3	300	Single	100	—	—	.5	400	6
CDFS1010	18	300	Single	—	—	80	.15	600	1
CDFS1011	7	600	Balanced	100	—	—	.5	600	6
CDFS1012	7	300	Single	80	—	—	.5	300	6
CDFS1013	7	600	Balanced	100	—	—	.5	600	6
★CDFS1015	N/A	600	Balanced	100	100	100	5.0	250 VAC	2

★Due to the required 5 ampere ratings on many sensing circuits, the CDFS1015 is designed to accommodate this current without damage to the filter.

For additional Filter engineering literature, write to Filter Manager, 150 Avenue L, Newark, New Jersey 07101.

CDE CORNELL-DUBILIER 150 Avenue L. Newark. N. J. 07101

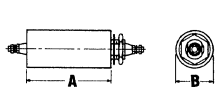
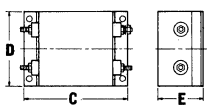
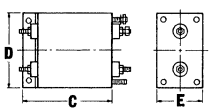
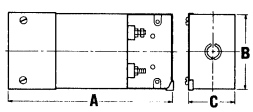
CDE CORNELL-DUBILIER

EMI Filters and Services

EDPF FILTER SERIES

The EDPF Series of EMI Filters (U.L. Listed, file #E41576B) is a uniquely standardized design approach to EMI Filter hardware that provides prompt service to the user in terms of selection and product availability.

SELECTION CHART

				
	Single Circuit Tubular Size	Two Circuit Three Circuit Four Circuit Open Terminal Style	Two Circuit Three Circuit Four Circuit Bulkhead Style	Two Circuit Three Circuit Four Circuit Enclosed Terminal Style
VOLTAGE	250 VAC	250 VAC	250 VAC	250 VAC
FREQUENCY	50 or 60 CPS	50 or 60 CPS	50 or 60 CPS	50 or 60 CPS
CURRENT RATINGS	1 to 50 Amps	1 to 50 Amps	1 to 50 Amps in 2 Circuits 10 to 200 Amps in 3 & 4 Circuits	1 to 50 Amps in 2 Circuits 10 to 200 Amps in 3 & 4 Circuits
DIMENSIONAL RANGE	A 2″ to 8″ B 1″ to 2.5″	D 2.25″ to 24.00″ C 3.25″ to 26.75″ E 1.50″ to 6.00″	D 2.25″ to 24.00″ C 2.75″ to 25.75″ E 1.50″ to 6.00″	B 2.38″ to 24.13″ A 5.25″ to 32.75″ C 1.56″ to 6.06″
CIRCUIT CONFIGURATIONS	L, π, T, 2L, 2T	L, π, T, 2L, 2T	L, π, T, 2L, 2T	L, π, T, 2L, 2T
INSERTION LOSS	Curves 1 through 9 published in the EDPF Catalogue are plotted per MIL STD 220 A impedance settings and plotted in a "Real World" impedance setting.			

The CDE publication, *EMC Compatibility Solution,* details the electrical and mechanical parameters of the entire series. In general, the needs of the EDP industry seemed best served by five standard circuit configurations; four basic combinations of circuits, in four standard packages:

Circuit configurations:

"L" circuit
"π" (pi) circuit — BAL. L (European)
"T" circuit — BAL. T (European)
2 L circuits — BAL. 2L (European)
2 T circuits

Circuit combinations:

single circuit
2 circuits—normally used for single phase applications
Three circuits—used for both single phase and three phase applications
Four circuits—used for three phase plus neutral coil applications

Mechanical configuration:

single circuit—tubular
two, three and four circuit units:
open terminal
or bulkhead mount
or enclosed terminal

The tubular and bulkhead mounted mechanical configurations can be supplied with either a capacitor or an inductor input, as defined by the user. The open terminal and enclosed terminal configurations can be oriented with respect to input, as needed.

Insertion loss has been diagrammed two ways—within a Mil-Standard 220A (under load) condition and within a typical impedance setting for primary circuits. The assumptions for the latter were, a source impedance of .001 ohms, and load impedance determined by the voltage and current rating of the filter. Note that the EDPF series is rated 250 VAC. (Example: a 50 amp circuit yields a 5 ohm load; 250 VAC/50 amps = 5 ohms.) The "real world" condition further takes into account saturation within the inductors due to current flow.

It has been typical to specify filter **voltage drop** assuming the load to be purely resistive—which is rarely encountered. Therefore, the EDPF series is designed with voltage drop not exceeding 1 per cent of rated voltage—at full rated current—and having a lagging power of .8 to 1.0.

For additional Filter engineering literature, write to Filter Manager, Cornell-Dubilier, 150 Avenue L, Newark, New Jersey 07101.

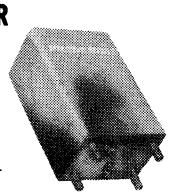
CDE CORNELL-DUBILIER 150 Avenue L, Newark, N. J. 07101

DATA DELAY DEVICES

253 CROOKS AVE., CLIFTON, N.J. 07011 Tel. (201) 772-1106

SHORT FORM CATALOG

STANDARD LINE & INTERSTAGE FILTER



FEATURES

- Hermetically sealed, metal case.
- Meet or exceed MIL-18327C
- Customized units available on request.

HIGH – PASS

PART NO.	PASS-BAND (<6db) HZ & ABOVE	STOP BAND MIN. db @ HZ	IMP. IN / OUT	CASE NO.
1120H-40A	40	33 26.5 42 20.0	600	3
1120H-200A	200	38 133 42 100	600	3
1120H-300A	300	40 200 50 150	600	3
1120H-500A	500	40 333 50 250	600	3
1120H-1000A	1000	40 667 50 500	600	3
1120H-50E	50	33 33 42 25	10K	3
1120H-100E	100	38 66.7 42 50.0	10K	3
1120H-200E	200	38 133 42 100	10K	3
1120H-300E	300	38 200 42 150	10K	3
1120H-400E	400	38 267 42 200	10K	3
1120H-500E	500	38 330 42 250	10K	3
1120H-800E	800	38 533 42 400	10K	3
1120H-1000E	1000	38 667 42 500	10K	3
1120H-2000E	2000	38 1330 42 1000	10K	3
1120H-3000E	3000	38 2000 42 1500	10K	3

LOW – PASS

PART NO.	PASS-BAND (<6db) HZ & BELOW	STOP BAND MIN. db @ HZ	IMP. IN / OUT	CASE NO.
1120L-200E	200	30 300 40 330	10K	1
1120L-300E	300	30 450 40 495	10K	1
1120L-500E	500	30 750 40 830	10K	1
1120L-600E	600	30 900 40 990	10K	1
1120L-1000E	1000	30 1500 40 1660	10K	1
1120L-3000E	3000	30 4500 40 4950	10K	1

BAND – PASS) (HIGH QUALITY)

PART NO.	fc (HZ)	PASS-BAND (.1db)	STOP-BAND MIN. db @ HZ	IMP. IN/OUT	CASE NO.
1120BP-1,500P	1,500	1,000 - 2,000 Hz.	40 60 - 4,000 Hz.	2,000	4
1120BP-2,700P	2,700	1,400 - 5,500 Hz.	40 400 - 9,000 Hz.	2,000	4
1120BP-3,000P	3,000	2,000 - 4,000 Hz	40 400 - 7,000 Hz.	2,000	4
1120BP-3,300P	3,300	500 - 20,000 Hz	40 60 - 40,000 Hz.	2,000	4
1120BP-5,000P	5,000	500 - 50,000 Hz	40 60 - 100,000 Hz.	2,000	4
1120BP-6,000P	6,000	4,000 - 8,000 Hz	40 400 - 15,000 Hz.	2,000	4
1120BP-11,000P	11,000	8,000 - 16,000 Hz	40 400 - 32,000 Hz.	2,000	4

BAND – PASS

PART NO.	fc (HZ)	PASS-BAND (2db)	STOP-BAND MIN. db @ HZ	IMP. IN/OUT	CASE NO.
1120BP-230E	230	175 - 285	27 87 - 570	10K	3
1120BP-340E	340	285 - 395	36 140 - 800	10K	2
1120BP-450E	450	395 - 505	36 195 - 1000	10K	2
1120BP-1050E	1050	995 - 1105	30 750 - 1500	10K	3

CASE NO.	CASE DIMENSIONS					
	L.	W.	H.	STUDS	CUT-OUT	MOUNTING DIM.
3	1-11/16	1-3/16	2-1/2	6-32 x 3/8	3/4" Dia.	1-1/4 x 3/4
2	1-11/16	1-3/16	1-5/8	6-32 x 3/8	3/4" Dia.	1-1/4 x 3/4
1	1.00	1.00	1-11/32	4-40 x 3/8	SEE BASE SKETCH	
4	2-3/16	1-13/16	2-9/16	6-32 x 3/8	3/4" Dia.	1-1/2 x 1-1/8

LOW PROFILE FILTERS

CASE Metal flat case to reduce hum pick-up.

PINS Straight pins for PC mounting.

NOTE Filters with other requirements than shown can be supplied. Our technical staff is ready to give you prompt service.

LOW-PASS

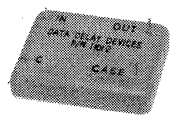
PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1101-1	10K	DC to 460Hz	600Hz	40db above 750Hz	1
1101-2	600	DC to 3KHz	3.4KHz	40db above 4.2KHz	1
1101-3	10K	DC to 4.4KHz	5KHz	43db above 6.3KHz	2
1101-4	1K	DC to 9KHz	10KHz	43db above 12.8KHz	1
1101-5	600	DC to 15KHz	18KHz	43db above 23KHz	1
1101-6	600	DC to 43KHz	50KHz	43db above 64KHz	2

HIGH-PASS

PART NO.	Imp. IN/OUT	PASS-BAND (1db)	PASS-BAND (3db)	STOP-BAND	CASE NO.
1102-1	10K	300Hz & above	200Hz	40db below 140Hz	1
1102-2	10K	600Hz & above	400Hz	40db below 280Hz	1
1102-3	10K	1.2KHz & above	800Hz	40db below 560Hz	1
1102-4	10K	3KHz & above	2KHz	40db below 1.4KHz	2
1102-5	10K	6KHz & above	4KHz	40db below 2.8KHz	2

BROAD BAND-PASS

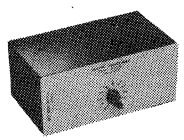
PART NO.	Imp. IN/OUT	PASS-BAND	STOP-BAND (36db) BELOW	STOP-BAND (36db) ABOVE	CASE NO.
1103-1	10K	1KHz to 2KHz	0.5KHz	4KHz	3
1103-2	10K	2KHz to 4KHz	1KHz	8KHz	3
1103-3	10K	4KHz to 8KHz	2KHz	16KHz	3
1103-4	10K	10KHz to 20KHz	5KHz	40KHz	4



MIL SPECS

These filters meet MIL-F-18327C specs. Grade 6, Class R, Life X.

DECADE INDUCTORS



DESCRIPTION

For audio and low frequencies. Used in prototype, lab. standards, wave filters, equalizers, tuned circuits and related applications. Switches are Make before Break and constructed of ceramic stator-and-rotor members with ball-and-socket detent. Contacts silver alloy.

SPECIFICATIONS

ACCURACY: ± .25% at 1KHZ (other freq. on request). DC RESISTANCE: Approx. 40 ohms per H. TEMPERATURE COEFFICIENT: ± 26 PPM/°C between 16°C and 32°C. MAX. VOLTAGE: 130 VRMS. MAXIMUM CURRENT:*. TERMINALS: Type 400 soldering lugs on .75 spacing. Type 1400 jack-top binding posts on standard .75 in. spacing. CASE DIMENSIONS: Type 400 8 x 3.5 x 4 (20.32 x 8.89 x 10.16 cm) Max. Type 1400 16.75 x 8.25 x 5.5 (42.54 x 20.32 x 13.97 cm) max. INDUCTANCE CHANGE WITH AC CURRENT:* INCREMENTAL INDUCTANCE:*.

*See catalog sheet on Decade Inductors.

TABLE I

TYPE	TOTAL IND.	IND. INCR.
400A	1mhy	0.1mhy
B	10mhy	1mhy
C	0.1mhy	.01hy
D	1hy	0.1hy
E	10hy	1hy
1400A	1.11hy	0.1mhy
B	11.11hy	1mhy

TABLE II

SWITCH SETTING	0.1 % INCR.	RMS I_1 (ma.) 0.25% INCREASE			
	400A	400B	400C	400D	400E
1	131	25	8.0	2.6	0.80
2 to 4	100	18	5.0	1.5	0.6
5 to 10	60	10	3.0	1.0	0.3

TOROIDS

DESCRIPTION

Exhibit the highest "Q" in the freq. range of 0.1 KHz to 1 MHz. Potted, miniature, temperature stable, and low cost. Matched units available.

SPECIFICATIONS

INDUCTANCE RANGE: 0.050 MH to 36 H. DC or AC VARIATION EXCITATION:* "Q" FACTOR: 250 Max.*. INSULATION RESISTANCE: Terminals to case 10,000 meg. at 100 VDC. TEMPERATURE COEFFICIENT: ± 18 PPM/°C from -55°C to +85°C. MULTIPLE TAPS: available. ACCURACY: ± 1% or ± .25%.

*See bulletin No. 90.

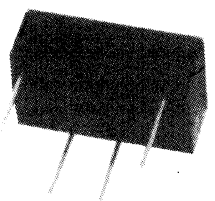
PART NO. COIL DES.	IND. MH @ 10 KHz	RDC OHMS	CD (PF)	MAX. (MA)	PART NO. COIL DES.	IND. MH @ 10 KHz	RDC OHMS	CD (PF)	MAX. (MA)
3D-90T-1	.05 ± 2.5%	.8	13	78	3D-90T-17	.86 ± 1.0%	7.1	22	40
3D-90T-2	.06 ± 2.5%	.9	13	78	3D-90T-18	1.0 ± 1.0%	7.8	24	40
3D-90T-3	.072 ± 2.5%	1.0	14	78	3D-90T-19	1.2 ± 1.0%	8.2	26	40
3D-90T-4	.086 ± 2.5%	1.05	14	78	3D-90T-20	1.5 ± 1.0%	11.0	27	31
3D-90T-5	.10 ± 2.5%	1.1	15	78	3D-90T-21	1.75 ± 1.0%	11.7	27	31
3D-90T-6	.12 ± 2.5%	1.25	16	78	3D-90T-22	2.0 ± 1.0%	12.8	28	31
3D-90T-7	.15 ± 2.5%	1.7	17	55	3D-90T-23	2.4 ± 1.0%	14.0	30	31
3D-90T-8	.175 ± 2.5%	2.0	17	55	3D-90T-24	3.0 ± 1.0%	18.7	30	25
3D-90T-9	.20 ± 1.5%	2.2	18	55	3D-90T-25	3.6 ± 1.0%	20.6	28	25
3D-90T-10	.24 ± 1.5%	2.4	18	55	3D-90T-26	4.3 ± 1.0%	22.6	32	25
3D-90T-11	.30 ± 1.5%	2.7	19	55	3D-90T-27	5.0 ± 1.0%	30.0	33	20
3D-90T-12	.36 ± 1.5%	2.9	19	55	3D-90T-28	6.0 ± 1.0%	33.6	34	20
3D-90T-13	.43 ± 1.5%	3.2	20	55	3D-90T-29	7.2 ± 1.0%	39.6	35	20
3D-90T-14	.50 ± 1.5%	4.4	20	47	3D-90T-30	8.6 ± 1.0%	50.5	38	16
3D-90T-15	.60 ± 1.5%	5.0	21	47	3D-90T-31	10.0 ± 1.0%	54.5	38	16
3D-90T-16	.72 ± 1.5%	5.4	21	47					

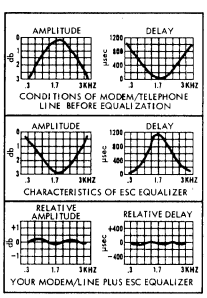
ESC YOUR BEST SOURCE FOR FILTERS DESIGNED TO MEET YOUR NEEDS

- Low Pass
- Band Reject
- RC
- Phase Matched
- Compromise Phase Delay
- High Pass
- Wideband
- Linear Phase
- Attenuation Matched
- Band Pass
- Audio
- Constant Group Delay
- Low Transient Response
- Attenuation Equalizers

ESC Dual-In-Line Filters

Five series of filters, three low pass and two high pass filters are listed in this catalog available upon request. A bandpass filter can be formed by tandem connection of a lowpass and highpass (minimum bandwidth is one octave). Full specification for attenuation and typical characteristics such as phase shift, group delay and pulse response are presented in catalog. Frequency range covers 1 Khz to 10 Mhz and Impedance from 50Ω to 5000Ω. Epoxy cast in DAP cases, size is only .46 x .76 x .25.

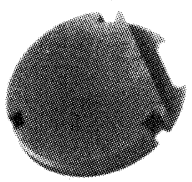




ESC Compromise Equalizers for Telephone Line Modem Designers

ESC produces custom designed compromise equalizers for modem manufacturers to correct for transmission line and modem produced amplitude and phase (delay) distortion. Equalization allows modem sets to be used at highest possible rates with minimum distortion. Contact ESC for your specific requirement.

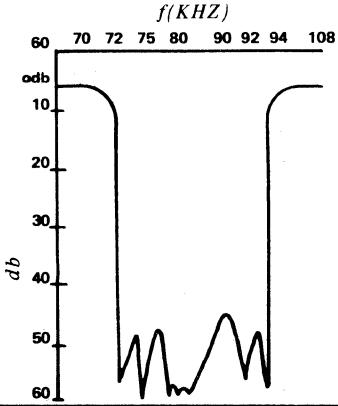
Sonar Filters in Phase and Amplitude Matched Sets

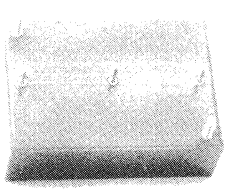


Linear phase bandpass and lowpass filters, with phase and amplitude matched passbands. Matching can be accomplished for any number of channels; generally three filters made a set, but as many as 900 have been phase and amplitude matched. ESC produces filters for Sonobuoys and audio comb analyzers.

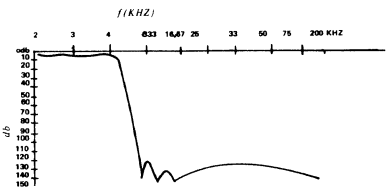
High Speed Data Modem Filters in 60 Khz 108 Khz Range

ESC produces a series of lowpass, bandpass and band suppression filters for use in high speed (150 Kbps) data modems. Filters have very sharp attenuation characteristics and are made in compact size for PC board capability.





Toll Free 800-631-0853 except N.J.

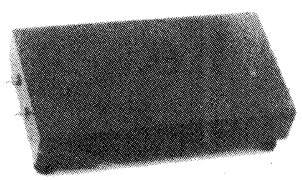


140 db Aircraft Radio Low Pass Filter

Provide 140 db attenuation of harmonic frequencies in audio band. Filters have controlled minimum phase shift, are miniature in size and fabricated in mu-metal cases for minimum external magnetic pickup. Size is only 1.2 x 1.0 x .58.

ESC Telephone Line Simulators

ESC Simulators are passive, stable LC Networks. They provide voice-band data system users with nominal worst case conditions of amplitude and envelope delay of Bell Telephone voice bandwidth data channel 3002 and C1, C2 and C4 conditioning. ESC will also design simulators to satisfy other custom requirements. Write for ESC Brochure on Telephone Line Simulators.

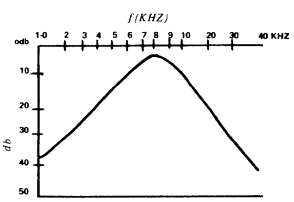


70 MHz Bandpass Filters for Modem and Microwave Links

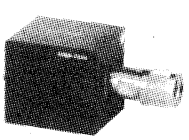
ESC produces 70 Mhz bandpass filters with 3db bandwidth in the range of 5% to 70% of 70 Mhz center frequency. Filters have a minimum group delay error and sharp attenuation response, typically with a ratio of 40db/3db bandwidth of 3:1.

High Reliability Miniature Filter to NASA Requirements

Filter is intended for use in equipment where extreme environmental conditions are encountered. Components in filter meet high-rel NASA requirement NPC 200-3.



Broad Band Video Transformers



Series of extended wide band transformers covering frequency ranges up to 8 MHz. Applications include impedance matching, interstage coupling, phase inversion, and elimination of ground loop problems encountered in video transmission. See photo and write for more details

The filters described above represent only a small segment of our total design capability. ESC also designs and manufacturers, typically. . .

Video	Fixed programmable and mechanically-variable delay lines for the TV broadcast industry, including video cable simulators and voltage variable delay lines.
Hi-Rel	Proven design, manufacturing capabilities, and facilities encompassing all quality levels dictated by MIL-I-45208 and MIL-Q-9858A.
Sonar	Delay lines used in beam forming systems. These units are manufactured to precision tolerances and are supplied in matched sets or groups.
ATC	Precision tapped delay lines for Air Trafic Control systems of all types, IFF, Beacon Systems, Tacan, Vortac, etc.

ESC ELECTRONICS CORPORATION

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Looking for electromagnetic delay lines? See our ad in section 2350.EEM

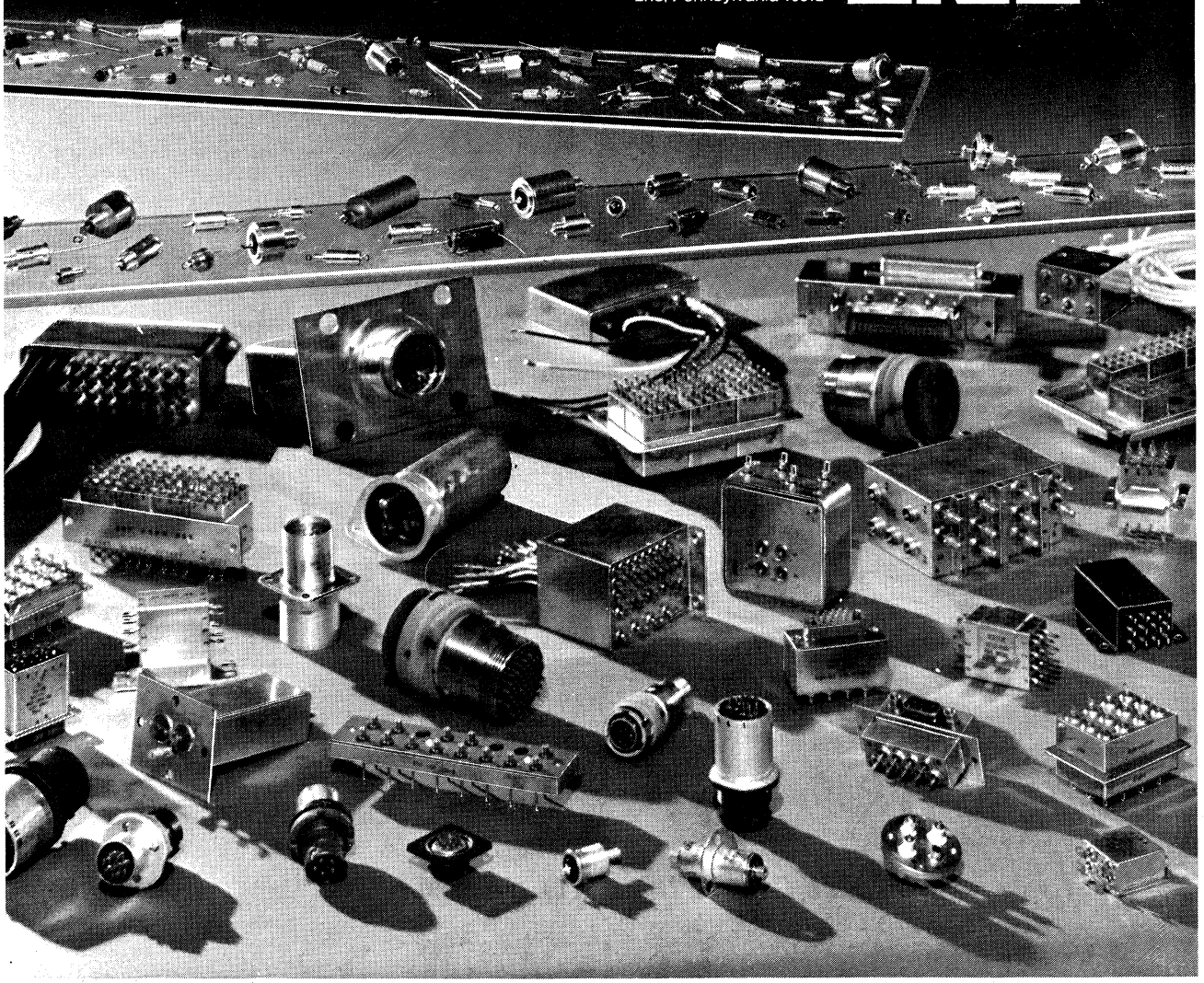
EMI FILTER
CAPITAL OF THE WORLD

FROM CERAMIC POWDER TO MIL-APPROVED TEST LAB...
ERIE HAS IT ALL, UNDER ONE ROOF

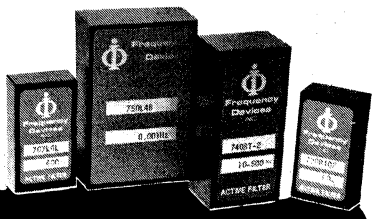
Only one company can deliver your total EMI Ceramic Filter needs . . . ERIE. We've been applying sophisticated ceramic and related technologies to developing superior filters for 35 years. Today ERIE has, by far, the broadest line of subminiature EMI Filters in the world. From tiny high frequency filters to broad band filters to custom filter assemblies, ERIE offers the ultimate in quality. And you get single-source responsibility too, for we build the complete filter in a plant devoted exclusively to the design and manufacture of EMI Filters. So come to ERIE for your filter needs. We'll put a team to work on your particular application. Aerospace. Communications. Avionics. Industrial Equipment. Whatever the market, we can help eliminate electromagnetic "noise" and emissions. In the meantime, write for our complete catalog . . . EMI Filters or call 613/392-2581.

ERIE TECHNOLOGICAL PRODUCTS, INC.
Erie, Pennsylvania 16512

ERIE



FREQUENCY DEVICES, INC.
signal conditioning modules



ACTIVE FILTERS SERIES 700

A to D Pre-Filtering
Geophysical and Meteorological Data Reduction
Noise Reduction
Contiguous Comb Filter
Demodulation Filter
Phase Lock Control
Avoid Aliasing Errors

High performance Active Filters offer Bessel, Butterworth, and Tchebyscheff transfer functions in 2—, 4—, and 6—pole designs. Low pass, high pass, band pass, and band reject models available. Filters are unity-gain, non-inverting.

Wide Frequency Range: .001Hz to 20KHz.

Low Drift: Δf_c <0.05/°C; Offset Drift: 30μV/°C.

Z_{in} to 1MΩ ; Z_{out} = 1Ω; Insertion Loss = .02db; Noise = 50μVrms.

CUSTOM DESIGNS include 1— to 8—pole transfer functions; non-standard transfer function (Cauer, Paynter, etc.) including cascaded characteristics; adjustable gains (to 40db); f_c drift to .01%/°C; or other features to meet the needs of a given application.

RESISTIVE TUNEABLE ACTIVE FILTERS SERIES 730

A to D Pre-Filtering
Vibration Analysis
Voltage to Frequency Conversion
Time Delay Filters
Test Instrumentation

Four-pole low pass filters with externally tuneable cutoff frequencies. High performance maintained over a 50:1 tuning range, slightly degraded performance over 500:1 range. Tuned with 4 equal external resistors.

Butterworth and Bessel Responses.

Covers range from 0.1Hz to 50KHz; Frequency drift to .01%/°C.

$Z_{in} = 10^9\Omega$; $Z_{out} = 1\Omega$; Insertion Loss = .02db.

RESISTIVE TUNEABLE ACTIVE FILTERS SERIES 760

Contiguous Comb Filters
Vibrations Studies
RMS Measurements
Harmonic Analysis
Noise Reduction
Waveform Purifier

Four-pole bandpass filters with externally tuneable center frequencies. An adjustment range of up to 1000:1 is achieved by switching in sets of four identical tuning resistors.

Butterworth response

Q's of 5 and 10

Covers range from 0.05Hz to 20KHz

$Z_{in} = 10^5\Omega$; $Z_{out} = 1\Omega$

Passband gain preset to unity, externally variable from 0 to 10

VOLTAGE TUNEABLE ACTIVE FILTERS SERIES 300

Spectrum Analysis
Adaptive/Tracking Filter
Frequency/Phase Locked Loops
Automatic Test Instrumentation
Sinewave VCO with Quadrature Outputs
Bandwidth Control

Versatile two-pole active filters which are tuneable over a 20:1 frequency range by application of a control voltage. Simultaneous low, high and band pass outputs are provided. Operational without external components, but gain or Q may be varied with a single resistor. Five models cover the range from 0.1Hz to 20KHz.

Linear tuning (1%).

Z_{in} = 100KΩ ; Z_{out} = 10Ω ; Insertion Loss = 0.2db.

PRECISION SINEWAVE OSCILLATORS WITH QUADRATURE OUTPUTS SERIES 400

Distortion Testing
Stable Frequency Reference
Resolver Excitation
Quadrature Mod/Demod
Arbitrary Reference Angles
Production Testing

A modular oscillator providing very low distortion (.04%) and two outputs in quadrature (90° ± 0.1°). Performance rivals expensive instruments at a fraction of the price. Fixed frequency models available from 1Hz to 20KHz (externally trimmable ±10%). Tuneable models externally variable over 1000:1 range.

Output amplitudes variable over 20db range (with resistor or voltage) with both outputs tracking to .01% over this range.

Low Frequency Drift (.01%/°C).

Spurious Noise (—85db).

Output Amplitude Ratio tracks to .001db/°C.

PRECISION RESISTIVE TUNEABLE OSCILLATORS SERIES 440

Electronic Musical Instruments
Production Testing
Arbitrary Ref. Angle Gen.
Quadrature Servo Ref.
Computer Controlled Oscillator

Modular resistive tuneable oscillators featuring low distortion (0.08%), quadrature buffered outputs 90° ± 0.1° out of phase with amplitude tracking to better than 100ppm/°C. Externally variable over 1000:1 range.

Low Frequency Drift (0.01%/°C)

Spurious Noise (—85db)

Adjustable Output Amplitudes (>20db)

Frequency Range (.05Hz to 20KHz)

MODULAR POWER SUPPLIES and DC/DC CONVERTERS

PC Board Mounting
Digital Logic Power Source
Transducer Power Source

Modular power supplies and DC/DC converters designed for PC board mounting. Featuring short circuit protection, precision regulation and high efficiency.

STANDARD SUPPLIES (INPUT VOLTAGE 105 - 125VAC)
Output Voltage (±15VDC) : 25mA, 50mA, 100mA
: 200mA, 300mA
Output Voltage (5VDC) : 1A

STANDARD CONVERTERS (5 or 12VDC to ±15 VDC)
Current : 25mA, 100mA

FAST DELIVERY: 2 Weeks ARO on Standards.
FUNCTION MODULES AND CUSTOM MODIFICATIONS AVAILABLE

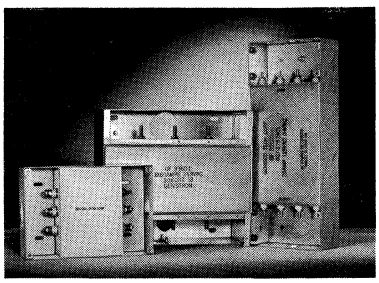
FREQUENCY DEVICES, INC. • 25 LOCUST STREET • HAVERHILL, MASS. 01830 • (617) 372-6930

Noise pollution problems got you perplexed?

Get with Genisco's filter knowhow for the right answer.

Almost 20 years of technological leadership in design, fabrication and testing takes the guesswork out of getting "best-fit" filters at economically feasible costs.

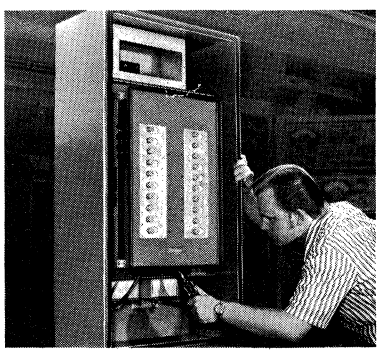
COMPUTER-PERIPHERAL RFI/EMI FILTERS



These heavy duty units have been awarded both UL and VDE* recognition. They encompass a wide range of ratings: 10-to-100A/115-to-480VAC from DC to 400Hz. Their unique circuitry has been specifically developed to interface with stringent "clocking frequency" requirements. They feature a dielectric strength of approximately 10 times the rated line-to-ground voltage; a voltage drop of less than 1% of the line-to-ground voltage at power frequency; continuous duty operation to +85°C; low leakage—5.0mA, max.; insertion loss vs. frequency range of 1-to-100MHz. They come in single or multi-circuit configurations.

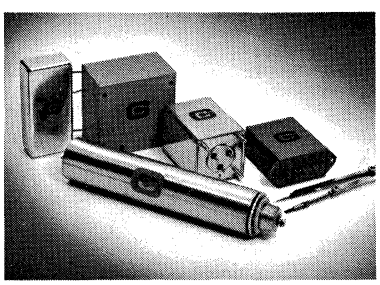
*Verband Deutscher Electrotechniker

HEAVY DUTY POWER-LINE FILTERS



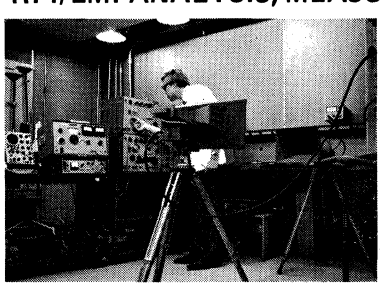
Tailored to specific requirements, using computer-aided design and advanced inductor and capacitor technologies, Genisco Power-Line Filter Assemblies provide optimum long-term dependable performance under stringent "real world" conditions. They're designed, built and tested to meet or exceed DCA/NEMA enclosure and MIL-F-15733 filter requirements as well as other applicable equipment specs. They are available with current ratings to 1,000 Amps and voltage ratings to 480V RMS (0 to 400Hz). They can be provided with circuit breakers and/or electronic surge arrestors in single and multi-filter shielded enclosure configurations. These assemblies provide over 100 dB isolation from 14 KHz through 1,000 MHz, and operate over a temperature range of -55 to +65°C.

HIGH-EFFICIENCY SIGNAL LINE FILTERS



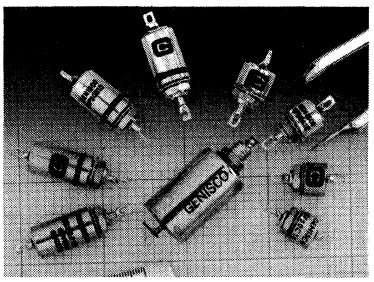
Packaged in a broad assortment of MIL-spec hermetic cases, they serve in such varied land line communication applications as telephone, teletype, carrier current, data-phone and computer link filtering systems. Their transmission loss, in the pass-band, is 1 dB or less. They also feature isolation of over 100 dB at frequencies ranging from 14KHz to 1.0GHz. Although designed for balanced transmission line systems, they still operate efficiently with mis-matches of as much as 2 to 1. Single or dual-line versions are available. These units meet applicable requirements of MIL-F-18327 and MIL-F-15733.

RFI/EMI ANALYSIS, MEASUREMENT, ENGINEERING SERVICES



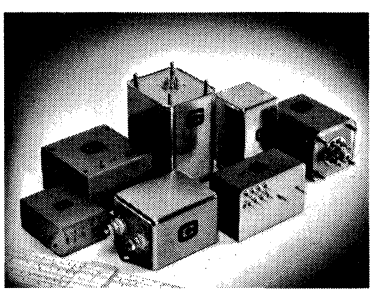
Genistron's long-term leadership in RF and EM interference technology, coupled with the most extensive independent test and evaluation facilities of their kind in the U.S., results in faster, more accurate and economical solutions to your noise interference compatibility problems. The all-inclusive service is conduced by experts in the RFI/EMI field using the latest in precision instrumentation as well as measurement and computer analysis techniques. Tests are conducted in a specially designed 4-room "screen room" suite. Contact us for a sample procedure and cost evaluation quotation.

RFI/EMI MINI-FILTERS



Make the most of your miniaturized filtering designs' performance with Genisco MINI-FILTERS. You'll not only save on space and costs, but also worries about long-term reliability. They're available from stock to assure fast deliveries. They come in a wide range of current handling values—from 10mA-to-10 Amps; and four voltage ratings—50, 100 or 200VDC and +28VAC (up to 400Hz). You can choose from 4 standard circuits—the "L", that's low in cost yet has excellent rejection capabilities; the "2L", which has the sharpest cut-offs and more low-frequency attenuation; "π" capacitive and "T" resistive input types, and their hermetically sealed cases meet MIL-F-15733. They operate from -55 up to +125°C.

WAVE FILTERS



All of Genisco's expertise has been employed to provide a broad spectrum of precision wave filtering units that are relatively inexpensive. They include a wide range of both high and low pass, as well as band-reject and band-pass types; single side-band; RF, AF and IF; equalizing and harmonic types; linear-phase units; telemetering, telegraph tone, and band-elimination types. These wave filters meet or exceed the requirements of MIL-F-18327 and the quality standards of MIL-Q-9858 as well as NASA's NPC 200-3. Their hermetically sealed cases conform to MIL-F-18327. Many of the types have Federal Stock Number assignments.

GENISCO TECHNOLOGY CORPORATION / GENISTRON DIVISION
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THE GUDEMAN CORPORATION
capacitors and EMI filters
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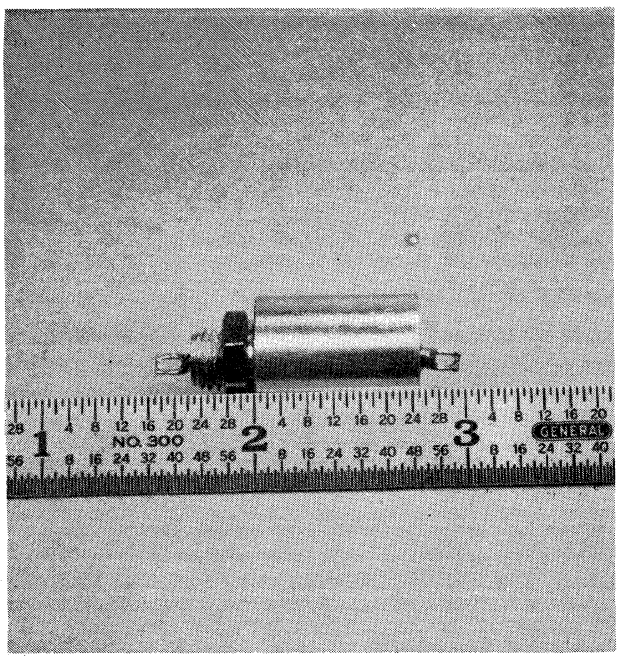
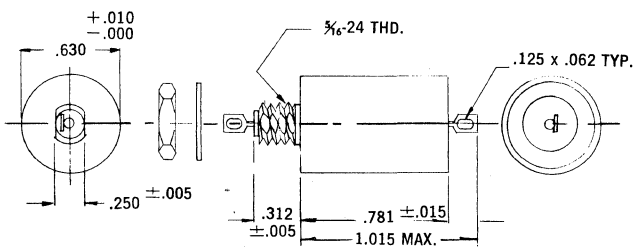
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

EMI and RFI FILTERS
polycarbonate dielectric
L type miniature filters



polycarbonate dielectric
L type miniature filter



specifications 64L6- /64RL6-* series

115 VAC 0-400 Hz, 250 VDC
500 VDC Dielectric Withstanding Voltage
1000 Megohm Minimum @ 250 VDC Insulation Resistance
−55°C to +105°C Operating Temperature
Meets or exceeds all applicable requirements of MIL-F-15733
*R in part number denotes capacitor at threaded end.

polycarbonate dielectric versus ceramic is ultimately superior for A/C applications

The **Gudeman Corporation** manufactures a full line of military and commercial EMI and RFI filters to meet the needs of most custom requirements.

Military types are designed to meet or exceed the applicable requirements of MIL-F-15733E. Commercial types to Underwriters Laboratories requirements or the customers individual specifications.

In addition to the popular tubular and bathtub style case configurations, the **Gudeman Corporation** offers case styles and mounting means custom designed to take full advantage of the volume and form factor available for that "special application."

ENGINEERING SERVICES
Please feel free to consult our application engineering department without obligation, for assistance on any problem relating to the design, use or application of low pass filters.

TESTING SERVICES
The **Gudeman Corporation** has complete facilities for testing equipment for radiated or conducted EMI to FCC regulations, at a very low cost.

Dash No.	Current (amps)	Insertion Loss (DB) MIL-STD-220A, Full Load					
		30 KHz	150 KHz	300 KHz	1 MHz	10 MHz	1000 MHz
-06	.06	20	50	60	70	70	70
-1	1		30	42	60	70	70
-2	2		22	30	50	70	70
-3	3		20	25	45	65	70
-5	5		15	22	35	60	70
-10	10		12	20	30	50	70

NOTE: Other currents (amps) and configurations (π & T) available upon request. Other tube sizes (.41 o.d.) available.

hisonic inc.

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PHONE: 913-782-0012

TELEX: 4-2562

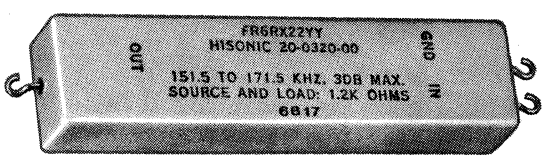
STANDARD FILTERS

FOR HIGHEST SELECTIVITY

Standard filters are computer designed by modern network methods for minimum stop to pass band ratios. Applications are those requiring optimum utilization of frequency spectrum.

CUSTOM FILTERS

Low, band or high pass and band stop filters with optimum amplitude and/or delay characteristics can be supplied to your special requirements and MIL-F-18327. Construction utilizes precision inductors and high quality capacitors of special films or silvered mica, according to frequency and space requirements. Operating frequencies range to 50 MHZ. Temperature stabilization for both amplitude and frequency can be effected. Mechanical styles may be epoxy encapsulated or hermetically sealed metal in sizes from 0.2 to 200 cu. in.



EXAMPLE CUSTOM FILTERS

BAND PASS

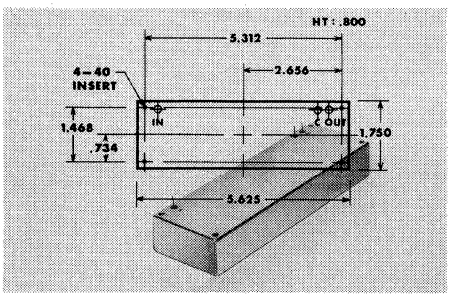
P/N		Pass Band db @ BW	Stop Band db @ BW	Impedance	Size
20-0340-xx	Series; f_0 .8-7.5KHZ	.15@1.0f_0	25@1.75f_0	2.7K/2.7K	1.3x3.0x1.0H
20-0450-xx	Series; f_0 4.5-7.1KHZ	4.0@98HZ	26@258HZ	600/600	1.5x3.6x1.0H
20-0521-12	f_0 9960HZ; IL .4db	1.0@1460HZ	35@4000HZ	2K/500	2.5x2.5x.7H
20-0501-10	f_0 30KHZ; IL .5db	.25@20KHZ	40@+30KHZ −24.7KHZ	4.7K/4.7K	1.4x2.0x.6H
20-0481-11	f_0 40KHZ; IL .5db	3.0@24KHZ	30@+50KHZ −27KHZ	4.7K/4.7K	1.1x1.9x.6H
20-0177-10	f_0 142KHZ; IL 20db	3.0@3.0KHZ	70@20KHZ	5K/470	1.8x2.0x.9H
20-0299-10	f_0 155KHZ; IL 3db	1.2@56.6KHZ	40@+120KHZ −80KHZ	1K/1K	1.3x1.4x.8H
20-0410-xx	Series; f_0 200-500KHZ	3.0@.10f_0	60@.85f_0	1K/1K	1.3x2.8x1.1H
20-0466-10	f_0 5.5MHZ; IL 4db	.5@40KHZ	40@980KHZ 65@1980KHZ	600/600	1.0x2.3x.7H
20-0527-10	f_0 10MHZ; IL 5db	.3@320KHZ	45@4.0MHZ	600/600	1.3x1.8x.9H
20-0459-10	f_0 11.8MHZ; IL 4db	2.0@1.0MHZ	50@+1.0MHZ −1.6MHZ	50/50	.6x3.2x1.0H
20-0539-10	f_0 30MHZ; IL 8db	.3@.64MHZ	20@3.2MHZ 30@6.2MHZ	500/500	1.4x2.0x.6H

LOW & HIGH PASS & BAND SUPPRESSION

P/N	Description	db@Abs.Freq.			Size
20-0212-10	200HZ Low Pass	3@185HZ	60@430HZ	1K/1K	1.0x1.7x1.5H
20-0388-xx	IRIG TELEM. VCO LP f_0 Range 4-70KHZ	1@1.07f_0	20@1.8f_0 36@2.8f_0	Source 18K Load 47K	.5x.8x.8H
20-0350-10	High Atten. LP	3@500HZ	105@1000HZ	1K/100K	.6x3.5x1.0H
20-0519-10	Voice Low Pass	5@2500HZ	40@4000HZ	600/600	1.3x1.8x.9H
20-0342-10	Voice Low Pass	1@3000HZ	40@3400HZ	600/600	1.5x4.0x1.1H
20-0475-10	Voice Low Pass	3@3500HZ	40@4500HZ	600/600	2.0x2.0x.5H
20-0414-10	Low Pass	.4@24.5KHZ	61@40KHZ	1K/1K	1.0x2.0x.5H
20-0399-10	Low Pass	.25@25KHZ	65@50KHZ	10K/10K	1.0x1.0x1.1H
20-0280-01 -02	Instrumentation LP W/BNC Connectors	3@500KHZ 3@1.2MHZ	18/Octave 18/Octave	75/75 75/75	1.3x1.3x1.0H 1.3x1.3x1.0H
20-0529-10	Video Range LP	1@4MHZ	40@5.5MHZ	200/200	1.3x2.0x.5H
20-0489-10	300HZ High Pass	3@300HZ	20@250HZ	200/6K	1.0x1.5x.5H
20-0473-00	Balanced High Pass	.5@1400HZ	50@750HZ	600/600	Field Test Case
20-0325-10	Speech+Tone Suppress	3@1.0&1.6KHZ	40@1.2−1.3KHZ	600/600	2.8x3.0x1.0H
20-0460-10	Band Suppression	.3@552&667KHZ	50@605−609KHZ	75/75	1.4x2.0x2.0H
20-0159-11	Band Suppression	.3@7.4&9.8MHZ	50@8.47−8.56MHZ	75/75	1.4x2.0x2.0H

DUAL FUNCTION FILTERS & SPECIAL NETWORKS

P/N	Description	Characteristics	Impedance	Size
20-0488-13	Isolated LPF &Video range XFMR	.6db@1.5MHZ,14db@2.5MHZ 3db .1 to 5 MHZ	200/200 200/200	.8x.8x.4H
20-0343-10	Common input voice LP & Signal BP Filter	1db@3KHZ,35db@3.4KHZ $f_0$3.4KHZ,6db@150HZ BW	600/600 Com/50K	2.5x4.0x1.1H
20-0232-10	Common input Voice LP & Signal BP Filter	1db@3.4KHZ,35db@3.8KHZ f_0 3.8KHZ,2db@20HZ BW	600/600 Com/50K	2.5x4.0x1.1H
20-0486-10	90/150HZ Glide/Slope Dual BP Filter	.25db@85−95HZ,20DB@50&150HZ .25db@142−158HZ;20DB@90&250HZ	1K/10K Com/10K	2.3x2.4x1.7H
20-0405-10	Isolated Dual Dis-symetrical BP Filter	3db2.1−2.5KHZ,30db@3.7KHZ 3db3.7−4.1KHZ,30db@2.8KHZ	1K/10K 1K/10K	1.6x1.9x.8H
20-0217-10	Common Input, Dual Narrow BP Filter	f_0 269KHZ,55db@63KHZ BW f_0 331KHZ,55db@75KHZ BW	1K/10K Com/10K	2.0x4.0x.7H
20-0463-11	Twin Tee RC Network	56db min @ 130 HZ	82/5M	1.6x1.6x.6H
20-0463-12	Twin Tee RC Network	56db min @ 140 HZ	82/5M	1.6x1.6x.6H
20-0412-11	Audio Delay Equalizer	90 us correction@2KHZ;Bal.Imp.	600/600	.9x1.3x1.0H
20-0478-10	Phase Shift Network	160±5 degrees 3−90KHZ	50/2K/2K	1.4x2.3x1.4H



SERIES 430 FSK TONE CHANNEL

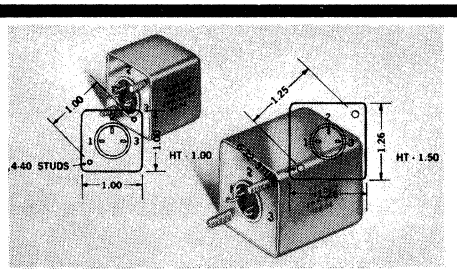
BAND PASS

(170HZ spacing)

SPECIFICATIONS:

Relative Attenuation	Freq.	Receiver No.	Trans. No.
(Receive Filters)	425	430-01	430-21
3 db max at ± 42.5 cps	595	430-02	430-22
20 db min at ± 85 cps	765	430-03	430-23
38 db min at ± 128 cps	935	430-04	430-24
(Transmit Filters)	1105	430-05	430-25
3 db max at ± 42.5 cps	1275	430-06	430-26
15 db min at ± 85 cps	1445	430-07	430-27
30 db min at ± 128 cps	1615	430-08	430-28
	1785	430-09	430-29
Insertion Loss−6 db max	1955	430-10	430-30
	2125	430-11	430-31
Terminations	2295	430-12	430-32
Input: 600 ohms	2465	430-13	430-33
(inputs all channels may	2635	430-14	430-34
be operated in parallel)	2805	430-15	430-35
Output: Receive 50K ohms	2975	430-16	430-36
Transmit 600 ohms	3145	430-17	430-37
	3315	430-18	430-38

In addition to series listed, other tone channel series with spacings from 85 to 500 c/s are available.



SERIES 68 MINIATURE LOW PASS

SPECIFICATIONS:

Relative Attenuation 3 db ± .5 @ fc	fc cps	Part No.
20 db min @ 1.3 fc	330	68-01
40 db min @ 1.5 fc	450	68-02
	600	68-03
Insertion loss−1 db max	660	68-04
	790	68-05
Terminations	900	68-06
Input−10K ohms	1050	68-07
Output−10K ohms	1200	68-08
	1600	68-09
Physical Specifications	2100	68-10
Case Hermetically Sealed Steel	3000	68-11
Size (330 to 900 cps)	3300	68-12
1.26"x1.26"x1.5" High	4000	68-13
Mounting: two 6-32 studs	4500	68-14
spaced 1.25"	5250	68-15
Size (1050 to 13000 cps)	6000	68-16
1"x1"x1" High	8000	68-17
Mounting: two 4-40 studs	10500	68-18
spaced 1"	11500	68-19
Terminals−3 solder type	13000	68-20

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OTHER PRODUCTS: Precision Inductors • Transformers & Reactors • Tuned Circuits • Amp/Phase Equalizers • Lumped Constant Delay Lines

HOPKINS ENGINEERING CO.

FILTERS

- EMI/RFI Custom
- Power
- Shielded Panelboards
- Signal Communications
- Gen. Purpose Tubular/Rectangular
- UL Data Processing
- Band Pass/Wave
- Special Chokes

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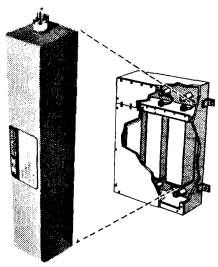
POWER FILTERS

Hopkins Power Line Filters are designed, built and tested to deliver maximum trouble-free continuous service year-after-year. Available as individual power filters, or housed in cabinet assemblies, these units are intended for use in shielded enclosures, secure installation and general power applications. They are available in various current ratings from 1 AMP through 200 AMPS.

1960 Series

The 1960 Series filters furnish 100 DB of attenuation from 14KHZ to 10GHZ when measured in accordance with Mil Standard 220A load conditions.

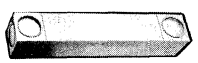


12600 Series

The 12600 Series filters furnish 100 DB of attenuation from 14KHZ to 10GHZ when measured in accordance with Mil Standard 220A. Also measured under full load conditions from 14KHZ to 20MHZ with special buffer networks to allow valid measurements below 100KHZ.

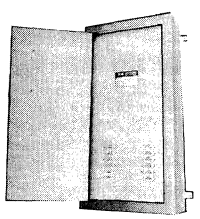
1776 Series and 1620 Series

Filters are also available in single and dual circuit units offering lower performance characteristics when required.

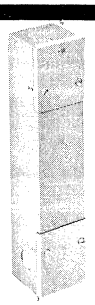


RF SHIELDED & FILTERED CIRCUIT BREAKER PANELBOARD

Hopkins R-F Shielded and Filtered C/B Panelboards are intended for use in installations where secure communication is mandatory. The unique design of these Panelboards maintains shielding integrity with the cabinet door **open**. Designs are available utilizing both the 1960 Series and 12600 Series filters. Circuit Breaker Complement must be specified when ordering.



COMMUNICATIONS/ SIGNAL LINE FILTERS

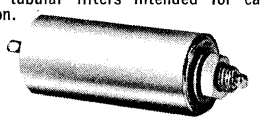


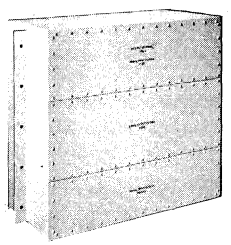
258B-S2

This unit is a Voice and Signal Line Filter offering 100 DB attenuation from 14KHZ to 1GHZ per Mil Standard 220A with outstanding reliability. Originally designed for use in 600 OHM balance system, it has been widely used in other applications such as Secure Communications.

F-4386 & F-4386-1

These Voice and Signal Filters are designed to meet the requirements of DCA Cir 175-6A Application #1. They are single circuit bulkhead mounting tubular filters intended for cabinet installation.





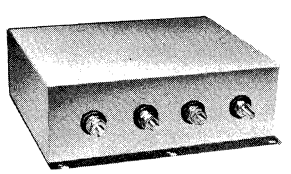
Special cabinet designs are available incorporating any number of the above filters modified for cabinet installation. These units are constructed with an R-F Shielded bulkhead between input and output housings in order to maintain shielding integrity required for secure installations.

UL RECOGNIZED FILTERS FOR DATA PROCESSING EQUIPMENT

The 44 Hopkins RFI Filters designed expressly for data processing equipment provide maximum suppression of Radio Frequency Interference and other extraneous signals detrimental to efficient operation of data processing equipment.

Hopkins RFI Filters are designed and tested to deliver maximum, trouble-free duty for many years.

You will speed production and save both time and money in the manufacture of your data processing equipment when you specify, whenever possible, off-the-shelf Hopkins RFI Filters which are included as recognized components.



The Hopkins line offers the widest selection of RFI filters recognized under the component program of Underwriters' Laboratories, Inc.

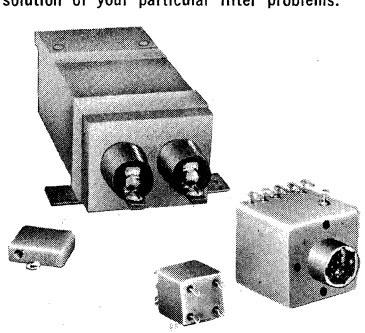
U.L. Yellow Card listings available upon request. Available in various amperage ratings and case styles.

EMI/RFI TESTING SERVICES AVAILABLE

— to determine compliance with military, customer or your individual requirements.

Custom Filters

Hopkins has long been a leader in the design and development of special custom filters to satisfy specific customer requirements. Thousands of designs are on file incorporating all voltage, current ratings and case configurations. Design and performance are verified by computer. Our complete Engineering and Manufacturing Facility is available to assist in the solution of your particular filter problems.



General Purpose Tubular Filters—14000 Series

Intended for use in critical applications where the "feed-thru" characteristic is necessary for good high frequency performance. Available in various circuit configurations from a single element capacitor thru multiple element Pi and T sections. Various performance characteristics are available to allow the user to select the unit best suited to his needs. Typical ratings from 50VDC @ 1 Amp. to 277 VAC @ 50 Amp.

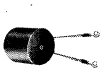
All units designed to meet requirements of MIL-F-15733.

These Units are available mounted in cabinets on special request. Contact Factory.

General Purpose Rectangular Filters—16000 Series

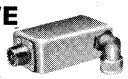
These units are intended to be used where installation is not critical. They are available in one, two and three circuit configuration as well as a wide variety of voltage and current ratings. Various attenuation characteristics allow the user to select the unit best suited to fit his particular needs. Typical ratings are from 50 VDC @ 1 Amp. to 277 VAC @ 50 Amp. All units are designed to meet the requirements of MIL-F-15733.

Electronic Wave Filters utilizing modern network design techniques are available as custom filters upon request.



SPECIAL CHOKES

BAND PASS/WAVE FILTERS



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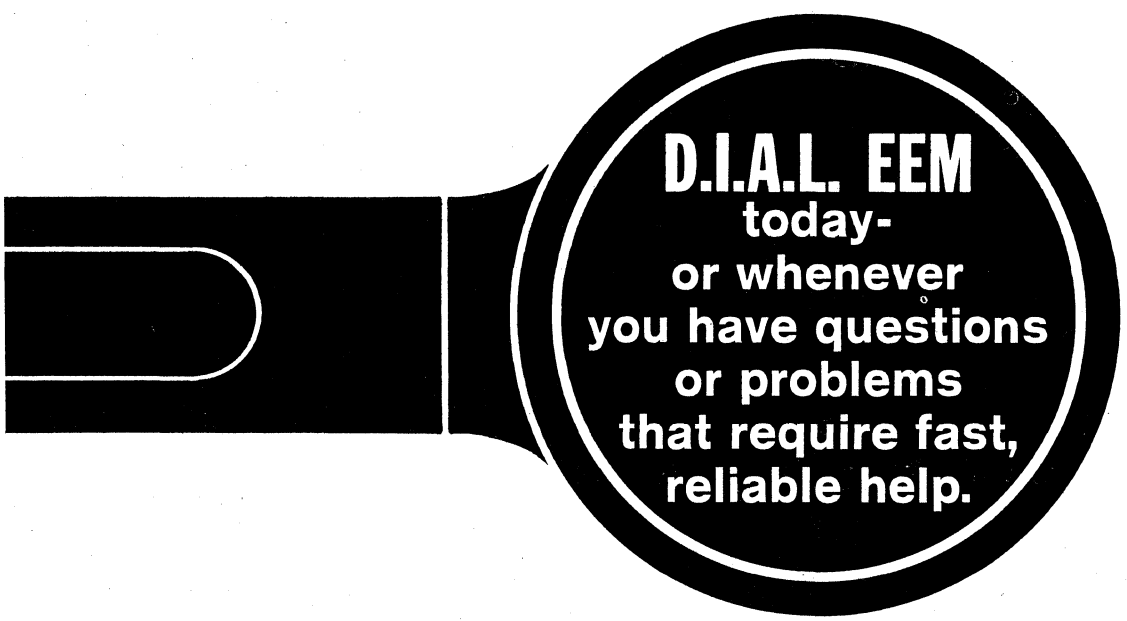

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ITHACO VARIABLE ELECTRONIC FILTERS

STANDARD FEATURES

• FREQUENCY RESPONSE	BUTTERWORTH & BESSEL	• AC COUPLED	IN HIGH-PASS
• ATTENUATION SLOPE	24db/OCTAVE	• OUTPUT LEVEL	20 V P–P
• FREQUENCY ACCURACY	±1%	• NOISE	LESS THAN 50μv
• PHASE ACCURACY	±2°	• INPUT IMPEDANCE	22MΩ
• DC COUPLED	IN LOW-PASS	• OUTPUT IMPEDANCE	50Ω

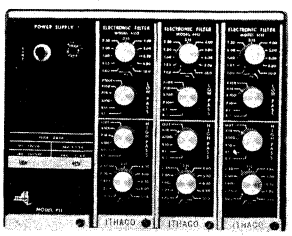
OPTIONS
- BATTERY OPERATION
- REMOTE PREAMPLIFIERS
- FILTER GAIN

MODIFICATIONS
- SPECIAL FREQUENCY RANGES
- SPECIAL FREQUENCY STEPS
- SPECIAL FREQUENCY RESPONSES

SERIES 4110
PLUG–IN VARIABLE ELECTRONIC FILTERS

3 AND 7 CHANNEL MOUNTING CASES

- FILTER FUNCTIONS — HIGH-PASS, LOW-PASS, BAND-PASS
- FREQUENCY RANGE — .01 Hz – 1 MHz
- FREQUENCY STEPS — 1/3 OCTAVE

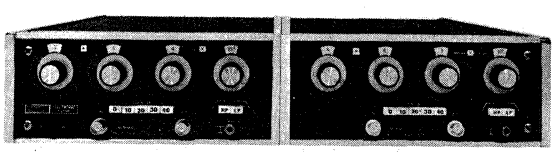


SERIES 4210
LABORATORY FILTERS

- FILTER FUNCTIONS — HIGH-PASS, LOW-PASS, BAND-PASS, BAND-REJECT
- FREQUENCY RANGE — .01 Hz – 1 MHz
- FREQUENCY STEPS — 1/3 OCTAVE

SERIES 4250
HIGH-PASS, LOW-PASS LABORATORY FILTERS

- FILTER FUNCTIONS — HIGH-PASS, LOW-PASS
- FREQUENCY RANGE — .01 Hz – 111 KHz
- FREQUENCY RESOLUTION — 3 DIGIT



DUAL HIGH/LOW-PASS FILTERS

- FILTER FUNCTIONS — BAND-PASS, BAND-REJECT, CASCADED HIGH-PASS OR LOW-PASS
- FREQUENCY RANGE — .01 Hz to 111 KHz
- FREQUENCY RESOLUTION — 3 DIGIT

ITHACO filters provide superior performance and are available in configurations suitable for single or multichannel applications. There is a model ideal for most acoustic, environmental test, geophysical, EW and general research applications. ITHACO also provides amplifiers, racks, power supplies, right up to customer engineered systems (see Section 1100).

ITHACO INC, 735 WEST CLINTON ST, ITHACA N Y 14850 PHONE (607) 272–7640 TWX 510–255–9307

DIP
dual In-line LC filters

UP TO 20 MHz
ON SPECIAL REQUEST!

Kappa's DIP-Filters are housed in a standard dual in-line package for PC board mounting.

DIP-Filters provide the design engineer with a variety of electrical characteristics compatible with high density assemblies on integrated circuit boards.

how to order

- ☐ 1. Enter tables for required stop band.
- ☐ 2. Select standard part number from required cutoff frequency and impedance.
- ☐ 3. Add Suffix L (Lowpass) or H (Highpass).
- ☐ 4. Consult factory for items not shown.

20 db STOPBAND		SPECIFICATIONS	39 db STOPBAND	
LOWPASS (L)	HIGHPASS (H)		LOWPASS (L)	HIGHPASS (H)
< .5 db at .1 Fc	< .5 db at 10 Fc	INSERTION LOSS	< .5 db at .1 Fc	< .5 db at 10 Fc
< ±1 db to Fc	< ±1 db to Fc	RIPPLE	< ±1 db to Fc	< ±1 db to Fc
< 3 db to Fc	< 3 db to Fc	ATTENUATION	< 3 db to Fc	< 3 db to Fc
> 20 db at 1.4 Fc & up	> 20 db at .715 Fc & lower		> 39 db at 2.5 Fc & up	> 39 db at .4 Fc & lower

STANDARD PART NUMBERS

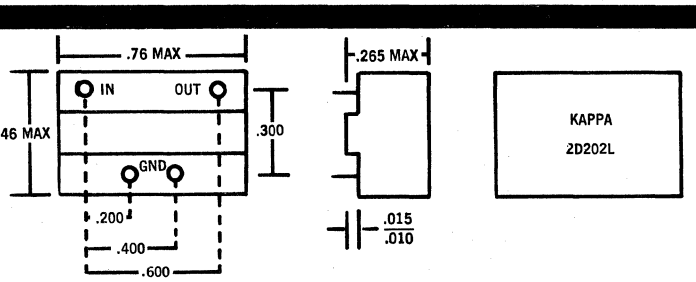
IMPEDANCE (Ω) 50	100	200	500	1K	2K	5K	Cutoff Frequency Fc
							1 KHZ
				1E202			2 KHZ
			1D502	1E502	1F502		5 KHZ
		1C103	1D103	1E103	1F103	1G103	10 KHZ
		1C153	1D153	1E153	1F153	1G153	15 KHZ
	1B203	1C203	1D203	1E203	1F203	1G203	20 KHZ
1A503	1B503	1C503	1D503	1E503	1F503	1G503	50 KHZ
1A104	1B104	1C104	1D104	1E104	1F104	1G104	100 KHZ
1A154	1B154	1C154	1D154	1E154	1F154		150 KHZ
1A204	1B204	1C204	1D204	1E204	1F204		200 KHZ
1A504	1B504	1C504	1D504	1E504	1F504		500 KHZ
1A105	1B105	1C105	1D105				1 MHZ
1A205							2 MHZ

STANDARD PART NUMBERS

IMPEDANCE (Ω) 50	100	200	500	1K	2K	5K
			2D102			
			2D202	2E202		
		2C502	2D502	2E502	2F502	
2A103	2B103	2C103	2D103	2E103	2F103	2G103
2A153	2B153	2C153	2D153	2E153	2F153	2G153
2A203	2B203	2C203	2D203	2E203	2F203	2G203
2A503	2B503	2C503	2D503	2E503	2F503	2G503
2A104	2B104	2C104	2D104	2E104	2F104	2G104
2A154	2B154	2C154	2D154	2E154	2F154	
2A204	2B204	2C204	2D204	2E204	2F204	
2A504	2B504	2C504	2D504	2E504	2F504	
2A105	2B105	2C105	2D105			
2A205						

Case drawing applies to all DIP-filters

Material: Black epoxy
Pins: .020 Tinned copper
.20 length, min.
Weight: ≈ 3 grams
Dip-Filters meet specification MIL-F18327C, Grade 5, Class R, —55°C to +105°C



Kappa NETWORKS, INC.

DELAY LINE SPECIALISTS • ELECTRIC WAVE FILTERS • MANUFACTURING ENGINEERS
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TEL. (201) 541-4226 TWX. 710-998-0489

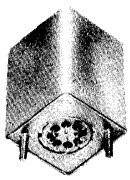
The following examples of **Kappa's** LC filter design capabilities are but a small representation of the broad range of our experience. Through our use of an IBM 360, level 60 computer, output data plotted against frequency including impedance, attenuation, phase, group delay and phase delay can be evaluated to supply an immediate quotation.

We can also computer-check your special filter requirements. Ask for details on our low-cost feasibility reports.

Low Pass • High Pass • Band Pass • Band Reject • Linear Phase • Constant Group Delay • Phase Matched • Attenuation Matched • Phase Equalizers • Delay Equalizers • Attenuation Equalizers • Low Transient Response •

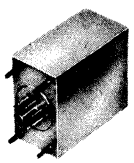
Kappa
the proven leader in computer-designed custom LC filters

LOW PASS FILTERS



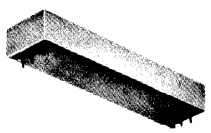
Frequency Range: DC to 50MHz
Impedance Range: 1 ohm to ∞
Stop Bands: 10 to 80db

BAND PASS FILTERS



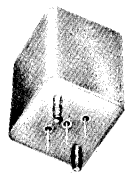
Frequency Range: DC to 50MHz
Bandwith: 1% to >100%
Stopband: 10 to 80db
Impedance Range: 1 ohm to ∞

HIGH PASS FILTERS



Frequency Range: DC to 50MHz
Impedance Range: 1 ohm to ∞
Stop Bands: 10 to 80db

BAND REJECT FILTERS

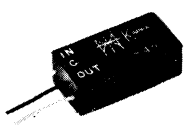


Frequency Range: DC to 50MHz
Band Width: 1% to >100%
Stop Band: 10 to 80db
Impedance Range: 1 to ∞

MATCHED PHASE & ATTENUATION

Typical Specifications:
Phase Matched ±2½% in Pass Band
Attenuation Matched ±.25db in Pass Band for use in Sonar & other multi channel systems.

MAXIMUM FLAT DELAY (BESSEL) FILTER



Size (Typical): .75" x .75" x 1.5"
Frequency Range: 1.5KHz to 1MHz
Z Range: 50 to 10 K
Overshoot: <1%
Delay Flat: <2% to Fc

LINEAR GROUP DELAY VIDEO FILTER

Typical Specifications:
L.P. Cutoff: 4.5 MHz
I.L.: <1db
Passband Ripple: <±.1db
Pass Band Delay Distortion: <25 nsec.
Stopband: >25db

GROUP DELAY & ATTENUATION EQUALIZER NETWORK

To correct system introduced delay distortion & attenuation roll off.

constant group delay filters

Computer-designed and checked to give equal ripple delay over the pass band insuring exact delay and attenuation characteristics.

Frequency Range: DC to 50 MHz
Impedance Range: 1 ohm to ∞
Temperature Range: −55°C to +125°C.
Complete Encapsulation
Hermetic Seal
P.C. Board Construction
Case Configuration:
Stock or Custom Designed
P.C. Card
Dual In-Line
Standard Hardware Program
All filters conform to applicable mil specifications.

Phase & Attenuation Matching

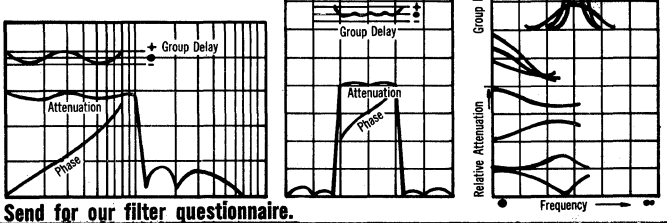
Differential phase and attenuation matched to eliminate the need for adjustments in multi-channeled systems.

Linear Phase Filters

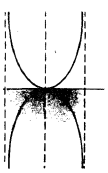
To reduce distortions and lower transient response in modulated systems.

Equalizers

Phase/Delay/Attenuation
Computer-designed correction network derived from system error curves.



Send for our filter questionnaire.



Kappa NETWORKS, INC.

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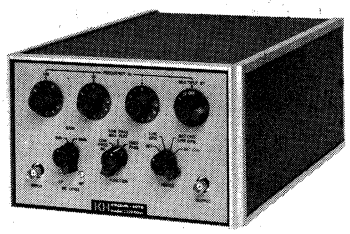
TEL. (201) 541-4226 TWX. 710-998-0489

Variable Electronic Filters

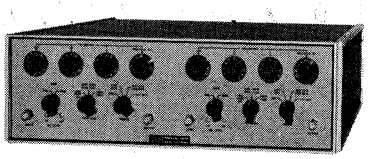
ALL MODELS PROVIDE: • Butterworth or Low Q Response • Odb Insertion Loss • High Input—Low Output Impedance • Low Noise • Floating Operation • Wide Dynamic Range **SOME MODELS INCLUDE:** • Battery Operation • 20 db Gain



Digital Tuned—High Pass, Low Pass

Model	Frequency Range	Atten. Slope db/oct.	Price
3320	0.001Hz to 100kHz	24	$725*
3321	0.01Hz to 100kHz	24	$635*
3340	0.001Hz to 100kHz	48	$1075*
3341	0.01Hz to 100kHz	48	$995*

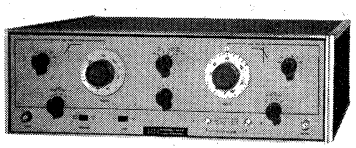
*Battery option add $70.00



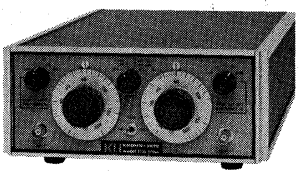
Digital Tuned—Band Pass, Band Reject
High Pass, Low Pass

Model	Frequency Range	Atten. Slope db/oct.	Price
3322	0.001Hz to 100kHz	24/48	$1395*
3323	0.01Hz to 100kHz	24/48	$1225*
3342	0.001Hz to 100kHz	48/96	$2075*
3343	0.01Hz to 100kHz	48/96	$1825*

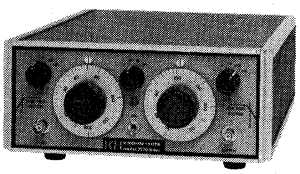
*Battery option add $140.00



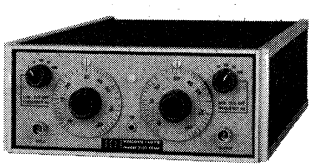
MODEL 3750 $925
Band Pass, Band Reject
High Pass, Low Pass
0.02Hz to 20kHz
6, 12, 18, 24 db/octave slope
Battery option add $140.00



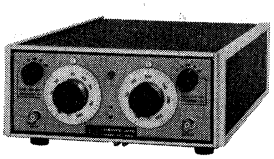
MODEL 3700 $595
Band Pass
0.2Hz to 20kHz
24 db/octave slope
Battery option add $70.00



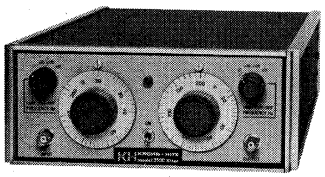
MODEL 3550 $590
Band Pass, Band Reject
High Pass, Low Pass
2Hz to 200kHz
24 db/octave slope



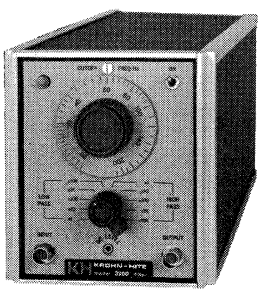
MODEL 3100 $650
Band Pass
10Hz to 1MHz
24 db/octave slope



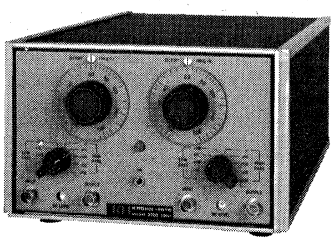
MODEL 3103 $675
Band Pass
10Hz to 3MHz
24 db/octave slope



MODEL 3500 $450
Band Pass
20Hz to 200kHz
24 db/octave slope



MODEL 3200 $450
High Pass, Low Pass
20Hz to 2MHz
24 db/octave slope



MODEL 3202 $795
Band Pass, Band Reject
Low Pass, High Pass
20Hz to 2MHz
24/48 db/octave slope

KROHN-HITE CORPORATION
580 Massachusetts Ave., Cambridge, Mass. 02139, (617) 491-3211, TWX 710-320-6538

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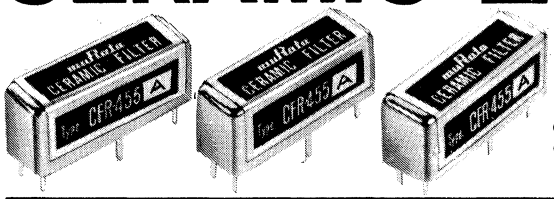
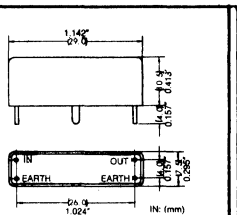
CERAMIC LADDER FILTERS



Murata ceramic ladder filters provide their outstanding performance and selectivity through the use of a piezoelectric effect on leadziroconate — titanate ceramics. Each filter consists of multiple ceramic elements coupled electrically in a ladder network. The various filters listed below differ only in selectivity characteristics and size, both of which depend upon the number of ceramic elements utilized in each type. Complete technical data is available from Murata Corporation of America.

CFS-455
455 KHz PRECISION CERAMIC FILTERS
FOR COMMUNICATIONS RECEIVERS

DIMENSIONS
Terminal Location:
(viewed from bottom, tab down)
Input: Upper Left
Output: Upper Right
Earth: Lower Left and Right

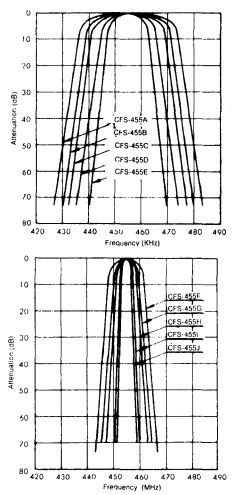


SPECIFICATIONS

MODEL	Center Frequency (KHz)	3dB Band Width (KHz) Min.	6dB Band Width (KHz) Min.	70dB Band Widtn (KHz) Max.	Insertion Loss (dB) Max.	In, Output Impedance (Ω)	Temperature Range (°C)
CFS-455 A	455	±13	±17.5	±30	6	1500	−20 to +80
CFS-455 B	455	±10	±15	±25	6	1500	
CFS-455 C	455	± 9	±13	±23	6	1500	
CFS-455 D	455	± 7	±10	±20	6	1500	
CFS-455 E	455	± 5.5	± 8	±15	8	1500	
CFS-455 F	455	± 4.2	± 6	±12	8	2000	
CFS-455 G	455	—	± 4	± 9	8	2000	
CFS-455 H	455	—	± 3	± 7.5	9	2000	
CFS-455 I	455	—	± 2	± 5	10	2000	
CFS-455 J	455	—	± 1.5	± 4.5	10	2000	

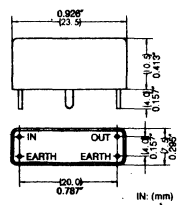
Stability of Center Frequency: Within 0.4% for 10 years Within ±0.3% from −20°C to +80°C

FREQUENCY CHARACTERISTICS



CFR-455
455 KHz STANDARD CERAMIC FILTERS
FOR COMMUNICATIONS RECEIVERS

DIMENSIONS
Terminal Location:
(viewed from bottom, tab down)
Input: Upper Left
Output: Upper Right
Earth: Lower Left and Right

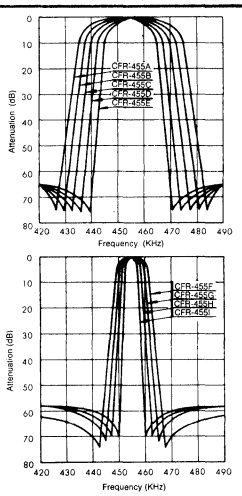


SPECIFICATIONS

MODEL	Center Frequency (KHz)	3dB Band Width (KHz) Min.	6dB Band Width (KHz) Min.	60dB Band Width (KHz) Max.	Spurious (dB) Min.	Insertion Loss (dB) Max.	In, Output Impedance (Ω)	Temperature Range (°C)
CFR-455 A	455	±13	±17.5	±30	45	6	1000	−20 to +80
CFR-455 B	455	±10	±15	±25	45	6	1000	
CFR-455 C	455	± 9	±13	±23	45	6	1000	
CFR-455 D	455	± 7	±10	±20	45	6	1500	
CFR-455 E	455	± 5.5	± 8	±16	40	8	1500	
CFR-455 F	455	± 4.2	± 6	±12	40	8	2000	
CFR-455 G	455	—	± 4	±10	40	8	2000	
CFR-455 H	455	—	± 3	± 7.5	40	9	2000	
CFR-455 I	455	—	± 2	± 5	40	10	2000	

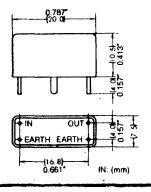
Stability of Center Frequency: Within 0.4% for 10 years Within 0.3% from −20°C to +80°

FREQUENCY CHARACTERISTICS



CFM-455
455 KHz ECONOMY CERAMIC FILTERS
FOR COMMUNICATIONS RECEIVERS

DIMENSIONS
Terminal Location:
(viewed from bottom, tab down)
Input: Upper Left
Output: Upper Right
Earth: Lower Left and Right

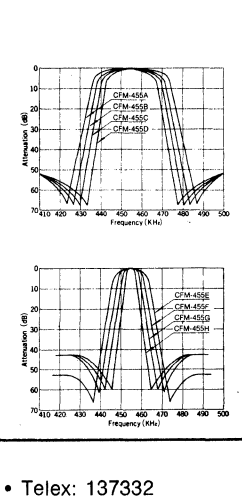


SPECIFICATIONS

MODEL	Center Frequency (KHz)	3dB Band Width (KHz) Min.	6dB Band Width (KHz) Min.	50dB Band Width (KHz) Max.	Spurious (dB) Min.	In, Output Impedance (Ω)	Insertion Loss (dB) Max.	Temperature Range (°C)
CFM-455 A	455	±13	±17.5	±30	40	1000	4.5	−20 to +80
CFM-455 B	455	±10	±15	±25	40	1000	4.5	
CFM-455 C	455	± 9	±13	±23	40	1000	4.5	
CFM-455 D	455	± 7	±10	±20	40	1500	4.5	
CFM-455 E	455	± 5.5	± 8	±16	35	1500	6	
CFM-455 F	455	± 4.2	± 6	±12	30	2000	6	
CFM-455 G	455	—	± 4	±10	30	2000	6	
CFM-455 H	455	—	± 3	± 7.5	30	2000	7.5	

Stability of Center Frequency: Within 0.4% for 10 years Within ±0.3% from −20°C to +80°C

FREQUENCY CHARACTERISTICS



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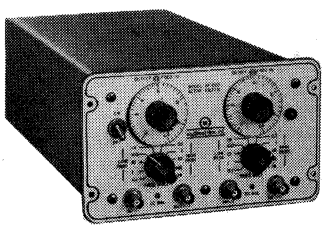
MULTIMETRICS ACTIVE FILTERS

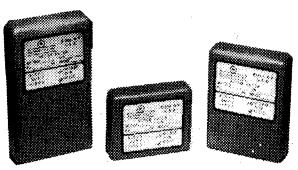
TUNABLE & FIXED 0.001Hz to 2MHz

- Top performance and versatility
- Individual channels are independent High or Low Pass Butterworth Filters
- Interconnected channels are Band Pass, Band Reject or have sharpened attenuation slopes
- Selectable Time Domain response for optimum transient (pulse) behavior
- All units rack mountable
- Quick delivery!

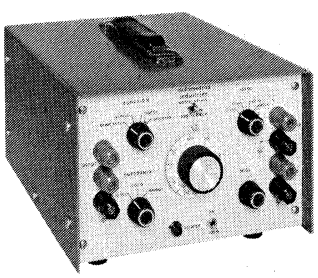


SERIES AF-100, AF-200

20Hz to 2MHz, 0.2Hz to 20kHz; tunable; ruggedly built, low cost package. Designed for a wide range of applications.

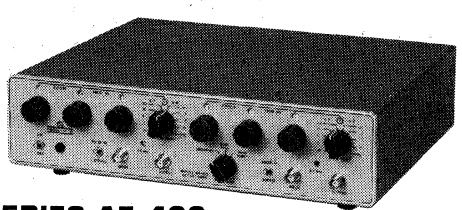


Fixed frequency, mini-sized modules. Low, high, band pass, band reject and notch functions, Butterworth, Chebyschev and elliptic responses. Frequencies from 0.001Hz to 100kHz. Other frequencies, response characteristics and pole configurations available.



SERIES AF-850A

35Hz to 3500Hz; ±1% accuracy; tunable; ideal for notched noise measurements and waveform analysis. Fully compatible with telephone channel transmission measuring techniques and equipment.



SERIES AF-400

0.001Hz to 99.9kHz; digital switch tuning; superb accuracy and stability. 115/230VAC or battery operated.

MODEL	AF-110	AF-120	AF-210	AF-220	AF-410	AF-420	AF-410L	AF-420L	AF-850A
FREQ. RANGE, Hz	20 to 2M		0.2 to 20K		0.01 to 99.9K		0.001 to 9.99K		35 to 3.5K
ACCURACY	±5%		±5%		±2%		±2%		±1%
CHANNELS	1	2	1	2	1	2	1	2	1
TUNING	CONTINUOUS				DIGITAL SWITCH				CONTINUOUS
SLOPE, db/Octave	24 (48 – 2 CHANNELS IN SERIES)								N/A
FUNCTIONS	HP, LP	HP, LP BP, BR	HP, LP	HP, LP BP, BR	HP, LP BYPASS	HP, LP BP, BR BYPASS	HP, LP BYPASS	HP, LP BP, BR BYPASS	BP, BR, BYPASS, GAIN

PASSIVE FILTERS AND NETWORKS – AUDIO FREQUENCY TO VHF
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Subsidiary of COMSTRON CORPORATION
120-30 Jamaica Avenue Richmond Hill, N.Y. 11418 Tel: 212-441-4240

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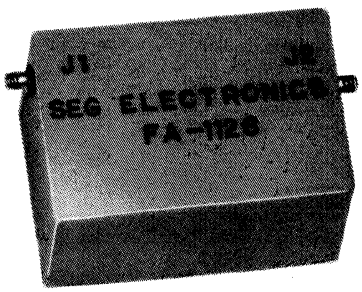
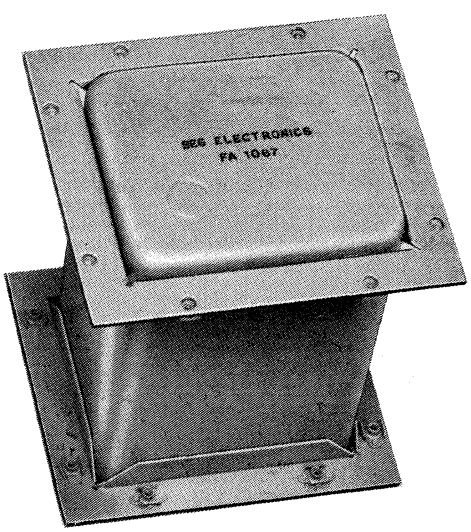
SEG ELECTRONICS CUSTOM FILTERS

BEFORE YOU BUY ANY FILTER CHECK OUR ■ DESIGN ■ DELIVERY ■ PRICE

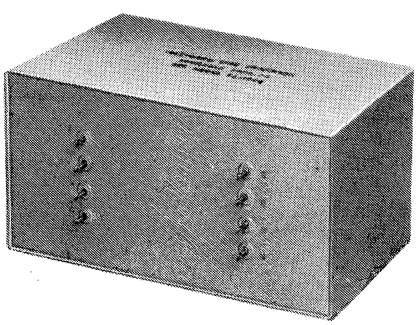




- LC & ACTIVE DC to 120MHz
- Datacom
- Telecom
- Eye Pattern
- Hilbert Transform
- Linear Phase
- High Pass
- Low Pass
- Band Pass
- Band Reject
- Matched
- Equalized
- Transversal
- Time Domain
- FDM
- Optimum
- Thompson
- Butterworth
- Chebyschev
- Cauer
- Bessell
- Elliptic
- Legendre
- Channel Simulation

SEG's on-time delivery of "impossible" filters, from engineering conception to mathematical synthesis, through quality oriented production, satisfies our most demanding customers.

Whatever your needs . . . from spectral shaping and phase correction to time-domain synthesis . . . you can rely on the filter experts at SEG. Computer-aided custom designs from DC to 120MHz with sharp rolloffs or phase correction or narrow bandwidths, all in production quantities with competitive pricing. NAME IT AND SEG WILL DELIVER IT ON SCHEDULE!



TELEPHONE DATA LINE SIMULATOR

Industry standard telephone line simulator. Simulates nominal worst case attenuation and delay per Bell and DCS schedules. Simulates 3002, C1, C2, C4 and DCS-S3. Also available are C-message weighting, F1A weighting, Telephoto, 1 and 2, etc.

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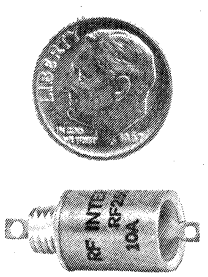
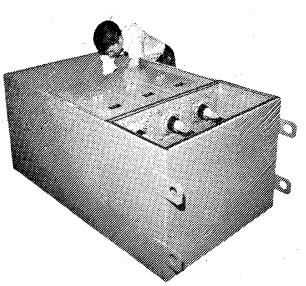
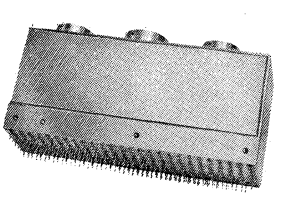
RF INTERONICS
100E Pine Aire Drive • Bay Shore, N.Y. 11706 • (516) 231-6400 • TWX 510-227-6233



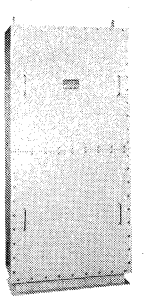
Subminiature "MICRO-FILTER"® for use in power and signal lines rated up to 115 VAC.



Much bigger ones, too. Ratings from 1 milliamp to 2,000 amps; 0.1 volt to 20,000 volts; fractions of an ounce to more than 1,000 lbs.



156 circuit, hermetically sealed high-reliability filter assembly — for use in aircraft data-link equipment.



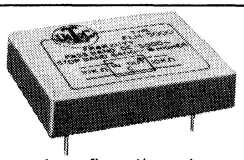
1100 circuit filter cabinet for red/black secure communications.

FILTERS

TRW® UTC TRANSFORMERS

NEW UTC "FLATS"* ELECTRIC WAVE FILTERS

DESIGNED, MANUFACTURED AND SUCCESSFULLY TESTED TO COMPLETE MIL-F-18327C SPECIFICATIONS



These filters meet today's need for flat component configurations, have excellent attenuation characteristics and are ruggedized to Grade 6, MIL-F-18372C. Straight pin terminals and flat construction make these units ideally suited for printed circuit applications. These filters are hermetically sealed in flat metal cases shielded to reduce hum pickup. FP-A Case: 2″ x 2″ x ½″ h., 2.5 oz. FP-B Case: 2″ x 1½″ x ⅜″ h., 2 oz. FP-C Case: 2″ x 1½″ x ½″ h., 2.2 oz.

FHH-200: Flat package high pass filter, source and load 10K ohms. Units are within 1 db up to 300 Hz 3 db ±1 db at 200 Hz, and have an attenuation of at least 40 db at frequencies below 140 Hz. FP-A Case. Mil Type: FR6RX33YY1.

FLH-600: Flat package low pass filter, source and load 10K ohms. Units are within 1 db from DC to 450 Hz, 3 db ±1 db at 600 Hz, and have an attenuation of at least 40 db at frequencies above 800 Hz. FP-A Case. Mil Type: FR6RX11YY1.

FLH-5000: Flat package low pass filter, source and load 10K ohms. Units are within 1 db from DC to 4.2 kHz, 3 db ±1 db at 5 kHz, and have an attenuation of at least 43 db at frequencies above 6400 Hz. FP-B Case. Mil Type: FR6RX11YY1.

FLL-3500: Flat package low pass filter, source and load 600 ohms. Units are within 1 db from DC to 3 kHz, 3 db ±1 db at 3500 Hz, and have an attenuation of at least 40 db at frequencies above 4500 Hz. FP-A Case. Mil Type: FR6RX33YY1.

FLL-18000: Flat package low pass filter, source and load 600 ohms. Units are within 1 db from DC to 15 kHz, 3 db ±1 db at 18 kHz, and have an attenuation of at least 43 db at frequencies above 23 kHz. FP-A Case. Mil Type: FR6RX11YY1.

FLL-50000: Flat package low pass filter, source and load 600 ohms. Units are within 1 db from DC to 42 kHz, 3 db ±1 db at 50 kHz, and have an attenuation of at least 43 db above 64 kHz. FP-B Case. Mil Type: FR6RX11YY1.

FBH-1: Flat package Broad Band Pass Filter has a source and load of 10K ohms. Units are within 3 db from 1 kHz to 2 kHz, and have an attenuation of at least 36 db at frequencies below 500 cps and above 4 kHz. FP-C Case. Mil Type FR6RX22YY1.

FBH-10: Same as FBH-1, except less than 3 db from 10 kHz to 20 kHz, attenuation of at least 36 db below 5 kHz and above 40 kHz.

INTERSTAGE AND LINE FILTERS

Available in stock frequencies listed below (numerical part of type — number is cutoff frequency in Hz). Compact shielded cases hermetically sealed to MIL-F-18327C specs. BMI, LMI, BML Cases: 1 3/16″ x 1 1/16″ x 1 5/8″ h.; wt., 6 oz. HMI, HML, LML Cases: 1 3/16″ x 1 1/16″ x 2½″ h.; wt., 9 oz. The BMI filters are band pass interstage units designed to operate between a vacuum tube plate (or 10,000 ohms) and a grid. They provide a gain of 2 at center frequency. BTI units are same as BMI, but 10,000 ohms output. BML band pass filters, similarly, work into a grid, but have an input impedance of 500/600 ohms. They provide a gain of 9.

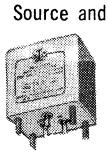
HMI filters are high pass interstage units.

LMI filters are low pass interstage units.

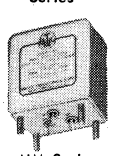
HML filters are high pass with input and output impedance of 500/600 ohms.

LML filters are low pass filters with input and output impedance of 500/600 ohms.

LLP low frequency low pass filter, loss of less than 40 db at 20 Hz. Source and load 100K ohms.



BM & LM Series



HM Series

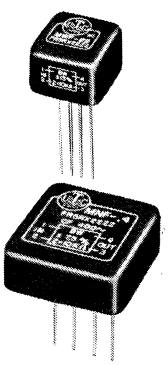
UTC Type	UTC Type	UTC Type	UTC Type	UTC Type
BMI-30	BMI-1000	HMI-100	LMI-50	LMI-5000
BMI-50	BMI-1500	HMI-200	LMI-100	LMI-10000
BMI-60	BMI-2000	HMI-300	LMI-150	LML-500
BMI-90	BMI-3000	HMI-400	LMI-200	LML-1000
BMI-100	BMI-4000	HMI-500	LMI-400	LML-1500
BMI-120	BMI-5000	HMI-800	LMI-500	LML-2000
BMI-150	BMI-10000	HMI-1000	LMI-800	LML-2500
BMI-200	BML-400	HMI-2000	LMI-1000	LML-3000
BMI-240	BML-1000	HMI-3000	LMI-1500	LML-4000
BMI-300		HML-40	LMI-2000	LML-8000
BMI-400	BTI-60	HML-200	LMI-2500	LML-10000
BMI-500	BTI-100	HML-300	LMI-3000	LML-12000
BMI-750	BTI-120	HML-500	LMI-4000	
BMI-800	HMI-50	HML-1000		

MNF/MWF BAND PASS TELE-MINIFILTER™

Both MNF and MWF types are designed for 10K source and load impedance. Low profile and pin terminals make these filters ideally suited for printed circuit applications.

MNF filters are down less than:
3 db. at ±7.5% of Center Frequency.
15 db. at ±25% of Center Frequency.
Attenuation is greater than 40 db. beyond 1.75 x Center Frequency and .58 x Center Frequency.

MWF filters are down less than:
3 db. at ±15% of Center Frequency.
15 db. at ±50% of Center Frequency.
Attenuation is greater than 40 db. beyond 2.5 x Center Frequency and .4 x Center Frequency.



MNF-4 thru MNF-5.4
1 3/16″ sq. x ½″ high
Weight 1 oz.

MNF-7.35 thru MWF-70
23/32″ sq. x ½″ high
Weight ⅓ oz.

UTC Type	Center Frequency kHz	Band Width± (%)
MNF-.4	.4	7½
MNF-.56	.56	7½
MNF-.73	.73	7½
MNF-.96	.96	7½
MNF-1.3	1.3	7½
MNF-1.7	1.7	7½
MNF-2.3	2.3	7½
MNF-3.0	3.0	7½
MNF-3.9	3.9	7½
MNF-5.4	5.4	7½
MNF-7.35	7.35	7½
MNF-10.5	10.5	7½
MNF-14.5	14.5	7½
MNF-22	22	7½
MNF-30	30	7½
MNF-40	40	7½
MNF-52.5	52.5	7½
MNF-70	70	7½
MWF-22	22	15
MWF-30	30	15
MWF-40	40	15
MWF-52.5	52.5	15
MWF-70	70	15

MINIFILTERS*

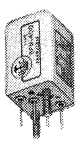
These units provide almost the same characteristics as the standard interstage units listed at the bottom left, although extremely miniaturized. Hermetically sealed to MIL-F-18327C specs. B Type Case: ¾″ x ¾″ x 1⅛″ h.; wt., 1 oz. H and L Cases: 1″ x 1″ x 1⅜″ h.; wt., 2¼ oz. Cutoff frequencies in Hz indicated by type number.

BPM units (BAND PASS) have 2:1 gain. Attenuation is approximately 2 db ±3% from center frequency, and 35 db per octave as shown. Input 10,000 ohms, output to grid, tapped for 10,000 ohms to provide for transistor circuits. For tube circuits continuity is on grid side, for transistor use continuity is on input side.

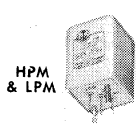
BPH units (BAND PASS) attenuation less than 3 db ±5% from center frequency, and 40 db per octave. Source and load 500 ohms.

HPM units (HIGH PASS) are down less than 6 db at cutoff frequency, and more than 30 db at .67 cutoff frequency, 40 db at .6 cutoff frequency. Input and output 10,000 ohms.

LPM units (LOW PASS) are down less than 6 db at cutoff frequency, and more than 30 db at 1.5 cutoff frequency, 40 db at 1.65 cutoff frequency. Input and output 10,000 ohms.



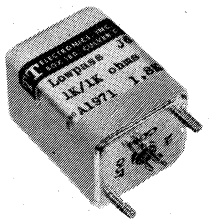
BPM



HPM & LPM

UTC Type	UTC Type	UTC Type
BPH-50000	BPM-2500	HPM-4000
BPH-100000	BPM-3000	LPM-200
BPM-400	BPM-3200	LPM-300
BPM-440	BPM-4000	LPM-500
BPM-500	BPM-4800	LPM-1000
BPM-600	BPM-5000	LPM-1500
BPM-750	BPM-6000	LPM-2000
BPM-800	BPM-6400	LPM-3000
BPM-1000	BPM-8000	LPM-5000
BPM-1200	BPM-10000	LPM-6000
BPM-1500	BPM-20000	LPM-8000
BPM-1600	HPM-500	LPM-10000
BPM-1800	HPM-1000	LPM-15000
BPM-2000	HPM-1500	

TTE *miniature* FILTERS



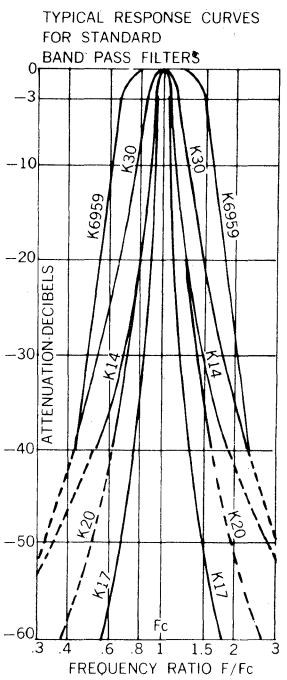
THESE PAGES CATALOG OVER 1,000,000 STANDARD FILTER TYPES — SPECIFY ANY COMBINATION OF FREQUENCY, SOURCE AND LOAD OHMS WITHIN THE MIN-MAX RANGES

These pages give complete electrical, mechanical and price information for ordering standard filters.

BANDPASS FILTERS FOR ANY CENTER FREQUENCY FROM 30Hz TO 100MHz (Specials from 10Hz upward)

Series	F_c Center Freq. Range Min.	Max.	Bandwidth @ −3db	Attenuation	Source, Ohms Min.	Max.	Load, Ohms Min.	Max.	Case Size	Approx. Price
K10	500Hz	9.9KHz	±1%F_c	30db at .92F_c & 1.1F_c	1K	500K	1K	500K	4	$44
K10A	10KHz	100MHz	±1%F_c	30db at .92F_c & 1.1F_c	50	10K	50	10K	3 or 11	$44
K11B	500Hz	9.9KHz	±1%F_c	30db at .94F_c & 1.06F_c	1K	500K	1K	500K	4	$65
K11C	10KHz	100MHz	±1%F_c	30db at .94F_c & 1.06F_c	50	10K	50	10K	3 or 11	$65
K12A	500Hz	9.9KHz	±2%F_c	30db at .92F_c & 1.1F_c	1K	10K	1K	10K	4	$65
K12B	10KHz	100MHz	±2%F_c	30db at .92F_c & 1.1F_c	50	10K	50	10K	3 or 11	$65
K13	30Hz	99Hz	±5%F_c	60db at .5F_c & 2F_c	1K	500K	1K	500K	5	$62
K14A	100Hz	100KHz	±5%F_c	40db at .5F_c & 2F_c	500	10K	100	1Meg	3	$33
K14B	300Hz	999Hz	±5%F_c	35db at .5F_c & 2F_c	700	15K	700	15K	11	$40
K14C	1KHz	99KHz	±5%F_c	43db at .5F_c & 2F_c	1K	1K	1K	10K	10	$40
K14D	100KHz	100MHz	±5%F_c	43db at .5F_c & 2F_c	50	100	50	100	10	$45
K17	100Hz	10KHz	±5%F_c	60db at .5F_c & 2F_c	500	10K	100	1Meg	4	$44
K17A	300Hz	999Hz	±5%F_c	50db at .5F_c & 2F_c	500	15K	500	30K	12	$51
K17B	1KHz	99KHz	±5%F_c	50db at .5F_c & 2F_c	100	50K	100	100K	11	$51
K17C	100KHz	100MHz	±5%F_c	60db at .5F_c & 2F_c	50	300	50	300	11	$56
K18	10KHz	100KHz	±5%F_c	60db at .5F_c & 2F_c	100	100K	100	500K	3	$44
K20	100Hz	3.9KHz	±7.5%F_c	40db at .57F_c & 1.75F_c	500	10K	500	10K	4	$51
K20A	250Hz	99KHz	±7.5%F_c	35 to 50db at .5F_c & 2F_c	1K	10K	1K	10K	10	$39
K20B	100KHz	100MHz	±7.5%F_c	40db at .67F_c & 1.5F_c	50	300	50	300	11	$56
K21A	1KHz	100KHz	±7.5%F_c	40db at .67F_c & 1.5F_c	500	10K	500	10K	3	$51
K30	100Hz	3.9KHz	±15%F_c	40db at .4F_c & 2.5F_c	500	10K	500	10K	4	$51
K30A	150Hz	99KHz	±15%F_c	25db at .45F_c & 2.2F_c	1K	10K	1K	10K	10	$39
K30B	100KHz	100MHz	±15%F_c	40db at .5F_c & 2F_c	50	300	50	300	11	$56
K31A	1KHz	100KHz	±15%F_c	40db at .5F_c & 2F_c	500	10K	500	10K	3	$51

The bandwidth for any of the above filters can be increased or decreased to specification.



WIDE BAND FILTERS: Bandwidths of ±16% or greater can be obtained by ordering TTE standard High pass and Low pass filter sections as a composite network. Select numbers from the Series H and J listings on the next page which give the desired attenuation slopes and combine these numbers. For example to obtain a slope of 40db at 0.65 of the lower freq. cut-off, F_{c1}, (High pass section) and 40db at 1.6 of the upper freq. cut-off, F_{c2}, (Low pass section) use H69B and J59B. Specify the two as K6959. **The high pass series number is first, followed by the low pass number.** Types with dissymmetrical attenuation slopes can be combined. Also specify the three db down cut-off frequencies F_{c1} and F_{c2} and impedance. The price is the sum of the HP and LP section prices.

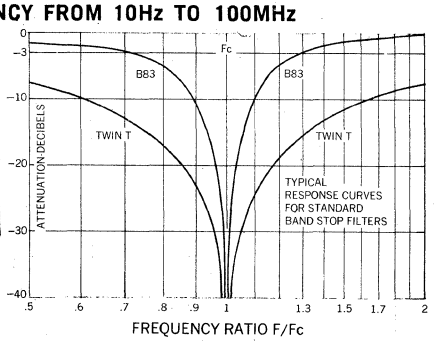
Telemetering: Refer to series K20, K21A, K30 or K31A. TO ORDER specify IRIG Channel number, source and load impedances.

TO ORDER BANDPASS FILTERS — Specify (1) TTE Series No., (2) minus 3db frequencies, (3) source impedance, (4) load impedance.

INSERTION LOSSES for bandpass types between equal terminations are from 0.5 to 6db depending upon bandwidth, frequency and size. K10 and K11 types have about 10 db, and K12 types about 5db flat loss. **SPECIALS** are available for center frequencies from 10Hz upward and 40db to 3db bandwidth ratios as sharp as 1.2:1. **TO ORDER** Specials, also specify (5) bandwidth and (6) stop band attenuation required.

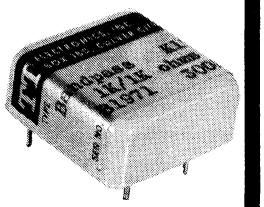
BAND REJECT STANDARD FILTERS FOR ANY CENTER FREQUENCY FROM 10Hz TO 100MHz

Series	F_c Center Freq. Range Min.	Max.	Bandwidth −3db	Attenuation	Impedance Ohms Min.	Max.	Circuit	Case No.	Approx. Price
B83	10Hz	1MHz	.77F_c & 1.3F_c	50 db Notch	600	1 Meg.	L-C	4	$34
D	10Hz	100KHz	.25F_c & 4 F_c	40 db Notch	SEE ORDERING INSTRUCTIONS BELOW		Twin-T	2	$15
F	10Hz	100KHz	.25F_c & 4 F_c	60 db Notch			Twin-T	2	$31
R20	100Hz	3999Hz	{3db Bandwidth to 40db		10K	50K	L-C	4 or 11	$40
R30	4KHz	100MHz	{Bandwidth Ratio = 5 or less		50	10K	L-C	4 or 11	$40



TO ORDER BAND REJECT FILTERS — Specify (1) TTE Series No. or Letter, (2) center frequency, (3) source impedance, (4) load impedance. For Series R20 and R30 specify 40db bandwidth. Twin-T prices and cases apply to all filters using capacitor values from 0.1 MFD to 500 pF. $C = 1/8.85\ F_{Hz}\ (R_{source}\ R_{load})^{1/2}$. C is in farads. Filters with null frequencies as low as 1 Hz are available. Terminations are regarded as resistive unless otherwise specified.

TTE *miniature* FILTERS



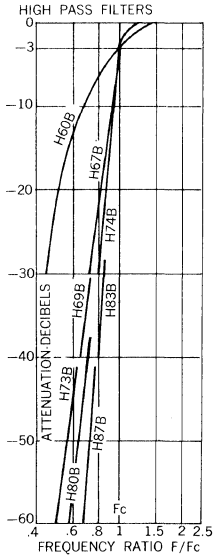
1-2 WEEK DELIVERY FOR STANDARD AND NEAR STANDARD TYPES — ALL GROUPS AVAILABLE IN FLAT PC MOUNTING CASES

HIGH PASS

STANDARD FILTERS FOR ANY CUT-OFF FREQ. FROM 75Hz TO 100MHz

Series	Min. Attn. db	Cut-off Ratio F/F_c	Approx. Price	Case Size
H60B	30	.45	$26	
H62B	40	.35	$26	
H64B	50	.25	$26	
H66B	60	.19	$26	75-124Hz CASE 5
H67B	30	.72	$35	
H69B	40	.65	$35	125-999Hz CASE 4
H71B	50	.56	$35	
H73B	60	.50	$35	1-100KHz CASE 3
H74B	30	.79	$44	- or -
H76B	40	.73	$44	200Hz-10KHz CASE 12
H78B	50	.67	$44	
H80B	60	.58	$44	10KHz-100MHz CASE 11
H81B	30	.83	$52	
H83B	40	.79	$52	
H85B	50	.73	$52	
H87B	60	.67	$52	

TYPICAL RESPONSE CURVES FOR STANDARD HIGH PASS FILTERS



SPECIALS: Special units available for cut-off frequencies down to 40Hz and above 100MHz.

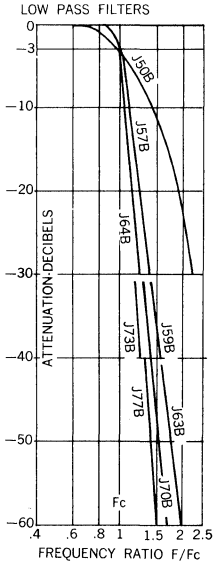
TO ORDER specify (1) TTE Series No. (2) minus 3DB freq., (3) impedance, (4) Case No. See table below.

LOW PASS

STANDARD FILTERS FOR ANY CUT-OFF FREQ. FROM 75Hz TO 100MHz (*And from 10Hz to 74Hz)

Series	Min. Attn. db	Cut-off Ratio F/F_c	Approx. Price	Case Size
J50B	30	2.2	$26	
J52B	40	2.9	$26	
J54B	50	3.9	$26	
J56B	60	5.3	$26	75-999Hz CASE 4
J57B	30	1.4	$35	
J59B	40	1.6	$35	1-100KHz CASE 3
J61B	50	1.8	$35	
J63B	60	2.0	$35	- or -
J64B	30	1.2	$44	200Hz-10KHz CASE 12
J66B	40	1.4	$44	
J68B	50	1.5	$44	10KHz-100MHz CASE 11
J70B	60	1.7	$44	
J71B	30	1.18	$52	
J73B	40	1.3	$52	
J75B	50	1.4	$52	
J77B	60	1.5	$52	
*J80B	40	2.0	$50	CASE 4

TYPICAL RESPONSE CURVES FOR STANDARD LOW PASS FILTERS



SPECIALS: Special units available for cut-off frequencies above 100MHz.

TO ORDER specify (1) TTE Series No. (2) minus 3DB freq., (3) impedance, (4) Case No. See table below.

PHASE LINEARITY IS REASONABLE. SOME TYPES ARE USED FOR PULSE TRANSMISSION.

SOURCE AND LOAD impedances are equal and resistive for standard HP and LP filters. The insertion loss is less than 0.5db for ±10% matching. Typical Passband flatness within ±0.2db.

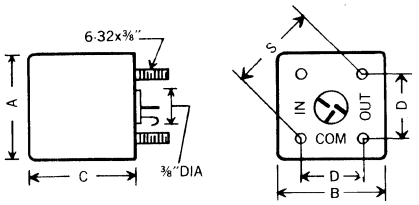
SPECIALS for other impedances and unequal terminations are available. Units with cut-off ratios as sharp as 1.06 (0.94 Highpass) are available.

IMPEDANCE GUIDE — HIGH PASS AND LOW PASS TYPES

Fc −3db	10Hz	50Hz	100Hz	500Hz	5KHz	10KHz	100KHz	500KHz	1MHz	5MHz	100MHz
Z MinΩ	10K	10K	5K	1K	500	100	50	50	50	50	
Z MaxΩ	15K	39K	39K	39K	20K	3K	3K	1K	300	75	

CASE DIMENSIONS AND MOUNTING INFORMATION FOR ALL FILTERS

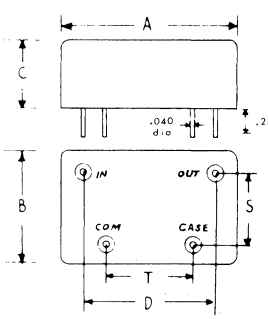
STANDARD CHASSIS TYPE



CASE	A	B	C	D	S	T	Mounting
STANDARD CHASSIS TYPE							
1	.75	.75	1.38	—	.56	—	(2)4-40 x 3/8
2	1.19	1.19	1.25	.75	—	—	(4)6-32 x 3/8
3	1.31	1.31	1.75	—	1.25	—	(2)6-32 x 3/8
4	1.63	1.63	2.38	1.19	—	—	(4)6-32 x 3/8
5	1.94	1.81	2.44	1.38/ 1.25	—	—	(4)6-32 x 3/8
FLAT PC BOARD TYPE							
10	1.27	1.27	.50	.90	.90	.60	PC PINS
11	1.88	1.44	.50	1.5	1.0	1.0	PC PINS
12	2.00	2.00	.50	1.5	1.5	1.0	PC PINS
15	2.96	1.93	.50	2.4	1.4	2.0	PC PINS

NOTES: TTE Filters are epoxy encased within hermetically sealed steel cases. The case finish is copper plate per MIL-C-14550 under fused tin per MIL-T-10727A. The maximum power output without de-tuning is 10 to 20 milliwatts for most low frequency types. K10 and K12 types are tested at 100mV and B83 types at .77V output for all imped. levels. Terminations are regarded as resistive unless otherwise specified.

FLAT CASES PC BOARD TYPE



From 500KHz upward flat case "Com" is connected to case.

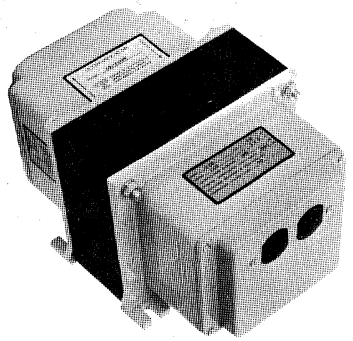
TTE COVERS THE RANGE —
VLF-LF-MF-HF-VHF-UHF
LC — CRYSTAL — POWER NETWORKS

TT ELECTRONICS
INC. 2214 SO. BARRY AVE. / LOS ANGELES, CALIF. 90064 / (213) 478-8224

TOPAZ ELECTRONICS

ULTRA-ISOLATION TRANSFORMERS

For eliminating power line noise problems associated with sensitive equipment



TOPAZ ULTRA-ISOLATION TRANSFORMERS are available in single-phase and three-phase versions, from 125 VA to 60,000 VA, and in step-up and step-down configurations, some with provisions for use on several different power line voltages. They are especially designed for these applications:

1. For isolating sensitive instrumentation from noisy power lines.
2. For isolating sensitive power lines from noisy equipment.
3. For isolating noisy equipment from noise-sensitive equipment when both share the same AC power source.
4. For maximum attenuation of common-mode noise (noise between ground and power lines).
5. For maximum attenuation of transverse-mode noise (noise between one side of the power line and the other side of the power line).
6. For completion of electrostatic guarding of equipment which is protected by an electrostatic shield.
7. For applications in which leakage currents must be kept below critical low levels.

TYPICAL SPECIFICATIONS

Common-Mode Noise Rejection:
Greater than 125 dB

Transverse Noise Suppression:
Greater than 125 dB at 1 kHz

Electromagnetic Noise:
Less than 0.1 gauss (–20 dB) at 18 in. radius

Standard Voltage Ratings:
120 (for 110, 115, 120 V lines*)
240 (for 208, 220, 230, 240 V lines*)
480 (for 360, 440, 480 V lines*)
*Maximum current = VA rating ÷ Nominal Voltage Rating

Operating Voltages:
To 110% of nominal

Operating Frequency:
57 to 63 Hz

Other Models Available:
50 & 400 Hz, 1ø and 3ø

STANDARD 60 Hz SINGLE PHASE MODELS

Power Rating	MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE ≤ .005 pF	≤ .001 pF	≤ .0005 pF	Primary VAC (Nominal)	Secondary VAC (Nominal)	Termi-nations	Wt. (Lbs.)	Price Each†	Typ. Del.
125 VA	1/811T25SR			120	120	Receptacle	11	$ 75	Stock
125		1/811T21SR		120	120	Receptacle	11	95	Stock
125			1/811T35SR	120	120	Receptacle	11	125	Stock
125 VA	1/811T25ST			120	120	Terminals	10	75	Stock
125		1/811T21ST		120	120	Terminals	10	95	Stock
125			1/811T35ST	120	120	Terminals	10	125	Stock
500 VA	1/211T25SR			120	120	Receptacle	18	110	Stock
500		1/211T21SR		120	120	Receptacle	18	138	Stock
500			1/211T35SR	120	120	Receptacle	18	185	Stock
500 VA	1/211T25ST			120	120	Terminals	17	110	Stock
500		1/211T21ST		120	120	Terminals	17	138	Stock
500			1/211T35ST	120	120	Terminals	17	185	Stock
1.0 kVA	0111T25SR			120	120	Duplex	28	180	Stock
1.0	0131T25SR			240	120	Duplex	28	180	2 Wks
1.0	0111T25ST			120	120	Terminals	27	180	Stock
1.0	0131T25ST			240	120	Terminals	27	180	2 Wks
1.0	0155T25FT			125/250*	115/230	Terminals	57	450	2 Wks
1.0	0111T25FT			120	120	Terminals	57	385	2 Wks
1.0		0111T21SR		120	120	Duplex	28	225	Stock
1.0		0131T21SR		240	120	Duplex	28	225	2 Wks
1.0		0111T21ST		120	120	Terminals	27	225	Stock
1.0		0131T21ST		240	120	Terminals	27	225	2 Wks
1.0		0155T21FT		125/250*	115/230	Terminals	57	565	2 Wks
1.0		0111T21FT		120	120	Terminals	57	460	2 Wks
1.0			0111T35SR	120	120	Duplex	28	300	Stock
1.0			0131T35SR	240	120	Duplex	28	300	2 Wks
1.0			0111T35ST	120	120	Terminals	27	300	Stock
1.0			0131T35ST	240	120	Terminals	27	300	2 Wks
1.0			0155T35FT	125/250*	115/230	Terminals	57	750	2 Wks
1.0			0111T35FT	120	120	Terminals	57	640	2 Wks

*Consists of (2) 125 volt coils with taps at 102, 110, and 118 volts

Power Rating	MODEL NUMBER GUARANTEED EFFECTIVE CAPACITANCE ≤ .005 pF	≤ .001 pF	≤ .0005 pF	Primary VAC (Nominal)	Secondary VAC (Nominal)	Termi-nations	Wt. (Lbs.)	Price Each†	Typ. Del.
2.5 kVA	0211T25SR			120	120	Duplex	43	275	Stock
2.5	0231T25SR			240	120	Duplex	43	275	Stock
2.5		0211T21SR		120	120	Duplex	43	345	Stock
2.5		0231T21SR		240	120	Duplex	43	345	Stock
2.5			0211T35SR	120	120	Duplex	43	460	Stock
2.5			0231T35SR	240	120	Duplex	43	460	Stock
2.5	0211T25ST			120	120	Terminals	42	275	Stock
2.5	0231T25ST			240	120	Terminals	42	275	Stock
2.5		0211T21ST		120	120	Terminals	42	345	Stock
2.5		0231T21ST		240	120	Terminals	42	345	Stock
2.5			0211T35ST	120	120	Terminals	42	460	Stock
2.5			0231T35ST	240	120	Terminals	42	460	Stock
5.0 kVA	0511T25FT			120	120	Terminals	112	510	Stock
5.0	0511T25ST			120	120	Terminals	62	415	Stock
5.0	0531T25ST			240	120	Terminals	62	415	Stock
5.0	0541T25ST			480	120	Terminals	62	415	2 Wks
5.0		0511T21FT		120	120	Terminals	112	640	Stock
5.0		0511T21ST		120	120	Terminals	62	520	Stock
5.0		0531T21ST		240	120	Terminals	62	520	Stock
5.0		0541T21ST		480	120	Terminals	62	520	2 Wks
5.0			0511T35FT	120	120	Terminals	112	850	Stock
5.0			0511T35ST	120	120	Terminals	62	695	Stock
5.0			0531T35ST	240	120	Terminals	62	695	Stock
5.0			0541T35ST	480	120	Terminals	62	695	2 Wks
10 kVA	1033T25ST			240	240	Terminals	160	740	3 Wks
10		1033T21ST		240	240	Terminals	160	940	3 Wks
10			1033T35ST	240	240	Terminals	160	1250	3 Wks
10	1065T25BT			240/480	120/240	Conduit	170	1290	4 Wks
10		1065T21BT		240/480	120/240	Conduit	170	1620	4 Wks
10			1065T35BT	240/480	120/240	Conduit	170	2240	4 Wks
15 kVA	1533T25ST			240	240	Terminals	250	895	3 Wks
15		1533T21ST		240	240	Terminals	250	1120	3 Wks
15			1533T35ST	240	240	Terminals	250	1495	3 Wks
15	1565T25BT			240/480	120/240	Conduit	260	1480	4 Wks
15		1565T21BT		240/480	120/240	Conduit	260	1850	4 Wks
15			1565T35BT	240/480	120/240	Conduit	260	2460	4 Wks
20 kVA	2065T25BT			240/480	120/240	Conduit	310	1660	4 Wks
20		2065T21BT		240/480	120/240	Conduit	310	2070	4 Wks
20			2065T35BT	240/480	120/240	Conduit	310	2750	4 Wks

† Current March 1973

TOPAZ also manufactures a wide line of power conversion equipment and uninterruptible power systems.

See Section 4000, Vol.1•909-1•911

TOPAZ ELECTRONICS
3855 Ruffin Road, San Diego, CA 92123—714-279-0831

USCC/Centralab

Electronics Division • Globe-Union, Inc.

EMI/RFI FILTERS

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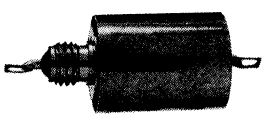
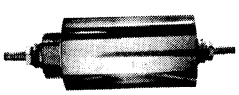
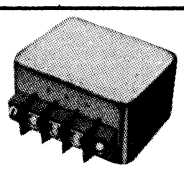
Complete design and prototype capabilities

Phone collect (213) 843-3822 NOW, for IMMEDIATE ACTION.

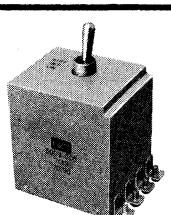
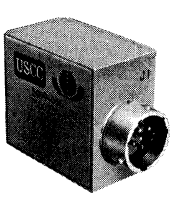
CERAMIC TYPES

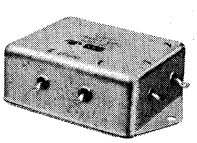
"BUTTON" SERIES	Epoxy or hermetically sealed; 50, 100, 200, 300 VDC and 115 VAC 0-400 Hz; 15 amps; L section	
MINIATURE 1000 and 2000 SERIES	50, 100, 200, 300 VDC and 115 VAC 0-400 Hz; .06 to 10 amps; Pi, L and T sections; .187" or .312" thread lengths	
MINIATURE 2400 SERIES	230 VAC 0-400 Hz; .1 to 10 amps; Pi, L and T sections	
SUBMINIATURE 3000 SERIES	3112: 100 VDC; 10 amps; L section 3223: 200 VDC; 10 amps; Pi section 3300: 50, 100 and 200 VDC; 10 amps; Pi and Multi-sections 3500: 100, 200 and 500 VDC; 25 amps; Pi section	
FEEDTHRU FILTER/CAPACITORS 9000 SERIES	50, 100 and 200 VDC; 10 and 25 amps; 1,000 pF to 1.5 Mfd	

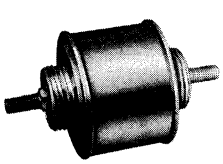
CONVENTIONAL TYPES

GENERAL PURPOSE 5000 SERIES	200, 400, 600 VDC and 115, 250 VAC 0-400 Hz; .5 to 20 amps	
FOR DATA PROCESSING EQUIPMENT 8000 SERIES	120 and 240 VAC 0-60 Hz; 1 to 50 amps; 20 to 60 db insertion loss @ 150 KHz; Tubular, rectangular and "bathtub" styles	

CUSTOMS





Utilizing ceramic or layer wound capacitors; single or multi-circuit designs; contact USCC/Centralab's Application Engineering Department

INQUIRE ABOUT USCC's COMPLETE EMI/EMC TESTING SERVICES.

U.S. Capacitor Corporation / Centralab, Electronics Division, Globe-Union, Incorporated

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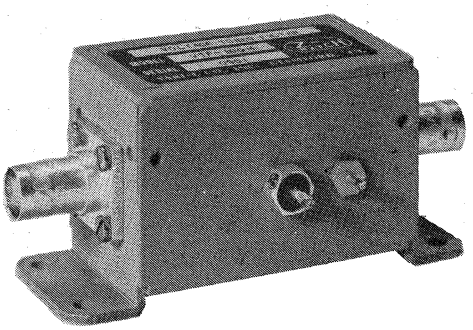
Z-MATCH

VOLTAGE TUNED FILTER



TYPICAL APPLICATIONS

- **Electrically tuned receivers — no moving parts — remotely tuned;**
- **Control of filter function by computer;**
- **Tracking filter for frequency synthesizers and other high distortion sources;**
- **I.F. Amplifiers with multiple frequencies;**
- **Phase modulators;**
- **Tunable frequency discriminators;**
- **Swept receivers for surveillance and intercept;**
- **Channel selection in receivers and transceivers — ganged to transmitter channel selector;**
- **Carrier locked receivers for frequency agility.**

Vari-L Company, Inc. has applied 18 years' experience in manufacturing of solid-state tuning devices to the often expressed need for a line of high quality, medium cost voltage-tuned filters and is pleased to announce the VTF series (Voltage-Tuned or Varacter-Tuned Filter) described below.

The Vari-L VTF line of filters features the following characteristics: 1. Constant bandwidth (in MHz) and constant insertion loss (output flat to within .25 dB) over the full tuning range. 2. Voltage tuning; no power drain. 3. No hysteresis; high tuning speed; sweepability. 4. Very low VSWR-input and output. 5. Low intermodulation distortion. 6. High power handling. 7. Compact; rugged; insensitive to mechanical shock and vibration. 8. Remotely tunable; programmable; adapted to closed loop operation. 9. Symmetrical passband; true Butterworth "textbook" performance. Request Bulletin #107 for specifications.

FIGURE 16. VTF FILTER SCHEMATIC

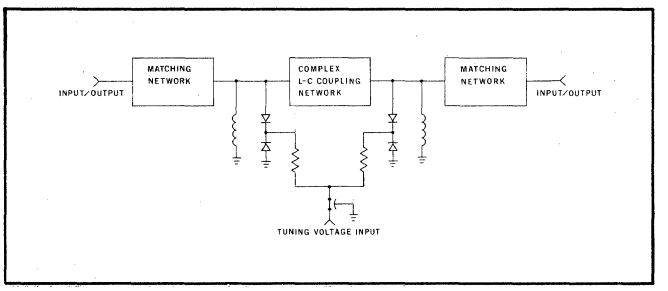


FIGURE 17. TYPICAL RECEIVER FRONT END USING VTF VOLTAGE TUNED FILTERS

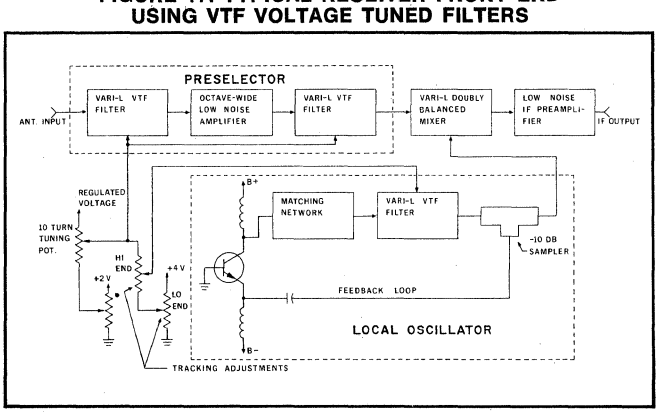
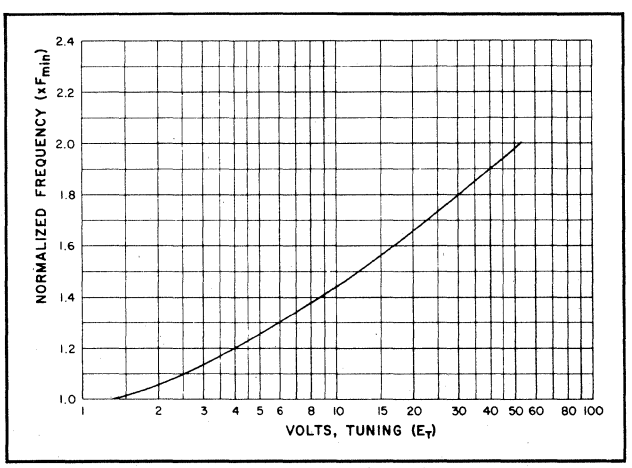


FIGURE 18

NORMALIZED FREQUENCY vs. VOLTAGE FOR OCTIVE RANGE VTF FILTERS



MODEL	TUNING RANGE (MHz)	BANDWIDTH (MHz)	TUNING VOLTAGE (VDC)	PRICE 1 - 9
VTF-1.5M	1.5 - 3.0	.18	1 - 55	$381
VTF-3M	3.0 - 6.0	.36	1 - 55	347
VTF-6M	6.0 - 12	.72	1 - 55	313
VTF-12M	12 - 25	1.5	1 - 55	279
VTF-25M	25 - 50	3.0	1 - 55	245
VTF-50M	50 - 100	6.0	1 - 55	225
VTF-100M	100 - 200	12.0	1 - 55	245
VTF-200M	200 - 400	24.0	1 - 55	296
VTF-400M	400 - 800	48.0	1 - 55	347
VTF-800M	800 - 1400	102.0	1 - 55	398
VTF-1G	1000 - 1800	160.0	1 - 55	415
HIGHER FREQUENCY MODELS AVAILABLE ON SPECIAL ORDER				

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VARI-L® RF COMMUNICATIONS SYSTEMS

The Vari-L Company, with a long standing leadership in development and manufacture of state-of-the-art components is now offering customized RF and communications systems based on Vari-L designed components. Systems and subsystems within the areas of receivers, frequency synthesizers, transmitters, and related RF and communications equipment are designed and packaged with a low development cost. Capabilities span the entire range of 10 KHz to 12.4 GHz. A Vari-L specialty is electronic tuning with low spurious and third order intermodulation distortion. Some examples are listed on this page. Call one of our engineers to discuss your requirements or to ask for a quote on your specialized needs.

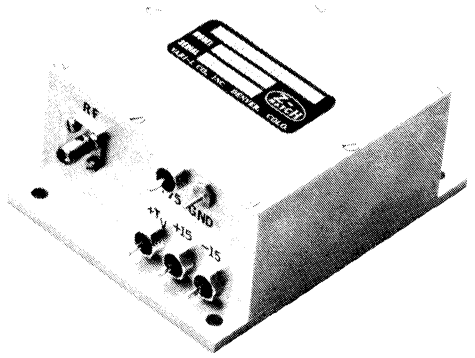
1% TUNING LINEARITY VOLTAGE TUNED FILTERS

Vari-L's LTF series combines our varactor tuned filters with a highly stable linearizer in one integrated package.

Features:

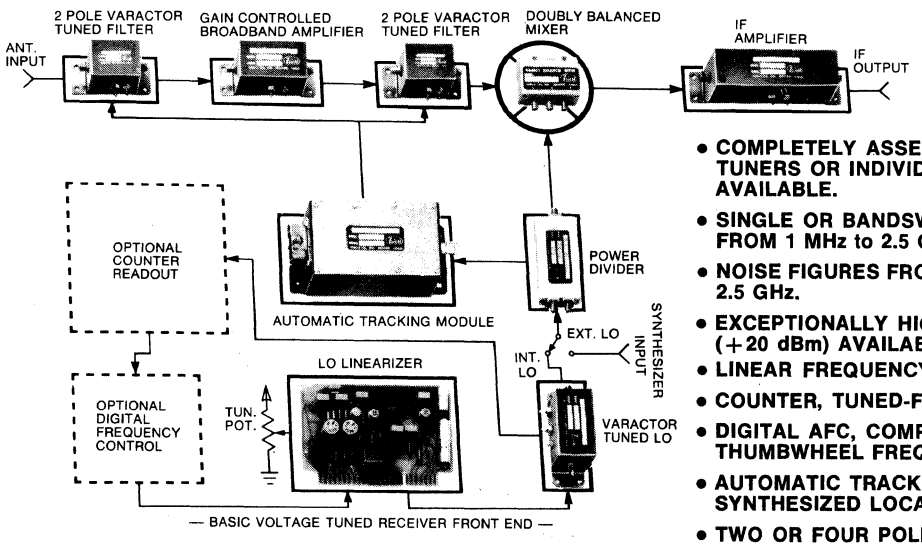
- **Better than 1% voltage vs frequency linearity**
- **Full octave tuning from 1 MHz to 2 GHz**
- **Constant loss, constant bandwidth, 2 pole Butterworth design**
- **Greater than + 20 dBm 3rd order intercept point**
- **0 to 10 volts tuning voltage**
- **Low temperature drift, internally temperature compensated**
- **Fast tuning, 5,000 sweeps per second**
- **1.5 : 1 maximum VSWR**
- **2 dB loss and 12% of f_1 bandwidth is standard**

Matching voltage tuned oscillators will be available soon.



ON THE RECEIVING END . . . . .?

Check Into VARI-L'S Electronically Tuned Front End Capabilities.



- **COMPLETELY ASSEMBLED AND INTEGRATED TUNERS OR INDIVIDUAL COMPONENTS AVAILABLE.**
- **SINGLE OR BANDSWITCHED MULTIPLE OCTAVES FROM 1 MHz to 2.5 GHz.**
- **NOISE FIGURES FROM 4.5 dB @ 100 MHz TO 8 dB @ 2.5 GHz.**
- **EXCEPTIONALLY HIGH INTERCEPT POINT (+20 dBm) AVAILABLE.**
- **LINEAR FREQUENCY VERSUS TUNING VOLTAGE.**
- **COUNTER, TUNED-FREQUENCY READOUT.**
- **DIGITAL AFC, COMPUTER CONTROL AND THUMBWHEEL FREQUENCY PRE-SET AVAILABLE.**
- **AUTOMATIC TRACKING MODULE FOR SYNTHESIZED LOCAL OSCILLATORS AVAILABLE.**
- **TWO OR FOUR POLE PRESELECTOR AVAILABLE.**
- **CONSTANT RF BANDWIDTH — CONSTANT NOISE THRESHOLD — CONSTANT SIGNAL-TO-NOISE RATIO.**

Write Or Call For Further Information.

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from Vernitron *(the filters people)*

Ceramic Communications Filters

Miniature, lightweight and rugged / Steep-sided selectivity / Large range of bandwidths / *Fixed-tuned* / Immune to magnetic fields / High stopband rejection and clean response / Highly stable with temperature and time.

These are prime characteristics of *ceramic* filters—first introduced by this company in 1958—which distinguished them from tuned-LC, mechanical and other varieties. They are also major reasons why Vernitron ceramic filters have been widely adopted for the best in land-mobile, airborne, marine, computer and data-communications systems, whether military, commercial or home-entertainment.

Vernitron engineers are specialists in filter design, with the latest in computer-aided facilities. Your inquiry will receive immediate response.

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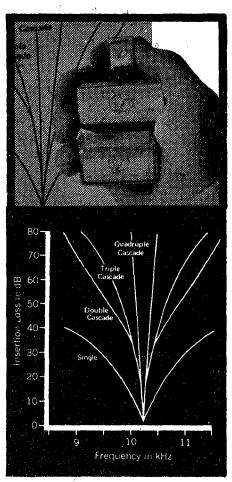
TWX: 810-427-2274

f_o–7.5 to 50 kHz

LOW FREQUENCY FILTERS (LF)

Single Resonator
2, 3 or 4 Resonator
Cascades



High-performance miniature for LF communications or Omega systems—featuring selection of any f_o from 7.5 to 50 kHz. Single-resonator units have rejection to greater than 40 dB; cascaded units to above 90 dB. Standard Omega models at 10.2, 11.33 and 13.0 kHz, available in commercial or hermetically-sealed militarized versions.

FEATURES

- **Any f_o Between 7.5 and 50 kHz**
- **Phase Stability <1.5° Over 60 dB Range**
- **Temp. Stability Within 0.2%**
- **Low Insertion Loss**
- **Passive—No External Power Req'd**
- **Fixed-tuned**

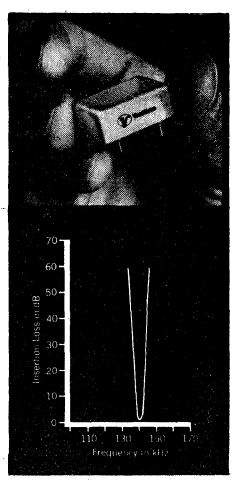
APPLICATIONS

Low frequency receivers, specifically Omega series; selective calling, underwater sound, command-destruct; air or maritime navigation receivers.

Write for Data Sheet 94037

f_o–50 to 270 kHz

MEDIUM FREQUENCY FILTERS (TLE)



Small, hermetically sealed and extremely shock-resistant, these rugged filters offer price and size advantages over LC types, and improvements in stability and dynamic range over active or other filters in the medium-frequency operating range. Typical shape factor is better than 3:1, stopbands to above 60 dB. Bandwidths range from ½% to 3%. Because they are significantly smaller and lighter than comparable filters in this range, they allow denser packaging and greater resistance to vibration and shock.

FEATURES

- **Any f_o Between 50 and 270 kHz**
- **–55°C to +85°C Operating Range**
- **Require no Shielding**
- **Low Insertion Loss**
- **½% to 3% Bandwidth Range**
- **Hermetically Sealed**

APPLICATIONS

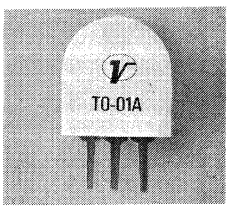
Selective calling systems, air navigation receivers, telemetry systems—especially where small size, light weight and inherent shock resistance are desired requirements.

Write for Data Sheet 94035

BUILDING BLOCKS... FOR BUILDING YOUR OWN

f_o–455 kHz and 500 kHz

TRANSFILTERS (TO Series)

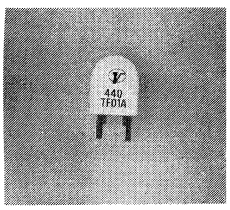


Low-cost replacement for transformer interstage elements in 455 and 500 kHz IF stages. Each contains a fixed-tuned ceramic resonator in 3-terminal configuration, with high-impedance input, low-impedance output and common. TO-01 is for low-impedance circuits; TO-02, for matching high-impedance drift transistors.

Write for Data Sheets 94019, 94020

f_o–200 to 700 kHz

TRANSFILTERS (TF Series)

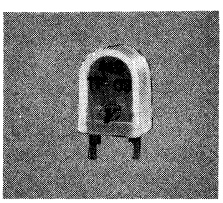


TF series Transfilters contain a stable piezoelectric resonator, ideal to replace an emitter bypass capacitor in an IF stage. Can also be used as a frequency-control element with oscillators where the high stability of a quartz crystal is not required. Ideal for automatic assembly.

Write for Data Sheet 94018R

f_o–455 kHz

IDENTICAL RESONATORS (IR)

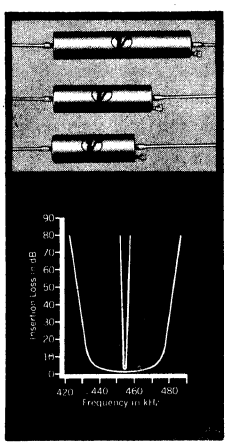


Design your own 455 kHz filter simply and at less cost than an equivalent lumped filter. Using two or more IR's, interconnected in prescribed networks (design tables available), you can produce filters of various complexities and a wide range of bandwidths. Ideally suited for low-cost home entertainment receivers.

Write for Data Sheet 94031

f_o–270 to 700 kHz

LADDER FILTERS



These rugged miniature filters combine highest vibration/shock resistance with the ultimate in selectivity, stability and shape-factors. Available in 6 dB bandwidths from 2 kHz to 85 kHz. Low-cost 9-disc models offer rejections greater than 50 dB; 11-disc models to above 60 dB. 17-disc units provide highest selectivity, stopbands to as high as 80 dB, shape-factors as sharp as 1.4:1. Hermetically sealed. Both bandpass and bandstop types available.

FEATURES

- **High stopband Rejection**
- **Small Size and Weight**
- **Vibration and Shock Resistant**
- **Wide Range of Shape Factors**
- **Bandpass and Bandstop Types**
- **Fixed-tuned**

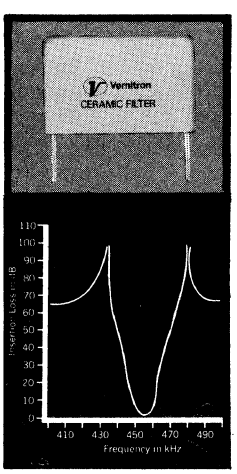
APPLICATIONS

Commercial or militarized hand-held, mobile 2-way, or airborne receivers where reliability and stability are key considerations. Large numbers used in military equipment for hostile environments.

Write for Data Sheets 94017, 94029, 94036

f_o–455 kHz

HYBRID FILTERS (TCF)



Highest selectivity at lowest cost. Computer-designed, fixed tuned to ±0.2% stability, these filters combine a ladder network of ceramic resonators with a tuned transformer to provide a dc path at input. Choice of standard bandwidths includes 4, 8, 12, 18, 30 and 35 kHz. Skirt-ratios range from 1.5 to 3.0, stopbands to as high as 90 dB.

FEATURES

- **High Selectivity/Cost Ratio**
- **Exceptional Stability**
- **Fixed-tuned LC Input**
- **Wide Choice of Bandwidths**
- **Compact and Rugged**

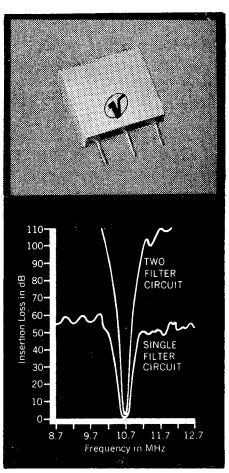
APPLICATIONS

Quality AM or FM receivers, airborne, land-mobile or marine. Fully compatible with transistorized or IC circuitry.

Write for Data Sheet 94026

f_o–10.7 MHz

FM FILTERS (FM4)



Low-cost 10.7 MHz monolithic miniature for quality auto and home-entertainment FM receivers. Replaces four tuned circuits 20 times its size. Bandwidth: 235 kHz at 3 dB; 825 kHz at 40 dB. Low insertion loss, negligible ripple, excellent stability under thermal shock. Fully compatible with IC circuitry. Designed for mounting by automatic assembly.

FEATURES

- **Miniature Size**
- **45 dB Stopband**
- **Monolithic Reliability**
- **Lumped-Filter Simplicity**
- **Immune to Shock**

APPLICATIONS

Automotive, home-entertainment and commercial FM receivers. A 2-filter configuration with gain stage between gives stopbands above 90 dB.

Data Sheet 94033

Beckman®

D-A Converters, Ladder Networks & Switches, Power Amplifiers

LINEAR HYBRID MICROCIRCUITS

DIGITAL-TO-ANALOG CONVERTERS

Model 845 is a complete 8-bit binary digital-to-analog converter with 4 preset output ranges. It has a slew rate of 0.2V/μsec min, and a settling time of 5.0 μsec/volt +1 μsec.
Price (1-9) $39.75

Model 848 is a complete 11-bit binary digital-to-analog converter with guaranteed monotonicity and accuracy levels. It offers 4 preset output ranges and features a slew rate of 4.0V/μsec min, and settling time of 0.25 μsec/volt +2 μsec. It is packaged in a hermetically sealed Kovar case and meets MIL-STD-883 requirements.
Price (1-9).....$95-$155 depending on accuracy code.

Model 849 is a 13-bit resolution binary digital-to-analog converter with four quadrant operation (AC reference). It accepts serial data input, is MOS compatible (high threshold), and features low power dissipation.
Price (1-9).....$155-$185 depending on accuracy code.

Model 869 is a 13-bit resolution binary 4 quadrant multiplying digital-to-analog converter (external AC or DC reference). Model 869 accepts parallel input data (TTL/DTL) and operates with reference frequencies to 10kHz.
Price (1-9) .....$150-$240 depending on accuracy code.

Model 875 is an 8-bit TTL compatible successive approximation analog-to-digital converter. Model 875 includes the reference, ladder network, comparator and successive approximation logic and has serial and parallel outputs.
Price (1-9) $240

MINIATURE POWER AMPLIFIERS

These miniature, unity voltage gain power boosters are designed to supplement the performance of available IC amplifiers (also operate with most miniature hybrid or discrete packaged amplifiers).

Model	± Supply Range	Output Max. Range	Minimum Load Resistance	Price (1-9)
821	10 — 20V	±16V	100Ω	$30.00
822	10 — 20V	±16V	50Ω	35.00
823	10 — 30V	±26V	$\frac{30\ (E_O\ max.)}{E_{CC} - E_O\ max. - 1}$	8.95
824	18 — 30V	±27V	140Ω	40.00
866	10 — 20V	±16V	50Ω	40.00

MODEL 841 LADDER SWITCH

Features: 0 to 2 mV switch offset. 5 (±3) ohms "on" resistance. 200 ns rise and fall time. 0 to 5 mA load range. R_{ON} and V_{OFFSET} independent of reference voltage used.
Model 841-1 Price (1-9).....$100

LADDER NETWORKS

Helipot Ladder Networks are miniature binary and BCD devices for use in digital to analog conversion applications requiring high accuracy and fast switching over a wide temperature range.

Model No.	Standard "R" Values	Rsw Compensation	Best Standard Accuracy	Pricing 1-9
811 (Binary)	5K, 10K, 20K	5Ω Bits 1-4	±122 ppm — 55°C to + 125°C	811-B12 $40.00
812 (Binary)	50K, 100K	500Ω All Bits	±122 ppm — 55°C to + 125°C	812-B12 40.00
814 (Binary)	10K	5Ω Bits 1-5	±30 ppm @ + 25°C and ±61 ppm — 20°C to + 85°C	814-D14 90.00
815 (Binary)	10K	None	±1952 ppm — 55°C to + 125°C	815 6.95
862 (BCD)	50K, 100K	500Ω All Bits	±300 ppm — 55°C to + 125°C	862-B 45.00
813	Binary network for Fairchild μA722			17.50
863	BCD network for Fairchild μA722			17.50

Beckman INSTRUMENTS, INC. **HELIPOT DIVISION** 2500 Harbor Blvd., Fullerton, Calif. 92634

Beckman®

DIP INTERFACE NETWORKS

STANDARD ECL TERMINATORS

Beckman ECL Terminators are specifically designed for, and compatible with, the following Emitter Coupled Logic families:

- Motorola MECL 10,000 Series
- Signetics 10,000 Series ECL
- Fairchild 9500 Series ECL
- Texas Instruments Series SN10000 ECL
- National Semiconductor 10,000 Series ECL

Each terminator network utilizes thick film resistor materials with layouts specifically designed for low inductive characteristics and the high speed requirements of ECL systems. Where possible, the terminator networks include .01 μF decoupling capacitors. Each capacitor occupies the entire top surface of the ceramic substrate and consists of 2 metal plates and a single layer dielectric selected specifically for high capacitance at high frequency.

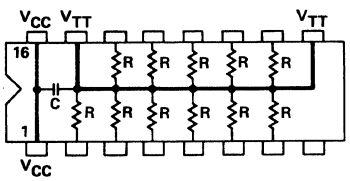


FIGURE 1 SERIES 898-41 —2.0 VOLT TERMINATORS

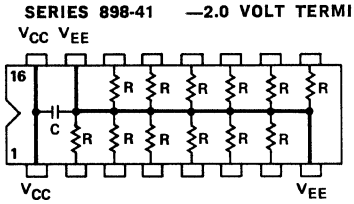


FIGURE 2 SERIES 898-42 —5.2 VOLT TERMINATORS

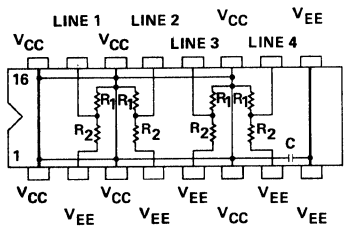


FIGURE 3 SERIES 898-43 THEVENIN EQUIVALENT TERMINATORS

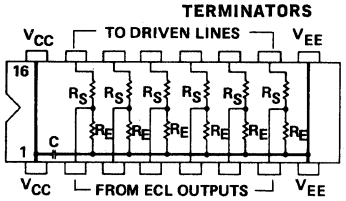


FIGURE 4 SERIES 898-44 SERIES LINE TERMINATOR

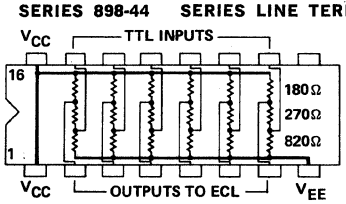


FIGURE 5 SERIES 898-45 TTL TO ECL TRANSLATOR

PRICES — ECL NETWORKS

1-99	100-499	500-999	1000
$2.50	$2.25	$1.50	$1.25

ECL Performance Specifications

Resistance Tolerance (+25°C)	R > 100Ω: ± 2% max.
	R < 100Ω: ± 2Ω max.
Resistance Temperature Coefficient	0 ± 100 ppm/°C
Capacitance Tolerance	0.01μf + 40%, − 20%
Capacitance Dissipation Factor	2% max.
Capacitor Voltage Rating	25 volts max.
Operating Temperature Range	−30°C to +85°C
Storage Temperature Range	−55°C to +125°C

STANDARD DIP INTERFACE NETWORKS

MODEL 899-19 RESNET™ DIP provides the passive attenuator network required for sense amp applications using the μA711 dual comparator.

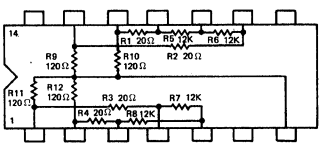


FIGURE 6 PASSIVE ATTENUATOR NETWORK

MODEL 899-40 RESNET™ DIP network provides the optimum termination resistance and threshold level for interfacing the Intel 1103 series with the Intel 3208A. It provides six 600 ohm resistors (R_3) for terminating six interconnecting bit lines. In addition, this network provides a voltage divider (R_1 and R_2) to supply the 150 mV Threshold level required for the 3208A. The Beckman Series 899-40 uses standard 5V TTL power for the threshold setting network.

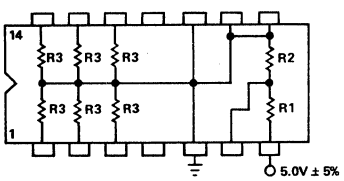


FIGURE 7 MEMORY — SENSE AMP INTERFACE

MODEL 899-60 DIODE NETWORK provides low capacitance, high conductance, and fast reverse recovery. It can be substituted for and will meet the electrical specifications of the following general purpose diodes:

IN914 IN4448 IN5318
IN4148 IN4532

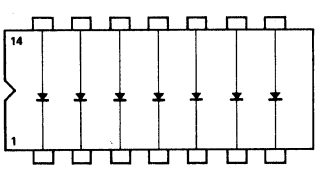


FIGURE 8 DIODE NETWORK

PRICES — INTERFACE NETWORKS

	1-99	100-499	500-999	1000
899-19	$2.20	$1.78	$1.55	$1.18
899-40	2.50	2.00	1.75	1.35
899-60	4.75	4.00	3.45	2.95

All prices and specifications subject to change without notice.

HYBREX

INTERNATIONAL AIRPORT INDUSTRIAL PARK
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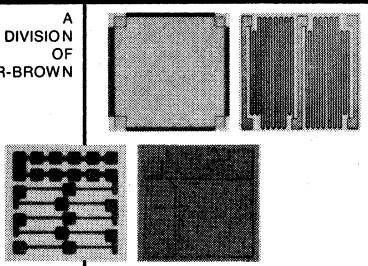
TEL.: 602-294-1431 • TWX: 910-952-1111

A DIVISION OF BURR-BROWN

Thin Film Chip Resistors
Resistor Arrays-Capacitors
Custom Hybrid Packaging
Custom Monolithic Circuits



THIN FILM CHIP COMPONENTS
for hybrid circuits. Available in chip and wafer form.

RESISTORS
Stable nichrome chip resistors, 250 mW power dissipation, gold backed, glass passivated.

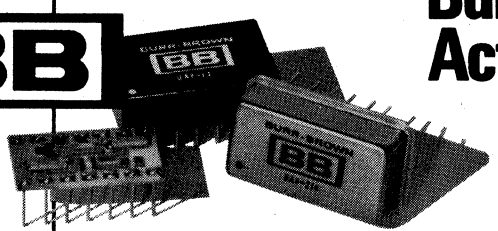
"S" SERIES
Resistance Range: 10 ohms to 3.6 megohms
Tolerance: 1%, 5%, 10%
Temperature Coefficient: 50 ppm/°C
Configuration: Center tap with 6 bonding pads
Chip Size: 30 X 30 mil to 80 X 80 mil

"E" SERIES
"R" Range: 10 ohms to 300 ohms
Tolerance: 1%, 5%, 10%, 20%
Temperature Coefficient: 50 ppm/°C
Configuration: 10 each "R" and 10 each 10 "R" per chip
Chip Size: 30 X 30 mil

CAPACITORS
Stable silicon dioxide chip capacitors, low leakage, low dissipation, gold backed.
Capacitance Range: 1 pf to 180 pf
Tolerance: 10%, 20%
Temperature Coefficient: 10 ppm/°C
Configuration: 1 capacitor/chip or 5 capacitors/chip
Chip Size: 25 X 25 mil and 40 X 40 mil

CUSTOM HYBRID PACKAGING
Hybrex is a major supplier to OEM's with unique circuit requirements. Hybrex has the capability to provide the right "mix" of all current technologies to best meet customer objectives including thick film, thin film, multichip hybrid and monolithic —plus in-depth engineering support. **For details on custom circuit capabilities, phone (602) 294-1431, and ask for a HYBREX Applications Engineer.**

BB Burr-Brown Active Filters



ATF 76 SERIES
This series of active filters is available with low pass, band pass, and band reject characteristics. These are complete factory-tuned units requiring no external components. They operate from ±15 volt dc power over a temperature range of −25°C to +85°C.

LOW PASS
Sixteen low pass active filter models are available in the ATF76 series. These are available with Butterworth (flat amplitude), Bessel (linear phase) or two choices of Chebyschev (sharp cutoff) responses with 2, 4, 6, or 8 poles. The cutoff frequency is user specified with standard values in the range of 0.001 Hz to 20kHz. Price (10-24) $25.50 to $116.00 depending on characteristics.

BAND REJECT (Notch)
The ATF76 series includes three standard notch filters with Q's of 2, 5, and 10 over the frequency range of 1 Hz to 20 kHz. At the users option the center frequency can be externally adjusted. Price (10-24) $36.00 to $40.00 depending on frequency.

BAND PASS
Ten standard "Q" selectivity band pass active filter models are available with single-tuned or stagger-tuned responses. Band pass filters are available with center frequencies (fc) from 1 Hz to 20 kHz and Q's from 1 to 50. Price range (10-24) $33.00 to $51.00.

UAF 10 and UAF 20—HYBRID UNIVERSAL FILTERS
These filters employ a multiloop negative feedback circuit which allows easy synthesis by the user of low pass, band pass, band reject, and high pass filters. The data sheet provides extensive applications information and tables of pole locations for standard filter responses (Bessel, Butterworth, and Chebyschev). All UAF's are available in either a 14 pin epoxy or a metal hermetic package with dual-in-line pin spacing.
UAF10 Standard Frequency
Range: DC to 20 kHz
Price (100-249) $16.00
UAF20 Wideband
Range: DC to 200 kHz
Price (100-249) $32.00

CUSTOM FILTERS
If a standard filter does not meet your special requirement Burr-Brown custom filter capability may offer you a significant advantage. Burr-Brown maintains a highly qualified staff to analyze, design and manufacture special filters. For special packaging or complex active filter requirements Burr-Brown uses its completely equipped hybrid microcircuit manufacturing capability.

BB BURR-BROWN
RESEARCH CORPORATION
International Airport Industrial Park • Tucson, Arizona 85706
TEL: 602-294-1431 • TWX: 910-952-1111 • Cable: BBRCORP

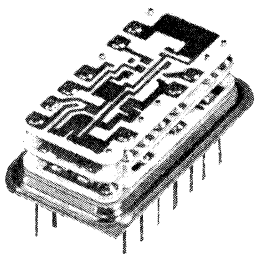
FOR BURR-BROWN INSTRUMENTATION AMPLIFIERS, POWER SUPPLIES AND OP AMPS, SEE SECTION 1100 / FOR BURR-BROWN DATA CONVERSION PRODUCTS OR ANALOG CIRCUIT FUNCTIONS, SEE SECTION 2000

amplifiers / DAC-ADC / multipliers-dividers
analog functions/modular power supplies
active filters/data conversion products

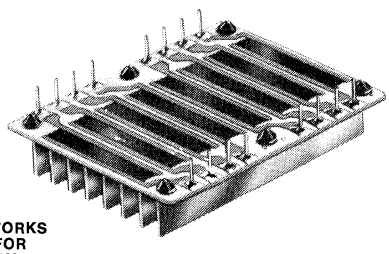
CTS MICROELECTRONICS, INC.

HYBRID CIRCUITS

TOTAL CAPABILITY IN HYBRID CIRCUITRY

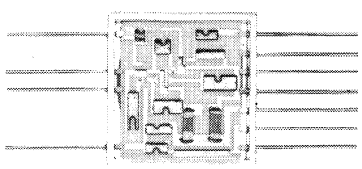


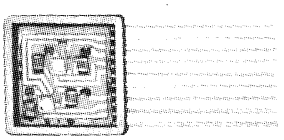
- IMPLANTABLE GRADE MEDICAL ELECTRONICS

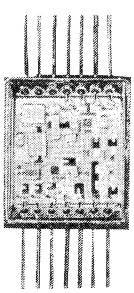


- CUSTOM RESISTOR NETWORKS AND HYBRID CIRCUITS FOR THE COMPUTER INDUSTRY

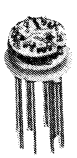
- Pioneers of the hybrid industry . . . first Cermet thick film circuits built in 1959.
- Packaging flexibility . . . including flat packs, TO-5, TO-8, plug-in packages, hermetic and non-hermetic DIP's and custom assemblies.
- Multilayer capability . . . more than ten conductor layers can be used to provide the highest circuit density available.
- Prototype and production facilities offer fast turn-around for low quantity orders and high volume requirements.
- Microsystems capability can provide a hybrid system in addition to individual requirements.
- Reliability is inherently high as a result of superior quality.



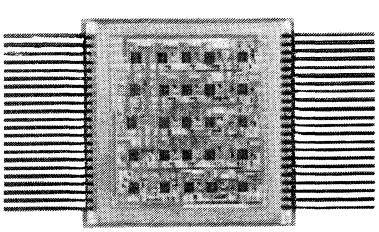




- HIGHEST RELIABILITY FOR AIRBORNE AND AEROSPACE EQUIPMENT



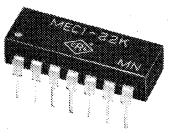
- D/A CONVERTERS
- VCO CIRCUITS
- CUSTOM MSI CIRCUITRY
- HYBRID MEMORIES



ORDERING INFORMATION: Place hybrid circuit orders at the following address:
CTS Microelectronics, Inc., P.O. Box 1278, Lafayette, Indiana 47902 • Telephone (317) 463-2565 • TWX 810-342-1882

CENTRALAB THICK FILM CIRCUITS

STANDARD DUAL-IN-LINE CERMET RESISTOR NETWORKS



PERFORMANCE SPECIFICATIONS

Substrate Material: 95% Alumina Ceramic
Dielectric Constant: 8.89
Thermal Conductivity: 0.053 cal./CM²/SEC/°C @ 100°C

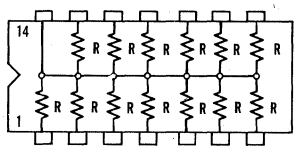
Conductive Inks: Palladium/Gold

Resistors:
Sheet Resistivity: 30 ohm/□ to 1 megohm/□
Resistor Values: 10 ohm to 10 megohm (typical)
Voltage Coefficient (+25°C): −0.002%/volt (typical)
Tolerance: ±1.0%
TCR (−55°C to +150°C): ±100ppm/°C
TC Tracking: 50ppm/°C max.
Temperature Range (Operating): −55°C to +125°C
Temperature Range (Storage): −55°C to +125°C

AVAILABLE RESISTOR VALUES (OHMS)

Series MEC-1 — 13 Resistor "Pull-up" Network, 14 Pin Package

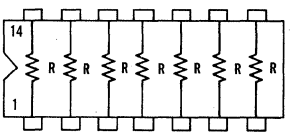
100	1.0K	6.0K	Individual resistor power rating 0.200 watts max. @ +25°C, still air. Total package power rating 2.5 watts max.
150	1.5K	6.8K	
220	2.0K	10.0K	
330	2.2K	15.0K	
470	3.3K	22.0K	
680	4.7K		



MEC-1

Series MEC-2 — 7 Resistor Network, 14 Pin Package

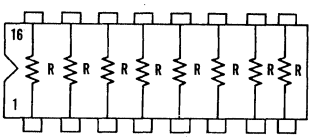
68	470	4.7K	Individual resistor power rating 0.250 watts max. @ +25°C, still air. Total package power rating 2.5 watts max.
100	680	6.8K	
110	1.0K	10.0K	
150	1.5K	15.0K	
220	2.2K	22.0K	
330	3.3K		



MEC-2

Series MEC-3 — 8 Resistor Network, 16 Pin Package

68	470	4.7K	Individual resistor power rating 0.250 watts max. @ +25°C, still air. Total package power rating 2.5 watts max.
100	680	6.8K	
110	1.0K	10.0K	
150	1.5K	15.0K	
220	2.2K	22.0K	
330	3.3K		



MEC-3

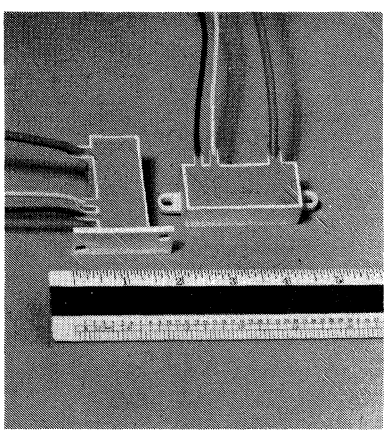
HIGH VOLTAGE RESISTORS*

These modules were especially designed for color television to perform the following useful functions:

- Provide a load on the CRT high voltage supply to improve high voltage regulation and thereby aid peak voltage limiting to help TV manufacturers meet the government's X-ray radiation limitations.
- Provide a focus voltage for the CRT from a tap between the two resistors in the module.
- Discharge the high voltage supply when the TV is turned off.

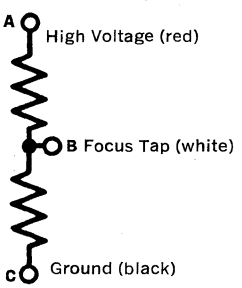
Other applications include: CRT terminals, x-ray equipment, electrostatic copy machines, and many applications requiring high voltage resistors.

*Patent Applied For.



Part numbers 418-8-H and 418-8-V listed under Underwriters Laboratories file E32296.

STANDARD RATINGS:



R_{AC} = 240 MΩ ±20%
(other values available)
$\frac{V_{AC}}{V_{BC}}$ = 6 ±5%
TCR = 0 ±250 PPM/°C
Voltage coefficient = 2 PPM/Volt
Operating voltage = 25 kV
Max. Operating Ambient = +70°C

CUSTOM HYBRID CIRCUITS

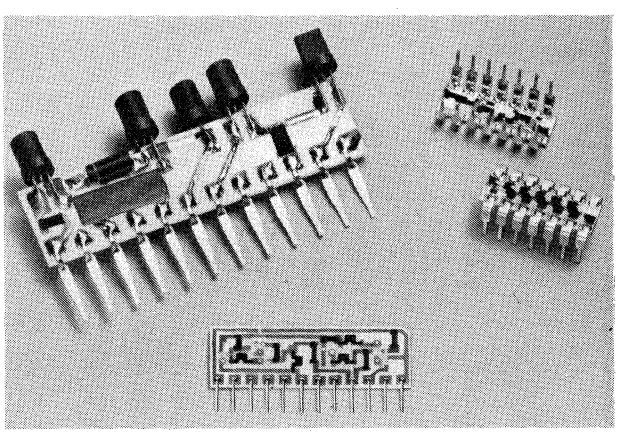
Centralab offers the flexibility to design and fabricate thick film modules to fit virtually any application and cost parameter.

Low-cost silver/carbon or PEC® systems for consumer applications.

- **Resistor Range** 10 ohms to 10 megohms
- **Resistor Tolerance** ±10% preferred minimum
- **Ratio Matching** ..... ±5% minimum
- **Capacitor Types** .. Ceramic and tantalum
- **Active Devices** Diodes, transistors & IC's
- **Operating Temp. Range** −55°C to +85°C

Noble metal/cermet or MEC systems for commercial and industrial uses:

- **Resistor Range** 3 ohms to 3 megohms
- **Resistor Tolerance** .... ±.5% minimum
- **Ratio Matching** ..... ±1% minimum
- **Capacitor Types** .. Ceramic and tantalum
- **Active Devices** Diodes, transistors & IC's
- **Operating Temp. Range** −55°C to +150°C



CENTRALAB Electronics Division • GLOBE-UNION INC.
5757 NORTH GREEN BAY AVENUE • MILWAUKEE, WISCONSIN 53201 • (414) 228-1200
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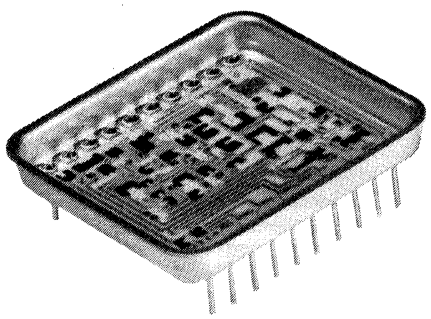
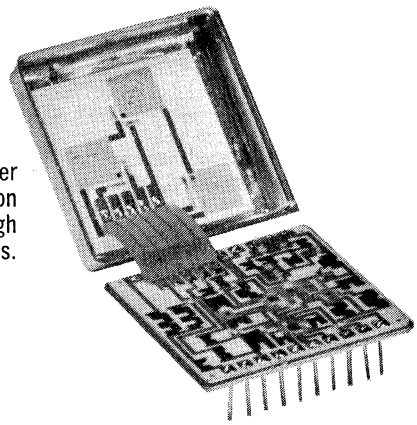
COLUMBIA COMPONENTS-HYBRID CIRCUIT DIVISION

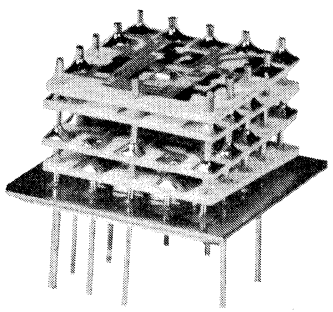
- Innovators in Packaging Thick Film Microcircuits Since 1965
- Miniaturization Without Loss of Reliability or Long Life
- High Yields thru Absolute Control of Processes Mean Low Cost to You
- Complete Manufacturing Capability in Custom Hybrids from Prototypes to High Volume
- Infinite Variety of Standard and Custom Ceramic, Plastic, and Metal Housings Including TO-5, TO-8, Flat Pack, Platform, and Butterfly Cases with Hermetic Sealing
- High Power Dissipation
- Modern Die and Wire Bonding Techniques and Equipment
- Processing per MIL-STD-883 and MIL-M-38510 Available



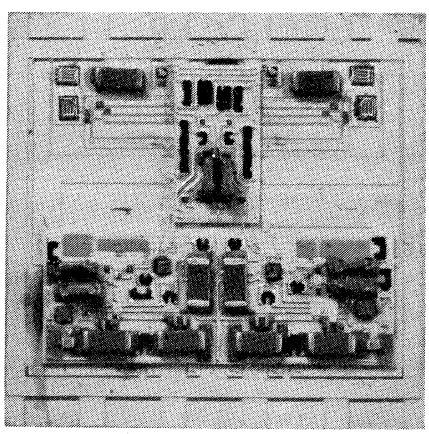
Ultra Reliable Digital Circuitry for Aerospace Environment Processed Per MIL-M-38510 and MIL-STD-883.



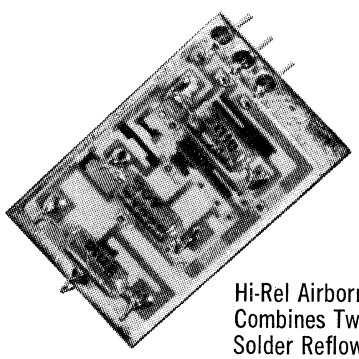
Extra High Power Dissipation Achieved through Dual Substrates.



Multi-Stacked Hybrid Computer Memory Illustrates One Type of Dense Packaging.



Multi-Layer "Mother Board" with Two Sub-Boards to Improve Thermal Dissipation and Increase Yield on Complex Hi-Gain Medical Amplifier



Hi-Rel Airborne Altitude Monitor Combines Two Technologies — Solder Reflow of Discrete Capacitors and Eutectic Die Bonding of Chips.

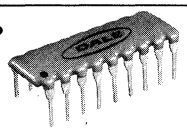
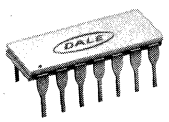
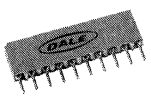
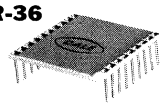
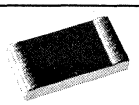
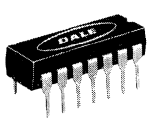
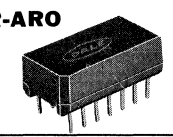
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

COMPUTER INSTRUMENTS CORPORATION /92 MADISON AVE., HEMPSTEAD, N.Y. 11550/516-483-8200

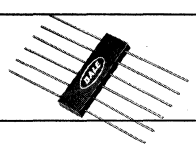
DEPENDABLE DALE® MICROCIRCUITS

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

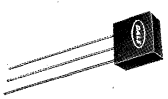
THICK FILM and DISCRETE NETWORKS

TYPE	BASIC DESCRIPTION	NO. OF PINS	CONDENSED SPECIFICATIONS
CDP 	DIP style with flame retardant coating. Suitable for automatic insertion. Also available in double width style.	14, 16, 18 (up to 24 in double width)	**Power Rating:** 1/8 watt maximum/resistor; maximum/package = 1-1/4 watts **Resistance Range:** 10Ω to 1 Meg. **Tolerance:** ±2%, 5%, 10% **T.C.:** ±200 PPM/° C
SDP 	DIP style with sandwich-type construction. Suitable for automatic insertion.	14, 16, 18	**Power Rating:** 1/8 watt maximum/resistor; maximum/package = 1-1/4 watts **Resistance Range:** 10Ω to 1 Meg., depending on tolerance **Tolerance:** ±1%, 2%, 5%, 10%, 20% **T.C.:** ±200 PPM/° C
SIP 	Single in-line package with epoxy coating.	4, 6, 8, 10	**Power Rating:** .1 watt maximum/resistor; maximum/package =1-3/8 watts **Resistance Range:** 10Ω to 1 Meg., depending on tolerance **Tolerance:** ±1%, 2%, 5%, 10%, 20% **T.C.:** ±200 PPM/° C
CSP	Single in-line package with flame retardant epoxy coating.	4, 6, 8, 10	**Power Rating:** 1/8 watt maximum/resistor; maximum/package = 1-1/4 watts **Resistance Range:** 10Ω to 1 Meg., depending on tolerance **Tolerance:** ±1%, 2%, 5%, 10%, 20% **T.C.:** ±200 PPM/° C
TKR-36 	Binary ladder network designed for precision digital to analog conversion. Double-width DIP style package with flame retardant epoxy coating.	20	**Resistance Values:** 1K, 5K, 10K, 20K **Accuracy:** ±1/2, 1, 2 LSB **Tolerance:** ±5% typical
RC 	Thick film chip resistor with choice of sizes to allow wide design flexibility in hybrid circuitry.	None	**Power Rating:** 75, 100, 150 and 300 mw **Resistance Range:** 100Ω to 500KΩ **Tolerance:** ±1%, 2%, 5%, 10%, 20% **T.C.:** ±200 PPM/° C
FDP 	DIP style with up to 11 discrete resistive elements. Suitable for automatic insertion. Meets functional requirements of MIL-R-10509 and MIL-R-55182.	14, 16	**Power Rating:** .05 watt maximum/resistor; maximum/package = 1/2 watt **Resistance Range:** 100Ω to 100KΩ **Tolerance:** .25% to 5% (1% standard) **T.C.:** 25 PPM/° C to 200 PPM/° C
SPR-ARO 	DIP style with up to 11 discrete resistive elements. For use where tight tolerance and low temperature coefficient are required. Meets functional requirements of MIL-R-10509 and MIL-R-55182.	14, 16	**Power Rating:** .1 watt maximum/resistor; maximum/package = 1 watt **Resistance Range:** 10Ω to 400KΩ **Tolerance:** .05% to 5% **T.C.:** 10 PPM/° C to 200 PPM/° C

SPECIALTY NETWORKS

	Discrete precision wirewound and film resistors packaged to your requirements and providing broad flexibility in meeting electrical and physical requirements.

REJECTION FILTER

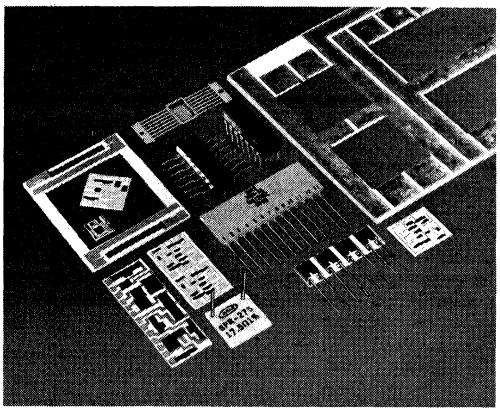
	Low cost, small size. In 50, 60, 150 Hz models. Moderate attenuation. Plastic case.

DEPENDABLE DALE® MICROCIRCUITS

THICK FILM MICROCIRCUITS

FEATURES

- Custom design allows you to specify design tolerance, packaging, environmental requirements.
- Engineering assistance for production design.
- Specialists in design of networks for high power dissipation.
- Standard dual in-line packaging or modular packaging with screened silicone coating and choice of lead types.
- Wide choice of pre-conditioning options.



ELECTRICAL CAPABILITIES*

Resistors

Tolerance: To 1% standard. Specials available.
Matching Resistance Ratio: ±0.2%
Temperature Coefficient: ±100-250 PPM/° C
T.C. Tracking: Down to 25 PPM
Resistivity: 10 ohms to 100KΩ/sq.
Resistance: 1 ohm to 1 Meg.
Stability: 1%/yr.
Power Dissipation: Depending on design and package requirements

Capacitors

Tolerance: ±10% standard. **Voltage:** 50-100 VDC **Capacitance:** 10 pf-.1 mfd

PHYSICAL

Capacitors: Tantalum, Ceramic (W or NPO characteristic)
Substrates: Alumina, Beryllia
Terminations: Wire Leads, Ribbon Leads or Solder Pads
Conductors and Land Areas: Platinum Gold, Palladium Gold, Gold, Palladium Silver
Crossovers: As required
Packaging: Dual in-line, single in-line, custom
Coating: Screened Silicone, epoxy, custom

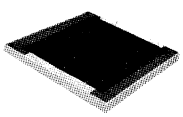
*For tighter parameters, contact Microcircuit Department.

PRECONDITIONING OPTIONS

- Power Aging
- Temperature Cycling
- Temperature & Power
- Temperature Aging
- Short Time Overload
- Thermal Shock
- X-Ray

To obtain prototypes for your circuit... contact your Dale representative or phone or write Dale at the address below. Dale's Microcircuit Department is geared to assist you with every phase of design—providing the shortest possible leadtime between concept and production ready component.

THICK FILM CHIP RESISTOR



Resistance Range: 100Ω to 300K. 10Ω to 5 Meg. by special order
Tolerance: ±20%, ±10%, ±5%, ±2%, ±1%
Temp. Coefficient: ±200 PPM (−55° C to +150° C) +25° C Reference
Load Life: 1% ΔR, 1000 hours at 80° C
Humidity: 1% ΔR per MIL-STD-202C
Temp. Cycling: −55° C to +150° C, ±0.5% ΔR
Operating Voltage: 100 VDC maximum

PHYSICAL	SIZE CODE	POWER RATING
.050 x .050	550	75mw
.050 x .075	575	100mw
.050 x .100	5100	150mw
.050 x .150	5150	300mw

WIREWOUND and FILM PACKAGED NETWORKS

FEATURES

- Choice of linear wirewound, bobbin wirewound, metal film, carbon film or cermet elements
- Less components to stock or handle
- Reduced inspection time
- Ease of assembly
- Matched resistors cannot be mixed or lost
- Complete environmental protection
- Dale networks meet or exceed requirements of MIL-R-26, MIL-R-93 or MIL-R-10509, depending on type of element used
- Packaged to meet your requirements

GENERAL RESISTOR ELECTRICAL CAPABILITIES

	WIREWOUND	FILM (Carbon & Metal)
Power Rating	.1 to 10 W	.02 to .5 W
Resistance Range	1 ohm to 1.5 Meg.	5 ohms to 5 Meg.
Tolerance	.02% to 1%	.1% to 1%
Tolerance Match	.005%	.05%
Temp. Coefficient	5 PPM/°C from 0° C to +75° C	25 PPM/° C
Temp. Coefficient Match	2 PPM/° C from 0° C to +75° C	7 PPM/° C
Resistance Stability	.005%/yr.	.03%/yr.
Operating Temp.	−65° C to +145° C	−55° C to +175° C

LADDER NETWORKS

- **Output Accuracy:** ± .05% full scale accuracy or ± 1/2 least significant bit, whichever is less.
- **Output Variation with Temp.:** ± .1% full scale accuracy or ± 1 least significant bit, whichever is less.
- **Operating Temp. Range** (For Accuracies Specified Above): −55° C to +70° C (Film Type) −55° C to +125° C (Wirewound Type).
- **Input Resistance** (All inputs connected): 1KΩ to 500KΩ
- **Output Resistance** (All inputs grounded): 250Ω to 125KΩ
- **Insulation Resistance:** 100 Megohms minimum.
- **Terminals:** Solderable or weldable wire leads.
- **Packaging:** Epoxy or Silicone resin potting. Transfer molded, Can be encapsulated. Other types of special packaging available to meet your requirements.

BINARY DIGITAL-TO-ANALOG LADDER NETWORKS

Resistor Parameters for meeting 4 and 8 bit dimensional requirements

	WIREWOUND	FILM
Power Rating	1/8 watt from −55° C to +125° C, derated linearly to 0 at +145° C	1/2 watt from −55° C to +70° C, derated linearly to 0 at +145° C.
Temp. Coefficient	0 ±20 PPM/° C from −55° C to +125° C. Lower T.C.'s available upon request	400 PPM/° C max. T. C.'s available down to 25 PPM/° C
Heat Rise	20° C max. at rated power	60° C max. at rated power

DALE ELECTRONICS, INC., Box 74, Norfolk, Nebraska 68701 Phone: 402-371-0080
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

Electronic
LABORATORY SUPPLY COMPANY

ELECTRONIC LABORATORY SUPPLY COMPANY offers a stock of over one million I.C.s in more than three hundred standard numbers for both commercial (0° to +75°C) and military (-55°C to +125°C) temperature ranges . . . available in plastic 14-pin and metal/glass 14-pin dual-in-line, 1/8" x 1/4" flat-packs, 1/4" x 1/4" metal flat-packs, and TO configurations. Many of these devices are available in chip form, as well as raw packages, for the hybrid manufacturer. All devices are 100% guaranteed to meet manufacturers specifications . . . and at the **lowest prices.**

INTEGRATED CIRCUITS

Basic Nos. Below Preceded by WC/WM or RC/RM indicating W or R Mfr. & Temp. Range Class.
Nos. followed by suffix letter denoting package style (SUHL Nos. use suffix only)

Most items available in:
Com'l. Temp. Range 0 to +75°C (C)
Mil Temp. Range -55 to +125°C (M)

Most items available in:
Plastic 14-Pin DIL (D)
Metal/Glass 14-Pin DIL (K)
1/8 x 1/4 Metal Flat Pack (G)
1/4 x 1/4 Metal Flat Pack (Q)
TO-5 Can (T)

DTL DIGITALS (W&R)					TTL DIGITALS (W ONLY)				LINEARS–PERIPHERALS (W&R)				
201	227	267	432	530	948	6F130	6G140	7430	112	174	334	591	813
202	229	268	433	537	951	6F132	6G182	7440	115	181	335	592	815
204	231	270	436	539	962	6F133	6G210	7450	130	183	343	701	816
206	233	272	438	545	1000	6F201	6G211	7451	132	185	364	702	817
208	234	279	439	547	1001	6F202	6G213	7460	133	187	366	708	846
210	236	280	450	548	1003	6F211	6G222	7470	134	193	368	709	858
211	237	284	451	555	1004	6F213	6G240	7472	136	194	370	710	882
212	239	285	452	822	1033	6F250	6G241	7473	140	275	371	711	886
213	241	286	456	832	1226	6F251	6G242	7474	142	276	373	720	887
214	245	288	458	833	1227	6F252	6G243		144	286	374	726	888
215	246	289	461	843	1230	6F253	6G260		150	287	377	728	904
216	247	290	462	898	1231	6F260	6G261		151	306	379	730	921
217	248	291	463	899	1237	6F261	6G262		153	311	380	745	1146
218	255	292	464	930	1238	6F262	6G263		154	316	386	747	1488
220	257	295	470	932	6175	6F263	6G271		155	318	387	749	1709
221	258	296	492	933		6G40	6G272		161	321	459	750	3181
222	261	297	495	934		6G130	6G273		167	322	460	803	4100
224	263	298	496	944		6G131	7400		168	324	479	809	4300
225	264	299	499	945		6G132	7410		170	326	480	811	
226	266	431	510	946		6G133	7420		171	330	491	812	

TRANSISTORS

ELECTRONIC LABORATORY SUPPLY COMPANY offers a wide variety of transistors including standard and special germanium and silicon types. Particular emphasis is placed on the availability of RF Power devices ranging from 1.0 watt @ 400 MHz to 40.0 watts @ 175 MHz.

GERMANIUM TYPES		
2N110	2N1302	2N1750
2N128	2N1303	2N1752
2N167	2N1304	2N1754
2N169	2N1305	2N1864
2N240	2N1306	2N1866
2N344	2N1307	2N1867
2N345	2N1308	2N1868
2N346	2N1309	2N2048
2N388	2N1495	
2N393	2N1499-A	
2N404	2N1500	
2N496	2N1742	
2N499-A	2N1743	
2N501-A	2N1744	
2N502-A/B	2N1745	
2N503	2N1745	
2N600	2N1746	
2N1122-A	2N1747	
2N1158-A	2N1748	
2N1204-A	2N1749	

SILICON TYPES						
2N327-A/B	2N722-A/B	2N929-A	2N1028	2N2194-A/B	2N2369-A	2N3251-A
2N328-A/B	2N744	2N930-A/B	2N1034	2N2195-A/B	2N2484-A	2N3439
2N329-A/B	2N760-A/B	2N935	2N1035	2N2217	2N2604	2N3440
2N336	2N859	2N936	2N1037	2N2218-A	2N2605	2N3904
2N337	2N860	2N937	2N1118	2N2219-A	2N2800	2N3906
2N338	2N861	2N938	2N1119	2N2220	2N2801	2N3910
2N656-A	2N862	2N940	2N1131-A	2N2221-A	2N2837	2N3911
2N657-A	2N863	2N941	2N1132-A/B	2N2222-A	2N2838	2N3912
2N696-A	2N864	2N942	2N1613-A/B	2N2243-A	2N2904-A	2N3913
2N697-A	2N865	2N943	2N1711	2N2274	2N2905-A	2N3914
2N698	2N910	2N944	2N1890	2N2275	2N2906-A	2N4036
2N699-A/B	2N911	2N945	2N1893	2N2276	2N2907-A	2N4400
2N706-A/B/C	2N912	2N956	2N2102-A	2N2277	2N3019	2N4401
2N708	2N914	2N957	2N2185	2N2278	2N3020	2N4402
2N718-A	2N915	2N1024	2N2186	2N2279	2N3053	2N4403
2N719-A	2N916-A	2N1025	2N2187	2N2280	2N3058	2N4427
2N720-A	2N917-A	2N1026	2N2192-A	2N2303	2N3059	2N5401
2N721	2N918	2N1027	2N2193-A/B	2N2369	2N3250-A	

RF PRODUCTS

JEDEC

Type	Description	Pkg.
2N3375	3.0 watts min. at 400MHz – 28V	TO60
2N3553	2.5 watts min. at 175MHz – 28V	TO39
2N3632	13.5 watts min. at 175 MHz – 28V	TO60
2N3733	10 watts min. at 400 MHz – 28V	TO60
2N3866	1.0 watt min. at 400 MHz – 28V	TO39
2N4428	750mW min. at 500 MHz – 28V	TO39
2N4429	1.0 watt min. at 1.0GHz – 28V	MT59
2N4430	2.5 watts min. at 1.0GHz – 28V	MT66
2N4431	5.0 watts min. at 1.0GHz – 28V	MT66
2N4440	5.0 watts min. at 400 MHz – 28V	TO60
2N5016	15.0 watts min. at 400MHz – 28V	TO60 (G)
2N5090	1.2 watts min. at 400MHz – 28V	TO60
2N5589	3.0 watts min. at 175MHz – 13.6V	MT71
2N5590	10.0 watts min. at 175MHz – 13.6V	MT72
2N5591	25.0 watts min. at 175MHz – 13.6V	MT72
2N5641	7.0 watts min. at 175MHz – 28V	MT71
2N5642	20.0 watts min. at 175MHz – 28V	MT72
2N5643	40.0 watts min. at 175MHz – 28V	MT72

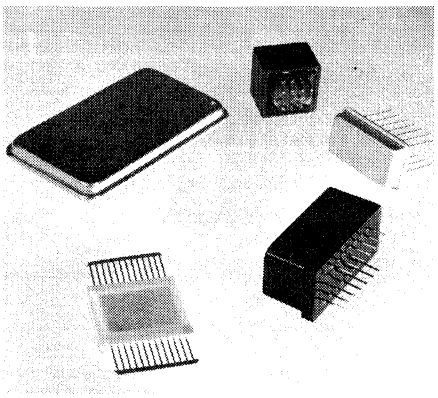
NON JEDEC

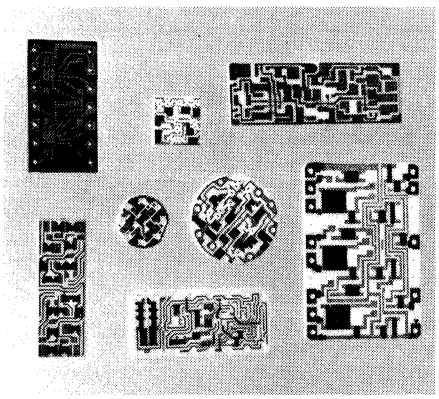
Type	Description	Pkg.
S708	dual chip 2N3866	TO-60
S739	2N3866	MT59C
S3006	2N3866 F_t 1.4GHZ–1.0W@1GHZ–28V	MT66
S3010	2N3866 F_t 1.2GHZ–1.5W@400MHZ–28V	MT59
S1010	2N4431 F_t 1.0GHZ–5W@1GHZ–28V	HERM-STRIP
S1000	2N4430 BW@1GHZ–28V	MT59
S1050	10W@1GHZ W/F_t 1.5GHZ	3LPT
S1051	9W@1GHZ W/F_t 1.5GHZ	MT59
S2002	2W@1GHZ W/F_t 1.2GHZ	MT66
V409	40W@260MHZ–28V W/F_t 300MHZ	TO-60
V410	20W@400MHZ–28V W/F_t 700MHZ	TO-60

CATV

S3008	dual chip 2N3866 W/F_t 700MHZ	TO-60

THICK FILMS
Substrates to Hybrids

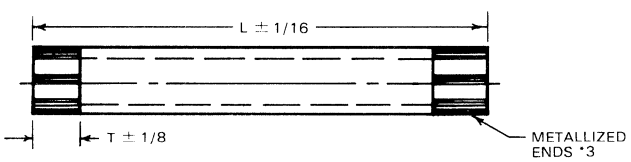




When you want to miniaturize, utilize our custom hybrids. They are the perfect solution to your problem of size! Or build your own if you prefer. But to build the best hybrids, be sure to start with the best materials . . . HTC thick film substrates, the finest thick film design available! In addition to the highest quality product, we offer:

- 2 to 4 week proto time
- quality volume production with a capacity of six million annually
- packaging flexibility

NON-REACTIVE POWER RESISTORS



Specifications

	CL-12	CL-18
Power Rating (CW)	25KW*	60KW**
Tolerance	5%, 10%, 20%	5%, 10%, 20%
TCR	300ppm	300ppm
VCR	−20ppm/V/in	−20ppm/V/in
Maximum Operating Temperature	260°C	260°C
Reactance	Excellent @ 1.5 Gh	Excellent @ 1.5 Gh
Substrate Material	High Purity BeO	High Purity BeO
Contacts	Palladium/Silver	Palladium/Silver
Resistor Material	Cermet	Cermet

Dimensions

Length	12.00" ± .062	17.750" ± .062
Diameter (OD)	1.250" ± .031	2.000" ± .100

*Dissipated in water-cooled mode — 20GPM through resistor with turbulent flow at 15 ft/sec

**Dissipated in water-cooled mode — 60GPM through resistor with turbulent flow at 12 ft/sec

The above power ratings are designed to show performance in peak heat sinking conditions. Excellent lower dissipation may be obtained with no cooling or with Alumina substrates.

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Control time intervals, convert a low level input control signal into a high level output signal, or convert positive step voltages into differentiated positive output pulses.

Ledex standard microelectronic pulser and driver circuits give you the interface to drive solenoids, stepping switches, stepping motors and other electromechanical products.

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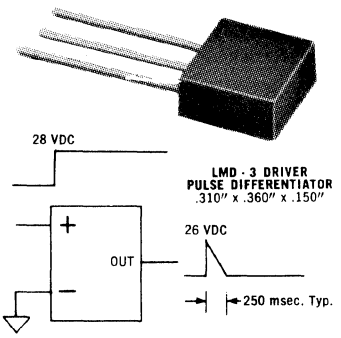
LMD-3 DRIVER PULSE DIFFERENTIATOR



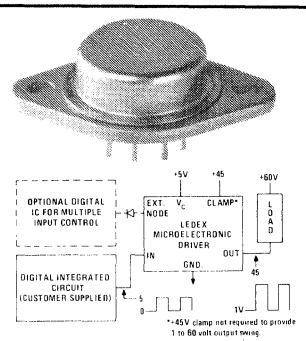
Hybrid microcircuit converts a positive step voltage into a differentiated positive output pulse. Useful as a driver for stepping switches and latching relays to reduce the average power or hold-in current when driving units with pulses of long duration. Upon application of an input pulse or voltage, a differentiated output pulse is produced which returns to zero, maintaining negligible standby power for continuous application of input voltage. Negative differentiation is inhibited on removal of applied voltage.

SPECIFICATIONS

	Value
Maximum input voltage	35VDC
Maximum output current	3 Amp
Maximum pulse rate	2PPS
Maximum V on drop	3V
Operating temp. range	0 to +100°C
Storage temp. range	−55 to +150°C
Pulse width	50 msec at 50% amplitude

Other Voltages and Output waveshapes on request.

LMD-5 POWER DRIVER
Switches 325 Watts

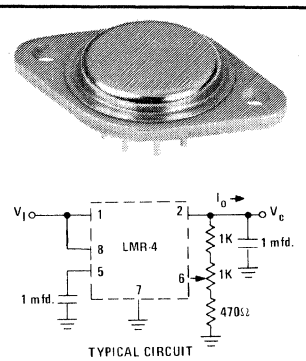


Hybrid power driver, up to 7 amperes, converts low level input signals into levels high enough to drive heavier loads, such as solenoids and motors. Includes conventional DTL input with non-inverting sinking output stage, expander node terminal for logic input control from other sources of system, and negative-going-transient protection in output circuit.

SPECIFICATIONS

	Value
Control voltage	+12V
Output voltage	+65V
Continuous current	5 Amp
Pulsed current	7 Amp
Operating temp. range	−65 to +150°C

LMR-4 VOLTAGE REGULATOR
Regulates up to 150 Watts; Optional Built-in Rectifier

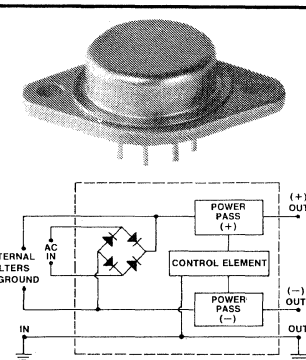


When you need a precision voltage regulator with a typical line regulation of 0.02%, try the LMR-4. This low profile TO-3 thick film hybrid circuit consists of an adjustable series regulator capable of regulating 8 to 50 volt DC power supplies. It includes an internal FET current source to give you excellent ripple rejection (40 db minimum). The LMR-4 permits the use of smaller filter capacitors. It can also be used as a driver for higher current regulators.

SPECIFICATIONS

Parameter	Typ.	Max.
Input voltage	—	60V
Output voltage	8 to 50V	8 to 50V
Load current	1 Amp	3 Amp
Line regulation	0.1%	0.2%
Load regulation	0.2%	0.5%
Power dissipation	10 Watts	25 Watts

LMR-11 VOLTAGE REGULATOR
Regulates Plus & Minus Voltages



The LMR-11 voltage regulator, also available with built-in rectifier, is a thick film hybrid plus-minus regulator designed for positive and negative voltages at currents up to 1 ampere per side. It includes a current limiter. Output, which is externally adjustable from 8 to 22 volts, is internally set for ±15 volts. Line and load regulation is 0.1%. When required, it can be supplied to meet provisions of MIL-STD-883.

SPECIFICATIONS

Parameter	Min.	Typ.	Max.
Input voltage	—	—	26V
Input to load voltage differential	3.0V	—	—
Output voltage	14.5V	15V	15.5V
Load current	1 Amp	1.2 Amp	—
Output voltage match	—	60mV	400mV
Ripple rejection	40dB	60dB	—
Line regulation	—	30mV	100mV
Load regulation	—	30mV	100mV

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LINEAR BIPOLAR INTEGRATED CIRCUITS

MATCHED TRANSISTOR ARRAYS

Type	Description	h_{FE} V_{CE}=5V	h_{FE} Match Min.	$\triangle V_{BE}$ (I_C=1mA) V_{CE}=5V	BV_{EBO} V min.	V min. BV_{CIO}	BV_{CEO} V min.	C_{OB} pF	$\partial\triangle V_{BE}/\partial T$ V/°C	Pkg. Code
SL360C	Matched pair, f_T=2.5GHz	65 typ*	0.9	3 typ	4.8	30	8	0.7	—	T2
SL362	Matched pair, f_T=1.6GHz	70 typ	0.9	5 typ	5	20	8	1.0	—	T2
SL3045	Diff. pair + triplet array f_T=600MHz	40-100	—	5 max†	5	20	15	1.5 typ	2 typ	D1
SL3145	Diff. pair + triplet array f_T=2.5GHz	80 typ	—	.45 typ†	5	20	8	—	1.6 typ	D1

* V_{CE}=2V, I_E=5mA
† Applies to pair and to any two of triplet

SL300/3000 SERIES −55 to +125°C

The SL300/3000 series is a range of well matched epitaxial bipolar NPN transistors in various configurations. The transistors have exceptional low noise characteristics with typical fT values in excess of 2.5 GHz. The SL362 has a noise figure of 1.6 dB.

AUDIO POWER AMPLIFIERS

Type	Description	Power output* W r.m.s. typ.	Supply Voltage +V	Distortion %	Preamp. Z_{in} MΩ	Package Code
SL402D	Class AB audio power	2.5	12-18	0.3	20	D8
SL403D	amplifier with preamp.	3.5	12-18	0.3	20	D8

* Into 8 Ω load

The audio amplifiers listed are designed specifically for use in consumer equipment, offering savings in cost, space and power consumption at greater reliability compared with equivalent circuits using discrete components.

The audio power amplifiers include a peak current sensing circuit which gives complete short-circuit protection.

LINEAR R.F. AMPLIFIERS

Type	Description	Video Amp. Gain dB	Upper Cut-off Frequency MHz Carrier	Upper Cut-off Frequency MHz Video	Dynamic range dB	Pulse Response ns t_R	Pulse Response ns t_F	Package Code
SL510C	Detector plus video amplifier. Video O/P 6V pk into 600Ω	27	100	24	31	16	16	T3
SL511C	or 0.5V pk into 50Ω	33	100	14	28	16	16	T3

SL510/511

The SL510 and SL511 comprise an r.f. pulse detector operating up to 100 MHz and a video amplifier.

LIMITING/LOGARITHMIC WIDEBAND AMPLIFIERS

Type	Description	Voltage Gain @ 60MHz dB min.	Voltage Gain @ 60MHz dB max.	Frequency Range MHz	Max. Rectified Output min.	Max. Rectified Output max.	Propagation Delay ns typ.	Package Code
SL521A	Wideband limiting voltage	11.3	12.7	7-150	1.00mA	1.10mA	2.0	T2
SL521B	amplifier incorporating	11.0	13.0	7-140	0.95mA	1.15mA	2.0	T2
SL521C	low-level video detection	10.7	13.3	7-130	0.90mA	1.20mA	2.0	T2
SL530	True log. limiting amplifier	14 typ		4-85	1.0V pk		7.0†	T2, F1

† Group delay match over input range = 0.6 ns

SL520/521 SERIES

The SL520 series are limiting wideband amplifiers incorporating low level detectors. They can be used in successive detection log amplifiers in radar transponders, instrumentation and control systems. They can be directly coupled, and the supply is decoupled on chip.

SL530 SERIES

When cascaded, the SL530 provides a logarithmic response at the input frequency and retains phase information throughout the strip.

RADIO-COMMUNICATIONS CIRCUITS

Type	Description	Voltage Gain dB	Upper Cut-off Frequency MHz typ	Noise Figure dB	A.G.C. range dB	Signal handling @ 1% cross-modulation mV r.m.s. No a.g.c.	Signal handling @ 1% cross-modulation mV r.m.s. Full a.g.c.	Supply Current @ 6V mA typ	Package Code
SL610C	R.F./I.F.	18-22	140	4	50	100	250	15	T2
SL611C	amplifier with	24-28	100	4	50	50	250	15	T2
SL612C	a.g.c.	32-36	15	3	70	20	250	3.3	T2

Type	Description	Input Range for 4dB Output Change dB	Input Range for 2.5dB Output Change dB	Supply Current @ 6V mA	Package Code
SL620C	Voice operated gain-adjusting device (VOGAD). Generates, from a speech waveform, a d.c. level suitable for connection to a.g.c. input of SL630	—	35	3.1	T2
SL621C	SSB a.g.c. generator. D.C. output suitable for a.g.c. input of SL610/11/12	110	—	3.1	T2

SL600 SERIES OF FULL TEMPERATURE (−55 to +125°C)

The SL600 series is a range of fully compatible communications circuits which, when used together, will form an SSB/AM system operating up to 100MHz. Used separately, the series provides a comprehensive range of r.f. and i.f. amplifiers (with full a.g.c. and bandwidths up to 140 MHz), a.g.c. amplifiers, VOGAD amplifiers and audio amplifiers — plus double balanced modulators and mixers with carrier leaks which can be as low as −60dB.

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LINEAR BIPOLAR INTEGRATED CIRCUITS

RADIO-COMMUNICATIONS CIRCUITS (Cont'd.)

Type	Description	Voltage Gain to Sidetone Output - dB	Voltage Gain to Output dB	VOGAD Operating Threshold μV r.m.s	VOGAD Output Level mV r.m.s.	Attack Time ms (adjust.)	Decay Rate dB/s (adjust.)	Supply Current @ 6V mA	Package Code
SL622C	A.F. amplifier & VOGAD circuit with sidetone	29	52	100	90	20	20	14	T3

Type	Description	A.F. Output For an SSB Signal of 20mV r.m.s. mV r.m.s.	A.F. Output For an a.m. Signal of 125mV r.m.s. 80% modulated mV r.m.s.	A.G.C. Output With Respect to Signal Input V d.c. 125mV r.m.s.	A.G.C. Output With Respect to Signal Input V d.c. 200mV r.m.s.	Package Code
SL623C	SSB demodulator, a.m. detector a.m. a.g.c. generator	30	55	2.0	4.6	T3

Type	Description	Gain Control Range dB typ	Differential Input Gain dB	Max. Output V r.m.s. 6V Supply	Max. Output V r.m.s. 12V Supply	P_{out} mW max.	Supply Current @ 6V mA	Package Code
SL630C	Headphone/microphone amplifier with overload protection, a.g.c. and mute facilities	100	38-42	1.2	2.8	175	5	T3

Type	Description	Intermod-ulation Products dB typ	Signal Leak dB typ	Carrier Leak dB typ	Max. Input Before Limiting mV r.m.s.	Supply Current @ 6V mA	Package Code
SL640C	Double balanced modulator	45	−40	−40	210	12	T2
SL641C	Double balanced mixer	45	−18	−25	250	10	T2

Type	Description	Max. Input Frequency MHz	V_{IN} Single Ended mV	Input Signal Suppression dB (max)	Min. Output Current (F_{in}=40MHz mA p-p	Supply Current @ 5V mA	Package Code
SL645C	Square Law Device	200	600	−10	0.2	5	T2

Type	Description	High Frequency Limit	VCO Stability Power Supply %/V	VCO Stability Temp. PPM/°C	Supply Range	Package Code
SL650C	Phase Locked Loop	1MHz	0.05 typ	20 typ	±3 to ±12V	D-3

The SL622C is a microphone amplifier with VOGAD circuit providing constant amplitude audio output. A side tone is also provided.

The SL623C is a complex chip, containing an SSB demodulator, an a.m. detector and an a.m. a.g.c. generator

The SL645C is a two quadrant square law element. Can be used as a frequency doubler and mean square detector for AGC loops.

The SL650 is a phase locked loop element for signal generation/detection for modern, f.m. detector.

DIGITAL BIPOLAR INTEGRATED CIRCUITS

PROCESS CONTROL CIRCUITS

Type	Description	Input Voltage V High	Input Voltage V Low	f Max MHz	Power Supply Current mA max	Package Code
SP520	Gray code counter	3.0 min	0.5 max	1.0	70	D3
SP521	Binary rate multiplier	3.0 min	7.0	60	70	D3
SP522	Phase lock divider and comparator	3.0 min	2.0	60	70	D3

SP520/SP521/SP522

These circuits are 1MHz custom-design devices which are now being made generally available. Originally intended to be used together, the circuits may equally well be used separately and will be of particular interest to designers in the fields of Process Control and Numerical Control.

HIGH SPEED DIVIDERS

Type	Description	Input Frequency Range (sinusoidal) MHz‡	Input Frequency Range (square wave)‡¶	Input Voltage (single input) p-p	Output Voltage p-p min	Power Consumption mA typ	Package Code
SP601A & B	Divide-by-4	10-150 min	DC-150MHz	300-800mV	1500mV	18	T2
SP602A & B	Divide-by-2	40-500 min	DC-500MHz	400-800mV	350mV	12	T2
SP603A & B	Divide-by-2	40-400 min	DC-400MHz	400-800mV	400mV	12	T2
SP604A & B	Divide-by-2	40-300 min	DC-300MHz	400-800mV	400mV	12	T2
SP607B	Divide-by-2	40-600	DC-600MHz	400-800mV	400mV	12	T2

* BCD output level drives 2 TTL inputs † About +3.90 V reference ‡ Guaranteed ¶ $t_r < 25$ nS

CONTINUED

SP600 SERIES

The SP600 series is a range of binary divider circuits with very high operating frequencies made possible by advanced bipolar process technology. All devices can be operated with single or double driven inputs. The SP600 series dividers are available in two guaranteed operating temperature ranges: 'A' types: −55°C to +125°C, 'B' types: 0°C to +70°C.

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DIGITAL BIPOLAR INTEGRATED CIRCUITS

HIGH SPEED DIVIDERS (Cont'd.)

Type	Description	Input Frequency Range (sinusoidal) MHz‡	Input Frequency Range (square wave)‡¶	Input Voltage (single input) p-p	Output Voltage p-p min	Power Consumption mA typ	Package Code
SP613B	Divide-by-4	100-700	DC-700MHz	400-1200mV	600mV	60	D1
SP614B	Divide-by-4	100-800	DC-800MHz	400-1200mV	600mV	60	D1
SP615B	Divide-by-4	100-900	DC-900MHz	400-1200mV	600mV	60	D1
SP616B	Divide-by-4	100-1000	DC-1000MHz	600-1200mV	600mV	60	D1
SP620B	Divide-by-5	40-400	DC-400MHz	400-800mV	400mV	55	D1
SP621B	Divide-by-5	40-300	DC-300MHz	400-800mV	400mV	55	D1
SP622B	Divide-by-5	40-200	DC-200MHz	400-800mV	400mV	55	D1
SP630B	Divide-by-10	40-600	DC-600MHz	400-800mV	400mV	70	D1
SP631B	Divide-by-10	40-500	DC-500MHz	400-800mV	400mV	70	D1
SP632B	Divide-by-10	40-400	DC-400MHz	400-800mV	400mV	70	D1
SP634B	Divide-by-10	40-700	DC-700MHz	450-800mV	*	80	D2
SP635B	Divide-by-10 w/BCD outputs	40-600	DC-600MHz	450-800mV	*	80	D2
SP636B		40-500	DC-500MHz	450-800mV	*	80	D2
SP637B		40-400	DC-400MHz	450-800mV	*	80	D2
SP640A & B	Divide-by-10/11	DC-200	DC-200MHz	3.50-4.10V†	To +3V Into 50 Ω	50	D2
SP641A & B		DC-250	DC-250MHz	3.50-4.10V†		50	D2
SP642A & B	Programmable	DC-300	DC-300MHz	3.50-4.10V†		50	D2
SP643B		DC-350	DC-350MHz	3.50-4.10V†		50	D2
SP646A & B	Divide-by-10/11 Programmable w/TTL outputs	DC-200	DC-200MHz	3.50-4.10V†	3 TTL Gates	50	D2
SP647B		DC-250	DC-250MHz	3.50-4.10V†		50	D2
SP648B		DC-300	DC-300MHz	3.50-4.10V†		50	D2
SP650B	Divide-by-16	40-600	DC-600MHz	400-800mV	600mV	60	D1
SP651B	Divide-by-16	40-500	DC-500MHz	400-800mV	600mV	60	D1
SP652B	Divide-by-16	40-400	DC-400MHz	400-800mV	600mV	60	D1
SP655A & B	Divide-by-32	25-180 typ	DC-180MHz typ	300-800mV	+.4- +8.5V	10	T2
SP657A & B	Divide-by-20	25-180 typ	DC-180MHz typ	300-800mV		10	T2
SP659A & B	Divide-by-16	25-180 typ	DC-180MHz typ	300-800mV		10	T2
SP670A & B	Divide-by-8	40-600	DC-600MHz	400-800mV	600mV	50	D1
SP671A & B	Divide-by-8	40-500	DC-500MHz	400-800mV	600mV	50	D1
SP672A & B	Divide-by-8	40-400	DC-400MHz	400-800mV	600mV	50	D1

* BCD output level drives 2 TTL inputs † About +3.90 V reference ‡ Guaranteed ¶ $t_r < 25$ nS

Variations of temperature ranges and custom selected frequency ranges are available upon request.

PECL II (SP1000 & SP1200 SERIES)

Type 0°C to +75°C	Type −55°C to +125°C	Function	D.C. Output Loading Factor, Each Output	Propagation Delay ns typ	Total Power Dissipation mW typ
SP1001	SP1201	Single 6-I/P gate, 3 OR O/P with pulldowns 3 OR O/P with pulldowns	25	4.0	115
SP1002	SP1202	Single 6-I/P gate, 3 NOR O/P with pulldowns 3 NOR O/P without pulldowns	25	4.0	80
SP1003	SP1203	Single 6-I/P gate, 3 OR O/P without pulldowns 3 NOR O/P without pulldowns	25	4.0	40
SP1004	SP1204	Dual 4-I/P gate, 2 OR with pulldowns 2 NOR with pulldowns	25	4.0	95
SP1005	SP1205	Dual 4-I/P gate, 2 OR with pulldowns 2 NOR without pulldowns	25	4.0	65
SP1006	SP1206	Dual 4-I/P gate, 2 OR without pulldowns 2 NOR without pulldowns	25	4.0	45
SP1007	SP1207	Triple 3-I/P gate, 3 NOR with pulldowns	25	4.0	110
SP1008	SP1208	Triple 3-I/P gate, 1 NOR with pulldowns 2 NOR without pulldowns	25	4.0	75
SP1009	SP1209	Triple 3-I/P gate, 3 NOR without pulldowns	25	4.0	60
SP1010	SP1210	Quad 2-I/P gate, 4 NOR with pulldowns	25	4.5	115
SP1011	SP1211	Quad 2-I/P gate, 2 NOR with pulldowns 2 NOR without pulldowns	25	4.5	95
SP1012	SP1212	Quad 2-I/P gate, 4 NOR without pulldowns	25	4.5	65
SP1013	SP1213	85MHz a.c. coupled J-K flip-flop	25	6.0	125
SP1014	SP1214	Dual R-S flip-flop (+ve clock)	25	6.0	140
SP1015	SP1215	Dual R-S-flip-flip (−ve clock)	25	6.0	140
SP1016	SP1216	Dual R-S flip-flop (single rail, +ve clock)	25	6.0	140

FUNCTIONS AND CHARACTERISTICS @ $V_{cc} = OV$, $V_{EE} = -5.2V$, $T_A = +25°C$

The PECL II series of monolithic integrated logic circuits are a direct second source of the Motorola MECL II series. The family has been designed as a non-saturating form of logic so as to eliminate transistor storage time as a speed limiting characteristic and permits high speed operation.

PECL II circuits feature fast propagation delay times with commensurate rise and fall times, simultaneous complementary outputs, and excellent noise immunity as a result of near constant power supply drain.

FEATURES

- Propagation typically 4ns per logic decision.
- Excellent noise immunity characteristics
- Simultaneous OR/NOR outputs
- High fan-in and fan-out capabilities
- Internally temperature compensated

PLESSEY Semiconductors

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DIGITAL BIPOLAR INTEGRATED CIRCUITS

PECL II (SP1000 & SP1200 SERIES) (Cont'd.)

Type 0°C to +75°C	Type −55°C to +125°C	Function	D.C. Output Loading Factor, Each Output	Propagation Delay ns typ	Total Power Dissipation mW typ
SP1020	SP1220	Quad line receiver	25	4.0	115
SP1023	SP1223	Dual 4-I/P OR/NOR clock driver	25	2.0	250
SP1026	SP1226	Dual 3-4-I/P Transmission line and clock driver	25	2.0	140
SP1027	SP1227	120MHz a.c. coupled J-K flip-flop	25	4.0	250
SP1030	SP1230	Quad exclusive OR gate	25	5.0	130
SP1031	SP1231	Quad exclusive NOR gate	25	5.0	130
SP1032*	SP1232*	100 MHz a.c. coupled Dual J-K flip-flop	25	4.5	180
SP1033	SP1233	Dual R-S flip-flop (single rail, −ve clock)	25	6.0	140
SP1034	SP1234	Type D flip-flop	25	4.0	185
SP1035	SP1235	Triple line receiver	25	5.0	140
SP1039*	SP1239*	Quad level translator (PECL to saturated logic)	7 (DTL)	12	200
SP1040	SP1240	Quad latch with pulldowns	25	8.0	250
SP1047	SP1247	Quad 2-I/P AND gate	25	5.0	130
SP1048	SP1248	Quad 2-I/P NAND gate	25	5.0	130
SP1062*	SP1262*	Quad 2-I/P NOR gate	25	2.0	320
SP1063	SP1263	Quad 2-I/P NOR gate	25	2.0	320
SP1070	SP1270	Quad latch without pulldowns	25	8.0	200

* In 16- lead D.I.L. All other types are 14- lead D.I.L.

PECL III AND IIIA (SP1600 SERIES)

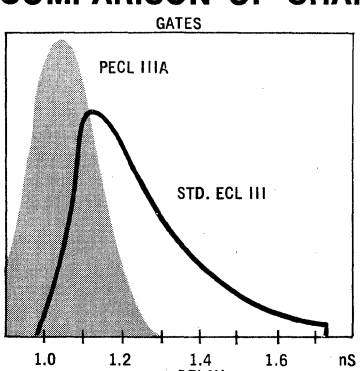
Type	Function	Propagation Delay @ 25°C When Driving 50 Ohm Load A - typ	A - Max	B - typ	B - Max	Power Dissipation mW (typ) No Load	Package Code A	B
SP1660	Dual 4 i/p OR/NOR (High Z)	1.0	1.4	1.1	1.7	120	S	DI/S
SP1661	Dual 4 i/p OR/NOR (Low Z)	1.0	1.4	1.1	1.7	120	S	DI/S
SP1662	Quad 2 i/p NOR (High Z)	1.0	1.4	1.1	1.7	240	S	DI/S
SP1663	Quad 2 i/p NOR (Low Z)	1.0	1.4	1.1	1.7	240	S	DI/S
SP1664	Quad 2 i/p OR (High Z)	1.0	1.4	1.1	1.7	240	S	DI/S
SP1665	Quad 2 i/p OR (Low Z)	1.0	1.4	1.1	1.7	240	S	DI/S
SP1666	Dual R-S Flip-Flop (High Z)	1.0	1.4	1.1	1.7	220	S	DI/S
SP1667	Dual R-S Flip-Flop (Low Z)	1.0	1.4	1.1	1.7	220	S	DI/S
SP1668	Dual clocked latch (High Z)	1.0	1.4	1.1	1.7	220	S	DI/S
SP1669	Dual clocked latch (Low Z)	1.0	1.4	1.1	1.7	220	S	DI/S
SP1670	Master Slave D type Flip-Flop (High Z) (C-C)	1.6	1.8	1.8	2.3	220	S	DI/S
SP1671	Master Slave D type Flip-Flop (Low Z)	1.6	1.8	1.8	2.3	220	S	DI/S
SP1690	UHF Prescaler Flip-Flop (High Z)	1.6	1.8	1.8	2.3	270	S	DI/S
SP1691	UHF Prescaler Flip-Flop (Low Z)	1.6	1.8	1.8	2.3	270	S	DI/S
SP1692	Quad Line receiver	1.0	1.4	1.1	1.7	220	S	DI/S

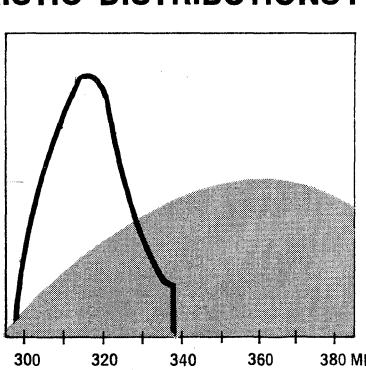
Flip-flop minimum toggle frequencies are 300 MHz for SP1670 and SP1671 and 500 MHz for SP1690 and SP1691.

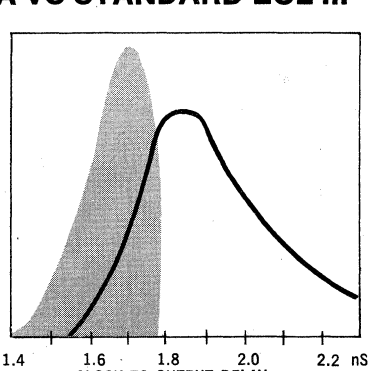
The SP1600 is a very high speed emitter coupled logic (ECL) range employing transistors in the non-saturating mode, and using Plessey Bipolar Process III technology is inherently the fastest type of integrated circuit logic series available. It is characterised by propagation delays around 1 nS and transition times less than 1.5 nS with 800 mV logic swing and offering a power delay product of 55 pJ.

The 'B' range of devices are a direct second source of the MECL III range whereas the 'A' range has improved dynamic performance. This ensures that the SPREAD in switching parameters is less under any drive conditions. This is a very important consideration in any logic system design.

COMPARISON OF CHARACTERISTIC DISTRIBUTIONS PECL IIIA VS STANDARD ECL III







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MEMORIES

MP4260/MP5260 DYNAMIC 1024-BIT R.A.M

Device Type	Temperature Range	Access Time Typical)	Cycle Time Read (min)	Cycle Time Write (min)	Power Dissipation	Package Code
MP 4260 D/N	−55 to +125°C	350 nS	600 nS	750 nS	400mW	D-2/P
MP 5260 D/N	−25 to +70°C	350 nS	500 nS	625 nS	400mW	D-2/P

The Plessey MP4260/MP5260 are 1024-word by 1 bit fully decoded random access memories using P-channel enhancement mode silicon gate MOS technology. The devices are bipolar compatible on all I/O lines except the precharge and read/write lines. They provide an efficient systems oriented approach to memory design. Tristate outputs are utilized to allow wired-OR capability and I/O data bussing.

MNOS NON-VOLATILE SEMICONDUCTOR MEMORIES

Device Type	Function	Non-Volatile Storage Time*	Voltage Write (Volts)	Write Time (μS)	Package Code
NOM 101C	Single MNOS Transistor	1 Year	35	100	T-1
NOM 102C	Dual MNOS Transistor	1 Year	35	100	T-2
NOM 104C	Quad MNOS Transistor	1 Year	35	100	D-1
NOM 301C	8x8 Array	1 Year	35	100	F-4
NOM 401C	8x8 Array	1 Year	35	100	—
NOM 411C	16x16 Array	1 Year	35	100	—
NOM 412C	16x18 Array	1 Year	35	100	—
NOM 413C	256x2 Array	1 Year	35	100	—
NOM 412C	256x4 Array	1 Year	35	100	—
NOM 422C	128x8 Array	1 Year	35	100	—

* Other storage times available.

The MNOS (Metal-Nitride-Oxide-Semiconductor) transistor is a non-volatile electrically-alterable semiconductor memory, specifically designed for applications where long-term data retention in power-off conditions is a major requirement.

MICROWAVE DEVICES

N CHANNEL GALLIUM ARSENIDE FET'S

Device Type	fT	Noise Figure	Gain @ Freq.	Package Code
GAT-1	4GHz	4dB @ 2.2GHz	10dB @ 1GHz	T-1, Stripline, LID, Chip
GAT-2	8GHz	5dB @ 3GHz	8dB @ 3GHz	Stripline, LIP, Chip
GAT-3	40GHz	6.5dB @ 9GHz	10dB @ 9.5GHz	———

The GAT 1-3 are N channel Schottky barrier gate field effect transistors for high frequency, low noise microwave front end and hybrid amplifier applications.

MICROWAVE TRANSVERSE ELECTRON (GUNN EFFECT) DIODES

	Frequency	C.W. Type Available Power Output	Pulse Types Available Power Output
C-Band	4-8GHz	5-200mW	2-20 Watts
X-Band	8-12GHz	5-300mW	2-30 Watts
Ku-Band	12-18GHz	5-100mW	2-5 Watts
Ka-Band	18-36GHz	5-10mW	———

Gunn effect diodes are solid state microwave sources which directly convert DC voltages to microwave frequencies. Bias voltages and operating currents vary with device types. High efficiencies are obtainable with low frequency drift. Broad and narrow band devices are available, and may be voltage and cavity tuned.

OPTOELECTRONIC PRODUCTS

- Silicon photovoltaic cells and arrays produced in a wide range which includes discrete cells, hybrid arrays, and monolithic arrays.
- Self scanned monolithic integrating light detecting arrays. The detector elements are sequentially read and recharged by shift registers incorporated on the chip. Available are single devices, and 1X72, 5X72, 10X10 and 32X32 arrays.
- Gallium prosphide light emitting diodes (LED's) in red and yellow — high brightness yellow LED's to 10,000 foot-lamberts.

PACKAGE DESIGNATIONS

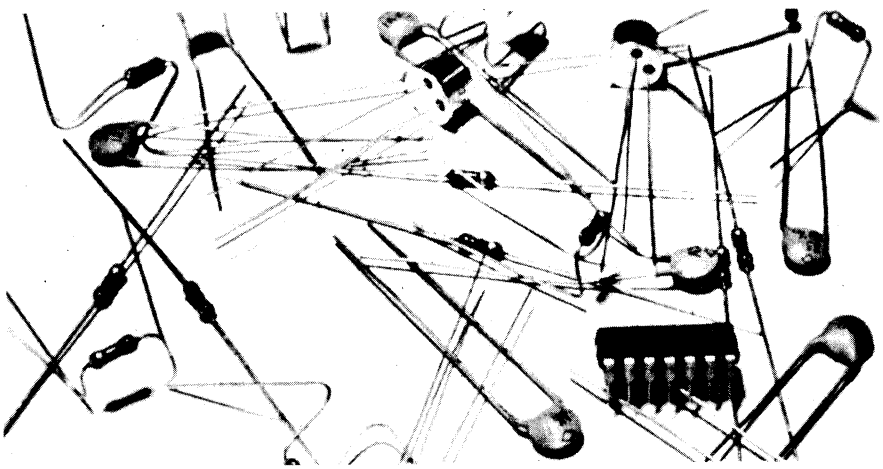
Code	Description
T-1	4 Lead TO-18
T-2	8-Lead TO-5
T-3	10 Lead TO-5
D-1	14 Lead Dual In-Line
D-2	16 Lead Dual In-Line
D-3	24 Lead Dual In-Line

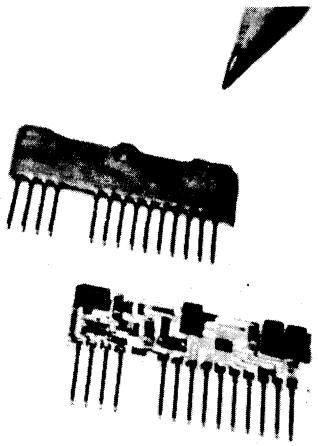
Code	Description
D-7	10 Lead Plastic W/ Bar Heat Sink
F-1	10 Lead Flatpack
F-2	14 Lead Flatpack
F-3	16 Lead Flatpack
F-4	22 Lead Flatpack

S — Suffix denotes stud type flatpack
P — Suffix denotes plastic package available

SCS CORPORATION
MICROSYSTEMS

CUSTOM HYBRID MICROCIRCUITS & MICROSYSTEMS



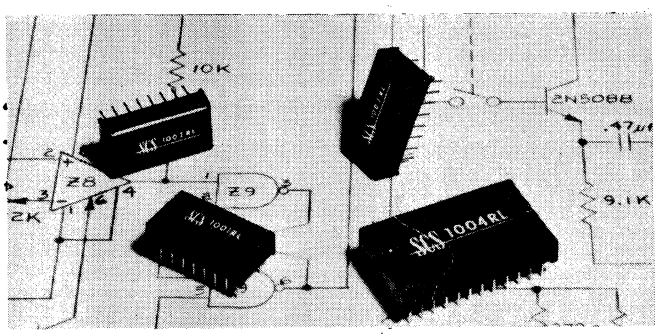


SCS Microsystems offers complete custom hybrid design, development and production service. Complex thick film hybrid microcircuits are produced in a variety of package configurations. Capabilities include multi-screen thick film substrate production plus competence in multi-chip semiconductor assembly. Standard substrates as well as standard plastic, ceramic and metal packages have been designed and tooled by SCS and are readily available for use in custom products.

Higher levels of system integration are available for customers who desire to subcontract complete subassemblies or systems. Groups of hybrids or combinations of hybrids and discrete components can be assembled to customer specifications.

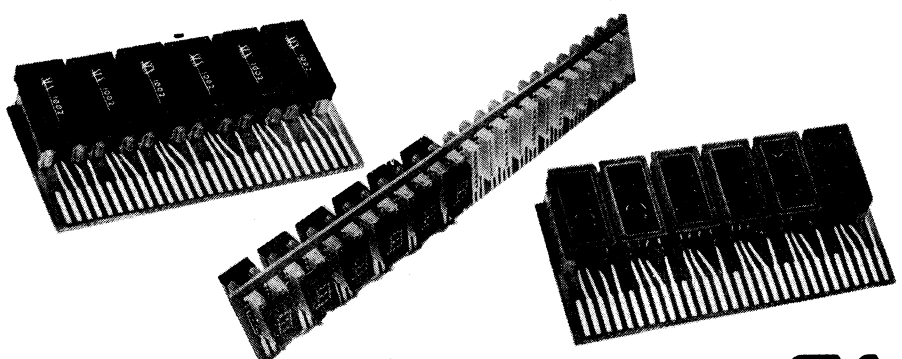
STANDARD CIRCUITS

Proprietary designs include special decoders, stepping motor controllers, tone filters, tone generators, power drivers and interface circuits. Modification of these designs to suit individual requirements may be possible. Contact factory or local representative for data and prices.



READOUTS AND ASSEMBLIES

A wholly-owned subsidiary, Luminetics Corporation, markets decoder/drivers and readout devices. Miniature incandescent or light-emitting-diode readouts are available as individual units or assembled on printed circuit cards, with decoder / drivers, counters, latches, etc.



SCS CORPORATION
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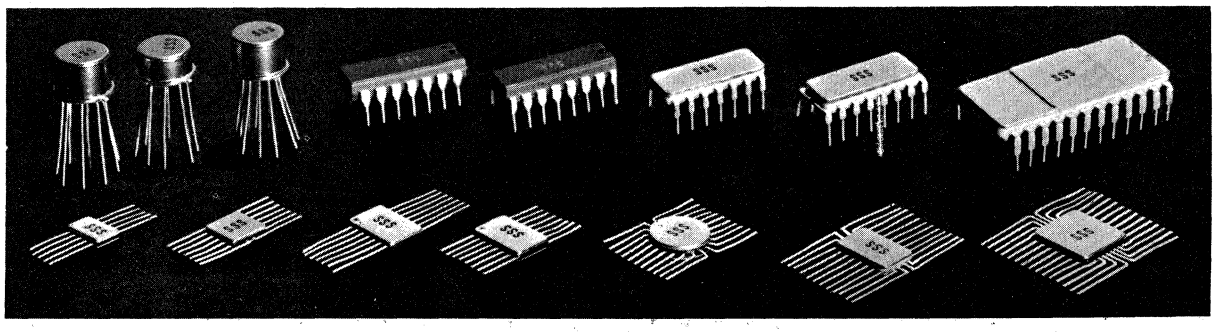

CMOS INTEGRATED CIRCUITS

CMOS integrated circuits are available in the following packages: Suffix D, ceramic dual inline; suffix E, plastic dual inline; suffix F, hermetic flat package and suffix T, TO-5 style.

SCL4000A SERIES

Feature: Low power of 10 nW typ. for gates and 10 μ W typ. for MSI circuits; single power supply, 3–15 volts; high noise immunity, 45% of supply voltage typ.; high speed to 10 MHz for gates and flip-flops. Temperature range – 55° C to +125° C except plastic types, –40° C to +85° C.

SSSI Number	Description
SCL4000AD SCL4000AE SCL4000AF	Dual 3-input positive NOR plus inverter gate
SCL4001AD SCL4001AE SCL4001AF	Quad 2-input positive NOR gate
SCL4002AD SCL4002AE SCL4002AF	Dual 4-input positive NOR gate
SCL4006AD SCL4006AE SCL4006AF	18-stage static shift register
SCL4007AD SCL4007AE SCL4007AF	Dual complementary pair plus inverter
SCL4009AD SCL4009AE SCL4009AF	Hex buffer, inverting type
SCL4010AD SCL4010AE SCL4010AF	Hex buffer, non-inverting type
SCL4011AD SCL4011AE SCL4011AF	Quad 2-input positive NAND gate
SCL4012AD SCL4012AE SCL4012AF	Dual 4-input positive NAND gate
SCL4013AD SCL4013AE SCL4013AF	Dual "D" type flip-flop with set-reset
SCL4014AD SCL4014AE SCL4014AF	8-stage static shift register
SCL4015AD SCL4015AE SCL4015AF	Dual 4-stage static shift register
SCL4016AD SCL4016AE SCL4016AF	Quad bilateral switch
SCL4017AD SCL4017AE SCL4017AF	Decade counter/divider with 10 decoded decimal outputs
SCL4018AD SCL4018AE SCL4018AF	Presettable divide-by-N counter
SCL4019AD SCL4019AE SCL4019AF	Quad AND-OR select gate
SCL4020AD SCL4020AE SCL4020AF	14-stage ripple-carry binary counter
SCL4021AD SCL4021AE SCL4021AF	8-stage static shift register, asynchronous input
SCL4022AD SCL4022AE SCL4022AF	Divide-by-8 counter with decoded outputs
SCL4023AD SCL4023AE SCL4023AF	Triple 3-input positive NAND gate
SCL4024AD SCL4024AE SCL4024AF	7-stage ripple-carry binary counter
SCL4025AD SCL4025AE SCL4025AF	Triple 3-input positive NOR gate

SCL4000A SERIES (CONTINUED)

SSSI Number	Description
SCL4026AD SCL4026AE SCL4026AF	Decade counter w/7-seg. display output and display enable
SCL4027AD SCL4027AE SCL4027AF	Dual J-K master-slave flip-flop
SCL4029AD SCL4029AE SCL4029AF	Presettable up/down counter
SCL4030AD SCL4030AE SCL4030AF	Quad EXCLUSIVE–OR gate
SCL4033AD SCL4033AE SCL4033AF	Decade counter w/7-seg. display outputs and ripple blanking
SCL4040AD SCL4040AE SCL4040AF	12-stage ripple-carry binary counter
SCL4041AD SCL4041AE SCL4041AF	Quad buffer-true/complement
SCL4042AD SCL4042AE SCL4042AF	Quad clocked "D" Latch

SCL4400A SERIES

All features of SCL4000A Series. Extended functional capability; fully compatible with other CMOS logic types. F package available at same price as D package (SCL4402AF).

SCL4402AD SCL4402AE	Dual 4-input expandable NOR gate
SCL4404AD SCL4404AE	8-stage synchronous binary counter
SCL4412AD SCL4412AE	Dual 4-input expandable NAND gate
SCL4416AD SCL4416AE	Quad bilateral switch/DPDT switch
SCL4441AD SCL4441AE	Quad low impedance buffer
SCL4426AD SCL4426AE SCL4426AF	Decade CTR/7 seg decoder
SCL4433AD SCL4433AE SCL4433AF	Decade CTR/7 seg decoder
SCL4445AD SCL4445AE	Oscillator/21-stage divider

SCL5000 SERIES

All features of the SCL4000A Series. Fully compatible with other CMOS logic types; complete CMOS system capability.

SCL5411T	Oscillator/16-stage divider
SCL5423F	Silicon gate time base
SCL5424F	4-digit CTR/DEC/driver (hours/min.)
SCL5425F	Silicon gate time base
SCL5428F	4-digit CTR/DEC/driver (hours/min.)
SCL5437A SCL5437F	Silicon gate time base
SCL5553D SCL5553F	256 x 1 random access memory (RAM)
SCL5555D	64 x 4 random access memory (RAM)

CMOS INTEGRATED CIRCUITS AVAILABLE IN CHIP FORM TO PERMIT CUSTOMER DESIGN OF SPECIAL OR HYBRID CIRCUITS TO SUIT INDIVIDUAL NEEDS. CUSTOM MSI AND LSI DESIGNS ALSO AVAILABLE. DATA SHEETS AND PRICING ON REQUEST.

SOLID STATE SCIENTIFIC INC.

MONTGOMERYVILLE, PA. 18936 ■ (215) 855-8400 ■ TWX-510-661-7267

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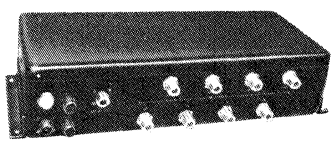
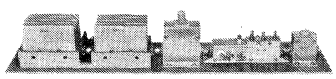


MULTICOUPLERS

Model HFM Series is designed to meet the needs of most systems.

General features:
- High isolation between outputs
- High dynamic range
- Low noise
- Modular construction
- Solid-state
- Octave bandwidth (if desired)

Model PM Series of passive multicouplers provides the ultimate performance in signal distribution.

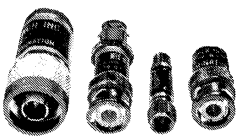


BROADBAND MULTIPLIERS (5-18,000 MHz)

These units utilize solid state devices. Using the frequency multiplier as the basic tool, lines of Signal Sources, Frequency Synthesizers and Multiplier Chains are now available.

General characteristics:

Frequency Range:	5-18,000 MHz
Bandwidths:	up to 27%
Power Output:	up to 5 watts
Efficiency:	as high as 50%



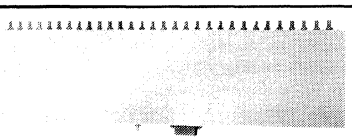
FIXED PAD ATTENUATORS & TERMINATIONS (DC—3 GHz)

FOR TYPES BNC, TNC C, N & OSM CONNECTORS

Integrated line of fixed pad attenuators, terminations and impedance-matching transformers provides means for rapid and accurate division of voltages over the frequency range of DC to 3 GHz, and for the matching of different impedances with minimum loss over a broad frequency band. The unit cost is within the practical price range of the large and small equipment user, as well as the research and experimental user.

General characteristics:

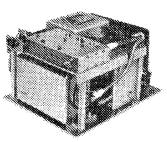
Frequency Range:	DC—3 GHz
VSWR:	1.25:1
Attenuation Accuracy:	±0.5 dB
Impedances (nominal):	50, 75, 90 ohms
Attenuation values:	1, 2, 3, 4, 6, 10, 12, 15, 20 dB (standard)



SWITCHES (10-1000 MHz)

A series of computer compatible solid state switches using PIN diodes in a broadband stripline matching structure. Can be directly addressed without interfacing. Units available with equal path lengths to all outputs, providing good phase coherence with phase and amplitude tracking on all ports. Switch matrix configurations are also available.

General Characteristics:
- Frequency Band: 10-1000 MHz
- Switch Configuration: 1x2 to 1x30
- Isolation: 70 dB min. (higher available)
- Insertion Loss: 1.0 dB max.
- VSWR: 1.2:1
- Operation Time: 1.0 μsec.
- Primary Power: ±4.5V, 50ma per crosspoint
- Sizes: 2" to 16"L x 4"W x ½"H



CONVERTERS

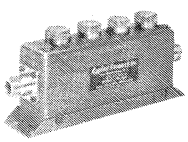
State of the art converters available for military or commercial application throughout the frequency range. All units are constructed to meet mil applications.

TELEMETRY CONVERTERS

These units permit the ready adapting of existing UHF telemetry receiving equipment for use in the 1435 to 1540 and 2200 to 2300 MHz telemetry band with high conversion gain.

General characteristics:

Long term stability:	better than ±.1 PPM over temperature range
Image rejection:	>than 50 dB
Noise figure:	better than 5 dB for 100 mc bandwidth (2.2 to 2.3 GHz)

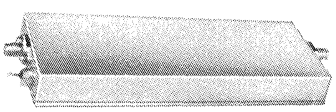


FILTERS (5-12,000 MHz)

Advanced network design techniques have developed filters operating in the frequency range up to 12,000 MHz. With electrical performance approximating theoretical expectations. In addition to Bandpass, Band Reject and Multiplex Filters, advanced network designs are available for antenna couplers, Diplexers, Interdigital Filters and many other types.

General characteristics:

Frequency Range:	5-12,000 MHz
Bandwidths:	up to several octaves
Insertion Loss:	as low as 0.25 dB
Power:	up to 3.5 kW (cw)
Band Reject Notches:	as narrow as ¼ % fo
Band Reject Attenuation:	as great as 75 dB



SOLID STATE RF AMPLIFIERS

(Power, low-noise, broadband, phase matched, linear and high dynamic range)

Constructed to meet mil and missile applications.

General characteristics:

Frequency Range:	up to 4 GHz
Bandwidths:	up to multiple octaves
Phase matching:	to within 1° over an octave
Noise figure:	as low as 1.5 dB
Gains:	up to 120 dB
Power output:	>than 20 watts

For complete details, write or call

Applied Research

INCORPORATED

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Port Washington, N. Y. 11050
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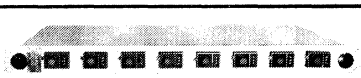

TUNABLE BAND REJECT FILTERS (5-2000 MHz)

Tunable multicontrol band reject filters provide high rejection of more than one and up to eight unwanted signals, or, extreme rejection of one. Low insertion loss and sharp skirt selectivity in the band reject region. Eight knobs and counter readout allow continuous tuning.

General Characteristics:
- Center Frequency: 5-2000 MHz
- Out-of-Band Insertion Loss: 0.5 dB
- Notch Bandwidth: narrow as ¼ % fo
- Notch Depth: 20 dB/section
- VSWR (outside of notch region): 1.5:1
- Size: 24" x 2" x 8"
- Connectors: BNC

ARRA INC.
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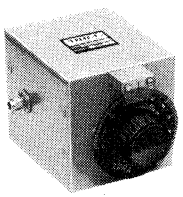
MICROWAVE

COMPONENTS • ASSEMBLIES • SUB-SYSTEMS

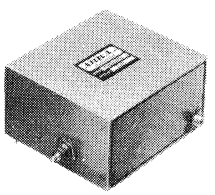
"THE BROADBAND GENERATION"

EACH MODEL 200-18000 MHz

VARIABLE ATTENUATORS



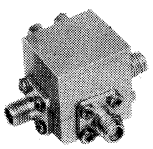
DIRECT READING



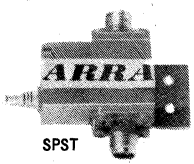
VOLTAGE VARIABLE

±1.0 db Accuracy

DIODE SWITCHES



SPDT



SPST

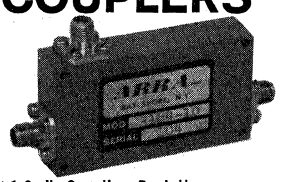
SP4T

Integrated Drivers Available

MINIATURE

DIRECTIONAL COUPLERS

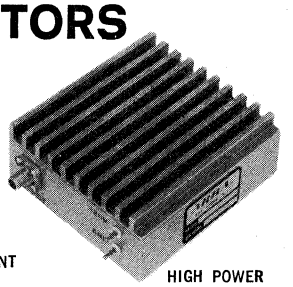
Freq. Range (GHz)	Coupling (db)	Min. Directivity (db)	Model No.
1.0-2.0	10	20	3164-10
	20	20	3164-20
	30	20	3164-30
2.0-4.0	10	20	4164-10
	20	20	4164-20
	30	20	4164-30
4.0-8.0	10	17	5164-10
	20	17	5164-20
	30	17	5164-30
8.0-12.4	10	15	6164-10
	20	15	6164-20
	30	15	6164-30



- ±1.0 db Coupling Deviation
- 10 Watt Average Power (10 db Models)
- 3 KW Peak
- SMA Female Connectors (3 mm)
- 0.2 db Max. Insertion Loss (Excluding Coupled Power)

SOLID STATE OSCILLATORS

CAVITY STABILIZED



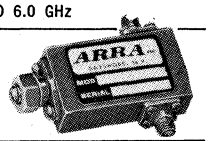
HIGH POWER

- LOW SPURIOUS CONTENT
- LONG TERM STABILITY
- FUNDAMENTAL FREQUENCIES TO 6.0 GHz

DIRECT READING

VARIABLE ATTENUATORS

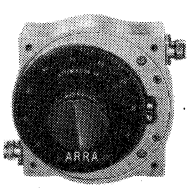
MINIATURE



100 db Range • 15 Watts Av. Input Power

Freq. Range	Min. Dynamic Atten. Range (db)	Attenuation vs. Freq. (±db)	Model No.
0.5-1.0	60	1.0	2952-60
0.5-1.0	100	1.5	2952-100
0.9-1.3	60	1.0	2-3952-60
0.9-1.3	100	1.5	2-3952-100
1.0-2.0	60	1.0	3952-60X
1.0-2.0	100	1.5	3952-100X
1.4-2.4	80	1.25	3-4952-80
2.0-4.0	60	1.0	4952-60X
2.0-4.0	100	1.5	4952-100X
*4.0-8.0	60	1.0	5952-60X
*4.0-8.0	100	1.5	5952-100X

* ONLY LESS THAN OCTAVE — CONSULT ENG. DEPT.



DIRECT READING DIAL
6 db Maximum
INSERTION LOSS

5 Watts • 3 Kw Peak
2 Ounces • 1¾" x 1" x ½"

Freq. Range (GHz)	Atten. Range (db)	Maximum VSWR	Maximum Ins. Loss (db)	Model No.
2.0-4.0	10	1.8	0.5	4804-10
2.5-4.0	10	1.5	0.5	4804-10X
4.0-8.0	10	1.5	0.5	5804-10
4.0-8.0	20	1.5	0.5	5804-20
6.0-11.0	10	1.5	0.5	5-6804-10
6.0-11.0	20	1.5	0.5	5-6804-20
6.0-11.0	30	1.5	1.0	5-6804-30
8.0-12.4	10	1.5**	0.5	6804-10
8.0-12.4	20	1.5**	0.5	6804-20
8.0-12.4	30	1.5**	0.5	6804-30
8.0-16.0 (usable to 18.0)	10	1.5 **	1.0	9804-10
	20	1.5 **	1.0	9804-20
	30	1.5 **	1.0	9804-30

** 1.7 VSWR ABOVE 11.0 GHz.

VARIABLE ATTENUATORS

500-11000 MHz • 10 Watts Average Power
0.5 db Max. Insertion Loss • 1.5 Max. VSWR

Freq. Range (GHz)	Atten. Range (db)	Atten. vs. Freq.	Form Factor	Model No.
DC-1.0	80			7684-80*
0.5-1.0	10		0-19	2614-10
1.0-2.0	30		0-19	3614-30
2.0-4.0	50		0-51	4674-50
2.0-4.0	20	±1.5	0-51	4674-20F
4.0-7.0	50		0-39	5684-50
4.0-8.0	20	±1.0	0-39	5684-20F
5.4-11.0	20	±1.5	0-39-2	5-6684-20F
7.0-11.0	50		0-39-2	6684-50
7.0-11.0	20	±1.0	0-39-2	6684-20F

* SEE CATALOG FOR VSWR, INSERTION LOSS & POWER.

Form:
0-39 & 0-39-2: 3" Dia.
0-19 & 0-51: 5" Dia.

ALSO . . .

- 100 w Average Variable Attenuators
- WAVEGUIDE ASSEMBLIES & COMPONENTS
- Broadband DC Blocks
- Broadband Terminations
- Broadband RF Shorts
- Mechanical Phase Shifters
- Broadband Diode Modulators . . . **and lots more.**

SEND FOR NEW CATALOG NO. 5

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You've found one source for:

CIRCULATORS & ISOLATORS

Model No.	Frequency Range (gc)	Type	RF Connectors
C3R21	4.4 - 5.0	3 Port	BRM
C4R96	8.2 - 10.0	4 Port	BRM
C3N28	2.75 - 4.0	3 Port	N
C4N94	4.4 - 5.0	4 Port	N
C5N03	5.4 - 5.9	5 Port	N
C2W35	4.4 - 5.0	Isolator	UG149A

DIRECTIONAL COUPLERS & HYBRIDS

Model No.	Frequency Range (mc.)	Coupling Attenuation (db)	RF Connectors
323R31	1 - 2 (gc)	3	BRM
323R62	4 - 8 (gc)	6	BRM
308N2	500 - 1000	20	Type N
313N3	300 - 2000	30	Type N
362A7	30 - 1000	70	1⅝" Flange
382A6	120 - 1000	60	3⅛" Flange

DC OUTPUT DIRECTIONAL COUPLERS

Model No.	Frequency Range (mc.)	Power Range (watts)	RF Connectors
596N2	1700 - 2400	0 - 4	Type N
263N5	2 - 30	0 - 60	Type N
576N6	28 - 1000	0 - 400	Type N
536.63	2 - 30	0 - 1200	Type LC
402A8	28 - 1000	0 - 4000	1⅝" Flange
442A9	28 - 1000	0 - 12000	3⅛" Flange

WAVEGUIDE DIRECTIONAL COUPLERS

Model No.	Frequency Range (gc)	Coupling Attenuation (db)	Overall Length—Inches
WL3A	1.12 - 1.70	30	4¾
WN3B	1.70 - 2.60	30	1⅞
WR4B	2.20 - 3.30	40	1⅞
WS4A	2.60 - 3.95	40	3⅝
WC5A	3.95 - 5.85	50	3⅝
WX6A	8.20 - 12.40	60	1⅞

DUMMY LOADS & TERMINATIONS

Model No.	Frequency Range (mc.)	RF Power Dissipation (watts)	RF Connectors
680R	0 - 10 (gc)	200 (mw)	BRM
601N	0 - 3000	5	N
634N	0 - 3000	150	N
674N	0 - 3000	400	N, 70 ohms
636N	0 - 3000	600	N
638A	0 - 2000	6000	3⅛" Flange

RF FILTERS & WAVEMETERS

Model No.	Frequency Range (gc)	Type	RF Connectors
FCTS504	3.4 - 3.6	Tunable BP	BRM
FCRS201	3.5	Band Reject	BRM
FCLB15B	980	Low Pass	1⅝" Flange
FCTA201	400 - 450	Tunable	TNC
FCTL213	1200 - 1400	Tunable	N
FIWE271	5.3 - 6.3	Wavemeter	C-MB

RF COAXIAL SWITCHES

Model No.	Frequency Range (mc.)	Type	RF Connectors
S21N373	0 - 3000	SPDT	N
S21R563	0 - 5000	SPDT	BRM
S21R383	0 - 5000	SPDT	BRM
S23R383	0 - 3000	DPDT	BRM
S54N473	0 - 3000	Transfer	N
S11N253	0 - 3000	Latching	N

RF WATTMETERS

Model No.	Frequency Range (mc.)	Power Range (watts)	RF Connectors
621N	1 - 100	0 - 120 (mw)	N
651N	25 - 1000	0 - 25, 100, 500	N
612A	44 - 1000	0 - 6000	3⅛" Flange
711N	8 - 1000	0 - 30, 75, 300	N
712N	25 - 1000	0 - 2.5, 5, 10	N
706N	28 - 1000	0 - 400	N

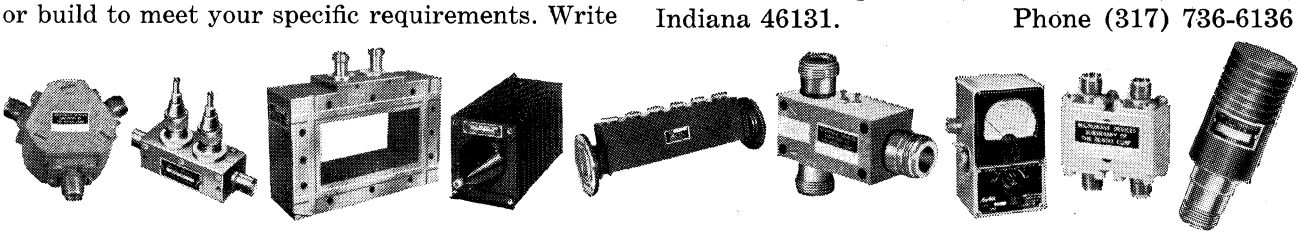
INTEGRATED DEVICES

Device	Model No.	Specifications
Triplexer	FCPC332	3 Channel, 4.7 to 4.9 gc; loss 1.5 db; VSWR 1.5
Coupler-Filter-Switch	CFSA391	200-400 mc., 1 vdc output, low pass SPDT
Dual Preselector	FCBS363	2 Channel, 3.4 to 3.7 gc; loss 1.5 db; VSWR 1.5
Frequency Multiplier	FMSE10	Input Freq. 2.74-3.35 gc, dblr., bdwth. 20%
Circulator-Coupler	C4CN036	4.4-5.0 gc, 4 pt. Cir.
Switch-Coupler	SC2N183	4.2 gc, Transfer Swt., pwr. & VSWR Monitor

MINIATURE COMPONENTS

Model No.	Frequency Range (gc)	Type	RF Connectors
MDC101	1 - 4	D.C. Block	BRM
MMT104	4 - 8	Monitor Tee	BRM
AFR03	0 - 5	Attenuator	BRM
AMN92	4.4 - 5.0	Variable Atten.	N
PMR03	5.4 - 6.5	Phase Shifter	BRM
PEN32	5.4 - 5.9	Phase Shifter	N

They're all available for fast delivery. Need a special microwave device? We're equipped to modify or build to meet your specific requirements. Write or call for our new catalog: Microwave Devices, The Bendix Corporation, Hurricane Rd., Franklin, Indiana 46131. Phone (317) 736-6136



Bendix Electronics

Daico RF Mini-Systems

IF SERIES DIODE SWITCHES AND RF RELAYS

Multi-position diode switches contribute the lowest switching transients and insertion loss consistent with speed and RF power. All of these items can readily be provided with T²L logic and internal driver.

Daico Industries' RF relays employ hermetically sealed switching elements which provide extreme resistance to the severe environments encountered in military aircraft and communications systems.

S IF 4 R T 70 300-800 SMA INFORMATION LEGEND (typical)

- SMA — (Connectors) TNC BNC (OSM) etc.
- 300-800 — (Frequency) MHz
- 70 — Isolation (db)
- T — Control T = T²L (includes driver) D = Driver Internal E = Driver External
- R — Termination of Unused Ports O = Open Circuit S = Short Circuit R = 50 Ohms
- 4 — Number of Poles or Bits
- IF — Series

Series	Range	Speed	RF Power
RL — Relay	DC-500 MHz	2 ms	50w cw
IF — Solid State	5-1100 MHz	1 μs	1w cw
RF — Solid State	500-3000 MHz	1 μs	10w cw
PW — S.S. High CW Pwr.	20-1100 MHz	3 μs	To 400w cw
PP — S.S. High Pulse Pwr.	200-1500 MHz	100 ns	To 8 kw pk
HS — S.S. High Speed	200-3000 MHz	To 10 ns	10 watts

- S — Product Type: S — Switch A — Attenuator C — Coupler P — Phase Shifter H — Hybrid X — Switch Matrix F — Filter M — Miscellaneous

DROP-IN SWITCHES
The Daico Industries' switch designs are available with coaxial pins or solder tabs which can be mounted directly onto a system PC card.

RF SERIES — DIODE SWITCHES
Switch designs SPST, SP2T, SP3T and Transfer have been optimized for performance over the 1-3 GHz regions. These units utilize the latest in RF stripline techniques to provide maximum isolation with insertion loss below 1 db.

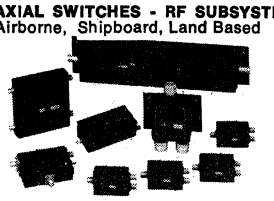
STEP PHASE SHIFTERS—IF SERIES
The IF series multi-bit phase shifters are also available with solid state or relay combining elements. The relatively narrow band device uses various lengths of coaxial line to vary phase.

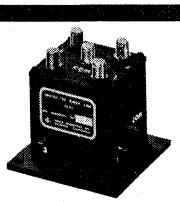
STEP ATTENUATORS — IF SERIES
Programmable attenuators are available with both solid state and relay combining elements. 0.1 db steps through 25.5 db, 1 db steps through 127 db.

HIGH POWER DIODE SWITCHES
These switches have been successfully employed in numerous CW and pulse systems. CW power levels to 400 W are available in frequency ranges from 20-1100 MHz. Pulse power levels to 8 KW are available in frequency ranges of 50-1500 MHz.

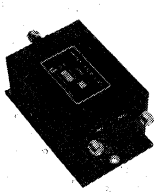
SWITCHING MATRICES
RF switching matrices are offered with both solid state and relay elements. These sub systems are provided with power supply, decoding logic and local or remote control capabilities.

MULTI-BIT PHASE SHIFTERS
COAXIAL SWITCHES - RF SUBSYSTEMS
Airborne, Shipboard, Land Based

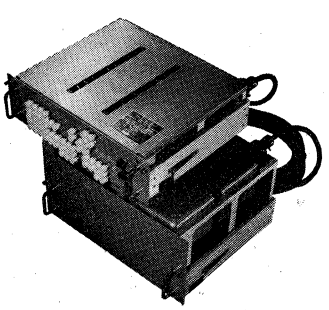




HIGH ISOLATION



HIGH POWER



SWITCH MATRIX

DAICO INDUSTRIES, INC.

2351 EAST DEL AMO BLVD., COMPTON, CALIF. 90220
TELEPHONE: (213) 631-1143 • TWX 910-346-6741

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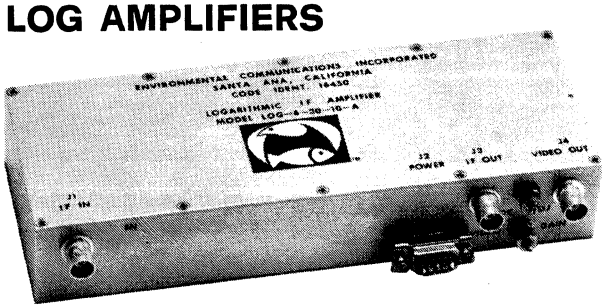
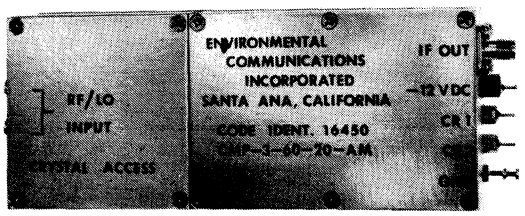
HIGH DYNAMIC RANGE LOG AMPLIFIERS



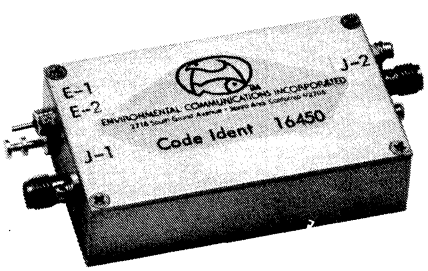
10-200 MHz Fo, 2-100 MHz BW, 80 dB Dynamic Range Standard, 90 dB available, LOG Accuracy ±1 dB over Entire Range from Nominal Sensitivity (25 mV/dB), 75 ohm Video Load Impedance, DC Coupled Video and Limited IF Output Standard. Log-6 Series

LOW NOISE MIXER PREAMPLIFIERS



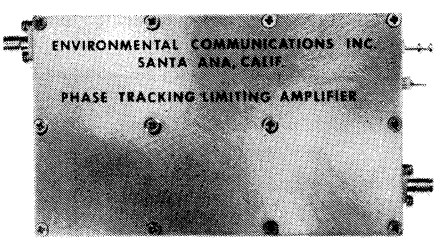
L through X Band at 20-30% RF BW, 7 dB typ NF, 13 dBm min LO-RF Isolation (depending on RF BW), VSWR 1.5:1 typ, 1.7:1 max Band Edges, IF to 200 MHz, IF BW to 60 MHz, RF to IF Gain 25 dB typ, Power Output +10 dBm at 1 dB Compression. MP-3 Series

WIDE DYNAMIC RANGE LOW NOISE PREAMPLIFIER



Frequency ranges 10 to >100 MHz, Bandwidth 10 to 120 MHz, Gain of 25 dB minimum with 1 dB output compression @ +10 dBm. Noise figure 1.6 dB over the frequency range, Phase matched to ±2° and amplitude matched to within 0.5 dB. LNP-2 Series

PHASE TRACKING LIMITING AMPLIFIER



Center frequency ranges 10 to 160 MHz, Bandwidths to 40%, Phase tracking ±2° and Amplitude tracking ±0.5 dB. Constant phase ±3° over a 70 dB dynamic range. LIM-4 Series

OTHER PRODUCTS DESCRIBED IN CATALOG: ■ LOGARITHMIC AMPLIFIERS ■ LOW NOISE PRE-AMPLIFIERS ■ LINEAR AMPLIFIERS ■ LIMITERS ■ LIMITER DISCRIMINATORS ■ MIXER PRE-AMPLIFIERS ■ IMAGE REJECTION MIXER PRE-AMPLIFIERS ■ STRIPLINE COUPLERS ■ STRIPLINE ATTENUATORS ■ FM RECEIVERS ■ FM TRANSMITTERS ■ UP CONVERTERS ■ LABORATORY AMPLIFIERS ■ CUSTOM SERVICES. 21 pictures of products can be seen in EEM '73, Vol. 4, page 430.

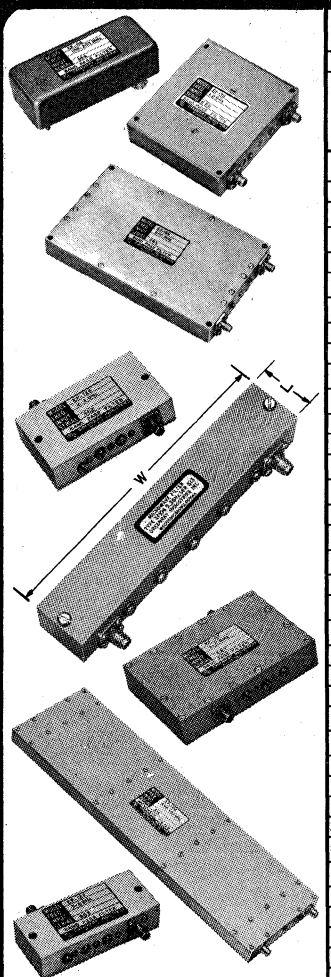
ENVIRONMENTAL COMMUNICATIONS INCORPORATED

For our Representatives nearest you, call toll-free 800-645-9200. In New York State, call collect (516) 294-0990.

BAND PASS FILTERS

HF, VHF, UHF, & MICROWAVE

HUNDREDS OF STOCK DESIGNS



NOTE: Insertion loss shown is the maximum value over the bandwidth shown of a standard filter. Special filters can be made on request to a lower insertion loss or a steeper skirt attenuation.

SMA (3mm) are standard connectors for all filters. Other type of connectors available on request. Specify exact frequency and model number when ordering.

*Length of filters varies with the frequency of operation according to table:

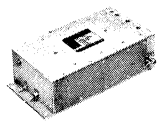
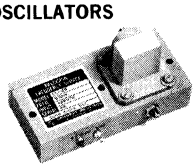
Center Frequency range (MHz)	Length L (in.) Approx.	Center Frequency range (MHz)	Length L (in.) Approx.
492-513	6.5	908-983	3.75
514-536	6.25	984-1073	3.5
537-562	6.0	1074-1180	3.25
		1181-1311	3.0
563-590	5.75	1312-1475	2.75
591-621	5.5	1476-1686	2.50
622-655	5.25	1687-1967	2.25
656-694	5.0	1968-2360	2.0
695-738	4.75	2361-2950	1.75
739-786	4.5	2951-3934	1.5
787-843	4.25	3935-5900	1.25
844-907	4.0	5901-8000	1.0

Specify Exact Frequency & Model Number When Ordering			Rejection Band Attenuation And Frequency				Smaller Sizes on Request		
Pass Band			Below Pass Band		Above Pass Band				
Frequency Range	Bandwidth min.	Insertion loss max.	Frequency	Attenuation min.	Frequency	Attenuation min.	Dimensions (inches approx.) W H L	MODEL	PRICE 1-3 UNITS
5- 25 MHz	2%	4 dB	f_o— 7%	20 dB	f_o+ 8%	20 dB	1.3 x 1.0 x 3.3	EF-140-4	
25- 100 MHz			f_o— 14%	45 dB	f_o+ 16%	45 dB	1.3 x 1.5 x 3.3	EF-140-5	$145.00
100- 300 MHz							1.3 x 1.5 x 3.3	EF-140-6	
5- 25 MHz	2% At 3 dB Pts.	6 dB at f_o	f_o— 5%	20 dB	f_o+ 6%	20 dB	1.3 x 1.0 x 3.3	EFF-140-4	
25- 100 MHz			f_o— 10%	45 dB	f_o+ 11%	45 dB	1.3 x 1.5 x 3.3	EFF-140-5	$145.00
100- 300 MHz							1.3 x 1.5 x 3.3	EFF-140-6	
5- 25 MHz	10%	3 dB	f_o— 14%	20 dB	f_o+ 14%	20 dB	2.3 x 1.0 x 3.3	EF-141-8	
25- 50 MHz			f_o— 25%	60 dB	f_o+ 25%	60 dB	2.3 x 1.0 x 3.3	EF-141-9	$195.00
50- 200 MHz							2.3 x 1.5 x 4.0	EF-141-10	
200- 300 MHz							2.3 x 1.5 x 4.0	EF-141-11	
5- 25 MHz	15%	1.5 dB	f_o— 17%	20 dB	f_o+ 23%	20 dB	2.3 x 1.0 x 3.3	EF-149-6	
25- 50 MHz			f_o— 33%	45 dB	f_o+ 45%	45 dB	2.3 x 1.0 x 3.3	EF-149-7	$195.00
50- 100 MHz							2.3 x 1.5 x 4.0	EF-149-8	
100- 300 MHz							2.3 x 1.5 x 4.0	EF-149-9	
5- 25 MHz	20%	0.5 dB	f_o— 35%	20 dB	f_o+ 50%	20 dB	2.3 x 1.0 x 3.3	EF-168-1	
25- 100 MHz			f_o— 50%	50 dB	f_o+ 90%	50 dB	2.3 x 1.5 x 4.0	EF-168-2	$195.00
100- 300 MHz							2.3 x 1.5 x 4.0	EF-168-3	
50- 100 MHz	Octave	3 dB	< 22 MHz		> 225 MHz		1.7 x 1.5 x 4.2	EF-116-8	
100- 200 MHz			< 45 MHz	45 dB	> 450 MHz	45 dB	1.7 x 1.5 x 4.2	EF-116-9	$235.00
150- 300 MHz			< 67 MHz		> 680 MHz		1.7 x 1.5 x 4.2	EF-116-10	
200- 300 MHz	0.7%	3 dB	f_o—2.5%	20 dB	f_o+2.5%	20 dB	3.0 x 0.8 x 10.5		
301- 380 MHz			f_o— 5%	40 dB	f_o+ 5%	40 dB	3.0 x 0.8 x 10.5		
381- 460 MHz			f_o— 8%	60 dB	f_o+ 8%	60 dB	3.0 x 0.8 x 10.5	EF-206	$395.00
461- 600 MHz			f_o— 14%	80 dB	f_o+ 14%	80 dB	3.0 x 0.8 x 9.0		
601- 800 MHz							3.0 x 0.8 x 8.0		
492- 907 MHz	2%	2.5 dB	f_o—2.8%	20 dB	f_o+2.8%	20 dB	5.0 x 0.8 x (*)	EF-125	$315.00
908-1311 MHz									$295.00
1312-1967 MHz			f_o—3.7%	40 dB	f_o+3.7%	40 dB			$285.00
1968-3934 MHz		2 dB	f_o— 5%	60 dB	f_o+ 5%	60 dB			$285.00
3935-5900 MHz									$295.00
5901-8000 MHz		2.5 dB							$315.00
492- 562 MHz	3%	3 dB	f_o—4.5%	20 dB	f_o+4.5%	20 dB	3.0 x 0.6 x (*)	EF-175	$290.00
563- 907 MHz									$280.00
908-1073 MHz									$270.00
1074-1311 MHz		2.5 dB	f_o— 5%	40 dB	f_o+ 5%	40 dB			$270.00
1312-1967 MHz			f_o— 7%	60 dB	f_o+ 7%	60 dB			$260.00
1968-3934 MHz									$260.00
3935-5900 MHz		3 dB							$280.00
5901-8000 MHz									$290.00
984-5900 MHz	5%	2 dB	f_o—3.9%	20 dB	f_o+3.9%	20 dB	6.5 x 0.8 x (*)	EF-174	$325.00
5901-8000 MHz			f_o— 5%	50 dB	f_o+ 5%	50 dB			$345.00
492- 562 MHz	10%	1 dB	f_o— 12%	20 dB	f_o+ 12%	20 dB	3.4 x 0.8 x (*)	EF-186	$295.00
563- 621 MHz									$285.00
622- 907 MHz			f_o— 19%	40 dB	f_o+ 19%	40 dB			$285.00
908-1180 MHz			f_o— 25%	60 dB	f_o+ 25%	60 dB			$275.00
1181-1311 MHz									$275.00
1312-3934 MHz									$265.00
3935-5900 MHz									$285.00
5901-8000 MHz			f_o— 28%	60 dB	f_o+ 28%	60 dB			$295.00
500-1000 MHz	Octave	1 dB	< 350 MHz		> 1300 MHz		5.0 x 1.0 x 4.5	EF-117-1	$395.00
1000-2000 MHz			< 700 MHz	50 dB	> 2400 MHz	45 dB	5.0 x 1.0 x 2.5	EF-117-2	$295.00
1500-3000 MHz			< 1000 MHz		> 3800 MHz		5.0 x 1.0 x 2.0	EF-117-3	$295.00
1200-4000 MHz	2-Octave	1 dB	< 700 MHz	45 dB	> 4850 MHz	45 dB	2.0 x 2.0 x 6.5	EF-117-10	$495.00
500-4000 MHz (Band Stop over this range)	2% Band Stop	>60 dB	f_o— 20%	< 1 dB	f_o+ 20%	< 1 dB	8.7 x 0.8 x (*)	EF-120	$495.00
			f_o— 4%	< 3 dB	f_o+ 4%	< 3 dB			
			f_o— 2%	< 20 dB	f_o+ 2%	< 20 dB			
500-2000 MHz	High Pass 2-Octave	1 dB	250 MHz	55 dB	No High frequency cut-off		1.7 x 0.8 x 2.3	EF-148	$165.00
700-2800 MHz			350 MHz						
1000-4000 MHz			500 MHz						

Greenray Industries, Inc.
840 West Church Road, Mechanicsburg, Pa.
Phone: 717-766-0223 TWX: 510-650-4939

MICROWAVE FREQUENCY SOURCES & AMPLIFIERS

500 MHz to 18 GHz

	Frequency range GHz	Tuning range	Stability	Power output (minimum)	Line Voltage	Tuning	Dimensions (inches) approx. L W H	Model	Price 1—3
CRYSTAL CONTROLLED SOURCES 	.5-1.0 1.01-2.0 2.01-4.0 4.01-6.0	Crystal Oscillators	± .00075% over 0 to 50°C temperature range	20 mW (for 5 mW and 100 mW, refer to catalog)	+ 28V dc	center freq. adjust.	3.8 x 3.4 x 2 3.8 x 3.4 x 3 3.8 x 3.4 x 2 4.5 x 3.4 x 2	EY-103-1 EY-104-1 EY-105-2 EY-106-1	$ 990.00 1190.00 1390.00 1590.00
	6.01-7.0 7.01-8.0 8.01-9.0 9.01-10	Fixed frequency					6.0 x 3.4 x 2 6.0 x 3.4 x 2 7.5 x 3.4 x 2 7.5 x 3.4 x 2	EY-107-3 EY-108-1 EY-109-1 EY-109-2	1790.00 2190.00 2390.00 2590.00
	.5-10	Freq. std. Option	±.0001% (ovenized)	As above	+ 28V dc	As above	As above	EYHK-(above)	add 100.00
	.5-10	Freq. std. Option	± 2 x 10^{-8} (ovenized)	As above	+ 28V dc	As above	L (above) + 1.5″	EYH-(above)	add 550.00
	.5-10	± .1% VCXO Option	± .007% 0 to 50°C	As above	+ 28V dc	As above	L (above) + 3.0″	EN-(above)	add 400.00
HIGH "Q" CAVITY STABILIZED MECHANICALLY TUNABLE OSCILLATORS	.5-.8 .8-1.2 1.2-1.6	300 MHz 400 MHz 400 MHz	± .05% 0 to 50°C	10 mW	+ 24V dc	Mechanical (Screw driver adjust.)	7.0 x 1.3 x 1.3 5.0 x 1.3 x 1.3 3.0 x 1.0 x 1.4	EL-130 EL-131 EL-101	490.00 490.00 445.00
	1.6-2.1 2.1-2.6 2.6-3.2 2.1-3.6	500 MHz 500 MHz 600 MHz 1500 MHz					2.0 x 1.0 x 1.4	EL-102A EL-132 EL-103A EL-128	390.00 390.00 390.00 545.00
HIGH "Q" CAVITY STABILIZED OSCILLATORS 	6.4-8.1 8.2-12.3 12.4-18	Gunn Oscillator Fixed freq.	± .2% 0 to 50°C	10 mW	+ 15V dc	Center freq. adjust.	3.8 x 2.5 x 1.9 3.4 x 2.3 x 1.6 3.1 x 2.3 x 1.6	EL-154 EL-155 EL-156	690.00
	6.4-6.9 8.2-10 10-12 13-14	500 MHz 1800 MHz 2000 MHz 1000 MHz	± .2% 0 to 45°C	5 mW	+ 15V dc	Mechanical (Screw driver adjust.)	4.5 x 2.5 x 2.3	EL-126AF1 EL-126AF2 EL-126AF3 EL-126AF4	1090.00
	6.4-14 Above ranges	Freq. ranges as above	± .05% (ovenized)	5 mW	+ 28V dc	Mechanical (Screw driver adjust.)	4.0 x 3.4 x 5.5	ELH-101A	1790.00
VOLTAGE TUNABLE OSCILLATORS (LINEARIZING NETWORKS AVAILABLE)	.58-1.0 .80-1.5	420 MHz 700 MHz	± .5% 10 to 45°C	20 mW	− 24V dc	Electrical 0 to + 65V	2.8 x 2.8 x 1.5	EP-149D EP-149E	890.00 990.00
	6.4-8.1 8.2-12.3 12.4-18.0	.6% tuning range	± .3% 0 to 50°C	10 mW	+ 15V dc	Electrical + 4 to + 30V	3.8 x 2.9 x 1.9 3.4 x 2.3 x 1.6 3.1 x 2.3 x 1.6	EP-168 EP-169 EP-170	945.00
	4.6-8.0 8.01-10	500 MHz 700 MHz	± .05% (ovenized)	40 mW	+ 28V dc	Electrical + 9 to + 60V	4.0 x 2.5 x 3.5	EPH-171 EPH-172	1345.00
WIDEBAND MICROWAVE AMPLIFIERS (Class "C") 400 MHz to 3.2 GHz!		**Bandwidth**	**Gain**			**Ripple**			
	.4-.8	400 MHz	8 dB	100 mW	+ 15V dc	4 dB	3.4 x 1.5 x 2.0	EA-168-2	275.00
	.8-2.0	1200 MHz	5 dB	60 mW	+ 15V dc	4 dB	2.0 x 1.5 x 1.1	EA-165-2	445.00
	.8-2.0	1200 MHz	10 dB	60 mW	+ 15V dc	4 dB	4.0 x 1.5 x 1.1	EA-166-2	645.00
	.6-2.0	40% B. W.	5 dB	80 mW	+ 15V dc	2 dB	2.0 x 1.5 x 1.1	EA-165-1	290.00
	.6-2.0	40% B. W.	10 dB	80 mW	+ 15V dc	3 dB	4.0 x 1.5 x 1.1	EA-166-1	485.00
	2.0-2.7	700 MHz	14 dB	600 mW	+ 28V dc	4 dB	6.0 x 2.7 x 2.0	EA-146-4	1695.00
	2.7-3.2	5% B. W.	5 dB	1500 mW	+ 28V dc	4 dB	2.5 x 1.5 x 1.5	EA-162	1795.00

TO ORDER: Specify exact center frequency or frequency range desired and Model Number.

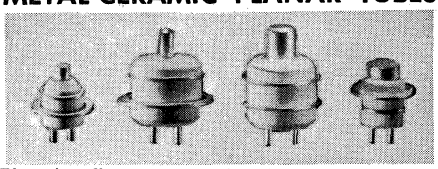
HUNDREDS OF VARIETIES IN OUR BIG NEW MICROWAVE CATALOG!

Greenray Industries, Inc.

840 West Church Road, Mechanicsburg, Pa. Phone: 717-766-0223 TWX: 510 650 4939

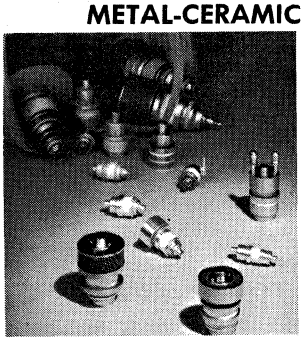
MICROWAVE DEVICES AND ELECTRON TUBES

METAL-CERAMIC PLANAR TUBES



General Electric offers an extensive line of planar tubes in diode and triode designs for oscillators, amplifiers, mixers, detectors, and many other high-reliability applications from d-c to 10 gc. Unsurpassed tolerance to environment as adverse as 3000 G's impact at 3-5 ms, 30,000 G's centrifuge, up to 48 G's RMS vibration (100-2000 cps, 3 min each plane) and −55 C to +400 C temperature. Have also withstood 10^{18} NVT and 10^{7} R/sec nuclear radiation. Minimum noise, in fractions of a db. Power outputs from low mw to 8kw peak. Tailored for CW, plate-pulsed, and grid-pulsed applications. Highest available ratio of power, efficiency, and gain-bandwidth to size and weight.

METAL-CERAMIC COAXIAL TUBES

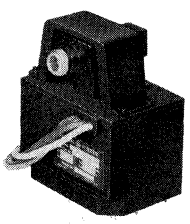


GE has the exact coaxial triodes and tetrodes for advanced VHF-UHF, RF power amplifiers, oscillators, or broad varieties of transmitter equipments to meet your most demanding application requirements. Advantages: high power gain, efficiency, voltage hold-off, duty factor; broad electronic bandwidth; long pulse-width life; reliable grid-pulsed amplifier or oscillator service.

VTM's

Miniaturized shielded

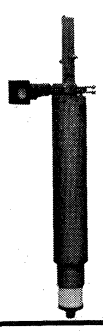
Magnetic and RFI shielded



Magnetic shielding and integral isolator

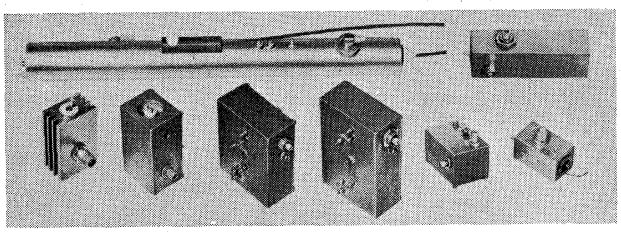
Voltage Tunable Magnetrons (VTM's) are high frequency, continuous wave oscillators operating in the microwave region. GE VTM's cover a wide range of frequencies — from 700 to over 5600 megacycles, with feasibility existing in X-band and down to 100 mc. Low power (up to 1 watt) for low-noise local oscillators, signal generators. Medium power (1-10 watts) for altimetry, telemetry. High power (over 10 watts up to 100's of watts) for broadband transmitters, barrage jamming, airborne applications. Also magnetically shielded VTM's at 1000-2000 mc and 2000 to 4000 mc (1 watt) for driver applications.

KLYSTRONS



GE has over 15 years experience in custom design, manufacture and repair of high-power, multiple resonator, amplifier klystrons and capability to produce klystrons for **specific** applications. The units, constructed of metal and ceramic, use ion pumps to maintain excellent vacuum conditions. Tunable types are designed so each cavity tunes at the same rate for perfect gang-tune tracking across frequency band. Broadband types are tunerless; flat freqency responses are rigidly, permanently determined during manufacture. Tunable and broadband pulsed ampilfier klystrons available in L, S bands.

MCM's*



***Microwave Circuit Modules with planar tubes or solid-state devices. May be used as Oscillators, Amplifiers, Multipliers, Detectors, Mixers, Integrated Isolators and Circulators.**

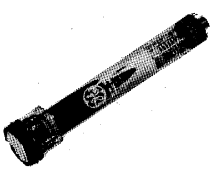
General Electric puts nearly 3 decades of commercial and military microwave component experience into the MCM. Designers can benefit from an unequalled output of highest performance active components including coaxial and planar gridded tubes. One source provides "in-house" ferrite know-how, critical testing experience and facilities, and full R&D back-up. Now, optimum integration of active devices in packaged circuits can help reduce design cycles, provide retrofit capabilities and lead to improved system performance with lower over-all cost.

MCM's with planar tubes or solid state are available.

CIRCULATORS AND ISOLATORS

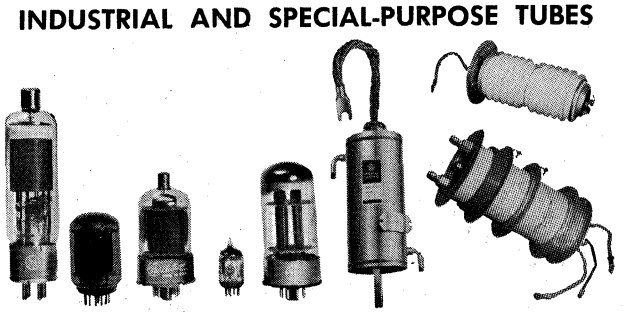
GE coaxial, stripline circulators and isolators can typically handle 100 to 500 watts CW and more, and are capable of operating under severe environmental conditions. All frequencies from 0.3 to 5.5 GHz are covered, and typical bandwidth in these frequency ranges is approximately 20 percent with greater bandwith available. Magnetically shielded and miniaturized units are available, with unique terminations and connections a specialty.

IMAGING AND DISPLAY DEVICES



GE offers industry's finest line of high-quality imaging and display tubes... including: image orthicons; industrial and commercial vidicons.

INDUSTRIAL AND SPECIAL-PURPOSE TUBES

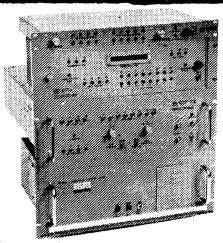


General Electric offers an extensive line of reliability-proven industrial and special-purpose tubes including the following popular types: ceramic, communication, Five-Star, glow tubes, ignitrons, industrial receiving, rectifier, thyratrons, transmitting tubes and triggered vacuum gaps.

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section 998-60, Schenectady, N. Y. 12345.

GENERAL ELECTRIC

LORCH COMMUNICATION EQUIPMENT MICROWAVE AND RF COMPONENTS



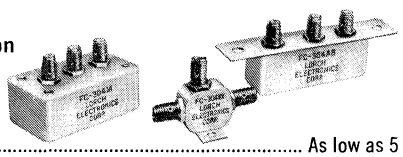
COMPUTER-CONTROLLED HF RECEIVING SYSTEM Model HR-240NS

Lorch Electronics Computer-Controlled HF Receiving System HR-240NS has a wide variety of applications in the 2 to 32 MHz HF range, including the following:

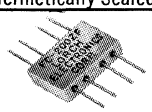
- Remote programmable (frequency and gain) communications
- On-the-air surveillance
- Accurately programmed spectrum search
- "Frequency hop" communications
- Signal level measurements
- Radio direction finding
- Multiple diversity reception

MICROWAVE & RF DOUBLE BALANCED MIXERS — 10 KHz to 11 GHz

Low intermodulation and spurious products



Conversion Loss	As low as 5 db
Isolation	To 85 db
Two Tone Intermodulation Ratio, Third Order Two tones, −30 dbm	To 140 db
RF Input	To 1 watt
Temperature Range	−65°C to +125°C
Hermetically Sealed	

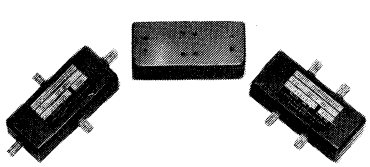


FLATPACKS

- Mixers — Double-Balanced
- Mixers — Low Distortion
- Power Splitters — Two Way, In-Phase
- Power Splitters — Two Way, 180°
- Power Splitters — Three-Way
- Power Splitters — Four-Way
- Transformers
- Directional Couplers
- Quadrature Hybrids
- Hybrid Junctions
- Frequency Doublers
- Filters

Lorch Electronics offers a large variety of flatpack configurations to meet your broadband component requirements for frequencies up to 1000 MHz (Mixers to 1500 MHz). These highly reliable networks range in size from 0.375″ x 0.375″ x 0.125″ to 0.810″ x 0.810″ x 0.125″. They can be supplied — economically — either off-the-shelf or custom-tailored to meet your special requirements.

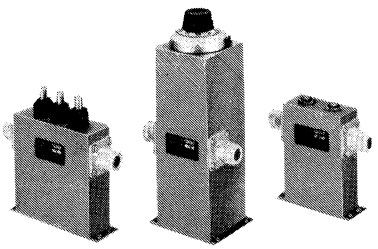
PHASE COMPARATORS



The phase comparators are broad band devices which accept two RF input signals of the same frequency, providing two video outputs, proportional respectively to the sine and cosine of the input RF phase difference.

Center Frequency Range	0.2 to 200 MHz
SSB Conversion Loss	11 db max.
Phase Error	±2° over 15% BW ±4° over 25% BW
DC Offset	±2 mV up to 60 MHz ±3.5 mV up to 160 MHz
Spurious Output	Minimized by low pass filters in each video port
VSWR	1.5 to 1

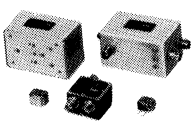
MICROWAVE FILTERS



- TEM Cavities
- Comb Lines
- Interdigitals
- Band Rejects
- Lumped Elements
- Waveguide Filters
- Tunable Filters
- Reference Cavities
- Preselectors
- Multiplexers

Lorch Electronics offers a large variety of filter devices to meet all your requirements from 100 KHz to 18 GHz.

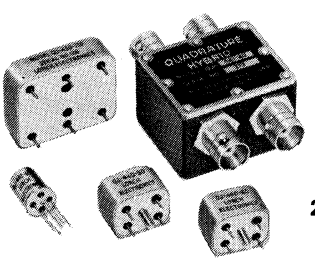
WIDE BAND ELECTRONIC SWITCHES



RF Frequency Range	1 to 1000 MHz
Switching Frequency Range	DC to 500 MHz
RF Input Level for 2 db Compression	To +23 dbm
Insertion Loss, ON Condition	To 1 db
Insertion Loss, OFF Condition	To 70 db
Temperature Range	−65°C to +125°C
Hermetically Sealed	
Standard Pin Packages, Connector Versions, Custom Packaging	

WIDE BAND RF AMPLIFIERS, SERIES AM-320

Frequency Range	0.1 to 1000 MHz
Noise Figure	To 3 db
Power Output for 2 db Compression	To +30 dbm
Third Order Intercept	To +45 dbm
Temperature Range	−20°C to +50°C



WIDE BAND HYBRID JUNCTIONS, QUADRATURE HYBRIDS, and POWER SPLITTERS

2, 3, 4, 5, 6, 8 and MULTIWAY

Frequency Ranges	From 10 KHz to 12.4 GHz
VSWR	1.2 to 1
Isolation	To 35 db
Phase Balance	±1°
Amplitude Balance	0.1 db
Temperature Range	−65°C to +125°C
Input Power	To 50 watts
Hermetically Sealed	
TO-5 Can, Standard Pin Packages, Connector Versions, Custom Packaging	

ELECTRONIC VARIABLE ATTENUATORS, FREQUENCY MULTIPLIERS, RF TRANSFORMERS, DIRECTIONAL COUPLERS, PHASE SHIFTERS, AMPLITUDE TRIMMERS

LORCH ELECTRONICS CORP.

105 Cedar Lane, Englewood, N. J. 07631 • 201-569-8282 • TWX: 710-991-9718

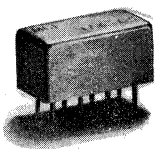
MINI-CIRCUITS' DOUBLE BALANCED MIXERS

Quality, performance, and price make our units winners throughout the world. Mini-Circuits clearly defines customers needs and tailors its product line with standard off-the-shelf items.

High volume production, multiple-part production and automated mass inventory means lower costs to you.

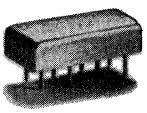
Visual inspection and test on every unit, individual component bonding, worst case derating, engraved markings, packaging in metal cases, hermetic sealing, exclusive use of hot-carrier dioded (individually tested and matched) means quality and reliability in every Mini-Circuits unit you purchase.

STANDARD LEVEL DOUBLE BALANCED MIXERS (+7dBmLO)



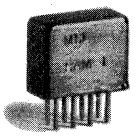
SRA SERIES

Miniature size, economically priced, provides frequency coverage from 3 KHz to 1250 MHz. Features 6 dB conversion loss, 40 dB isolation, temperature range −54°C to +100°C, shock and vibration protected for tough military requirements. Small quantity prices start from $9.95 each.



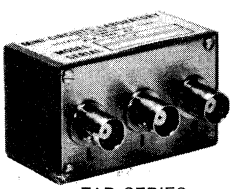
TAK SERIES

Miniature low profile size, provides frequency coverage from 10 KHz to 1250 MHz. Features 5.5 dB conversion loss, 40 dB isolation, temperature range −54°C to +100°C. Meets military specifications. Exact equivalents to competitive low profile units available. Small quantity prices start from $24.95 each.



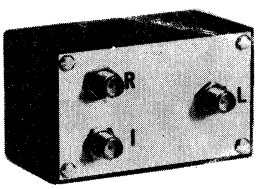
SAM SERIES

Micro-miniature size, requires same PC board area as a TO-5 transistor case. Premium high performance units. Frequency coverage from 100 KHz to 1500 MHz. Temperature range −54°C to +100°C, constructed for tough military requirements. Small quantity prices start from $15.95 each.



ZAD SERIES

Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Double shielded for tough EMI requirements. Frequency coverage from 3 KHz to 1250 MHz. Features 6 dB conversion loss, 40 dB isolation. Temperature range −54°C to +100°C. Small quantity prices start from $24.95 each.



MA SERIES

Cast aluminum case, SMA (3mm) connectors. Model MA-1 provides exceptionally broad frequency coverage 1 MHz to 2500 MHz. LO power +10 dBm, isolation greater than 40 dB, conversion loss 9.5 dB. Ruggedly constructed for tough military requirements. Single unit price only $99.95.

HIGH LEVEL DOUBLE BALANCED MIXERS (+17dBmLO)

SRA-H SERIES

Miniature size, provides frequency coverage from 10 KHz to 750 MHz. Features 6 dB conversion loss, 40 dB isolation, temperature range −54°C to +100°C. Offers increased dynamic range, 1 dB compression point at +10 dBm RF input. Small quantity prices start from $15.95 each.

ZAD-H SERIES

Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Double shielded for tough EMI requirements. Frequency coverage from 10 KHz to 750 MHz. Features 6 dB conversion loss, 40 dB isolation. Offers increased dynamic range, 1 dB compression point at +10 dBm RF input. Small quantity prices start from $30.95.

FOR COMPLETE SPECIFICATIONS, SEE MICROWAVES' PRODUCT DATA DIRECTORY

Mini-Circuits Laboratory MCL
2913 Quentin Rd. Brooklyn, N.Y.11229 (212)252-5252 Int'l Telex 620156
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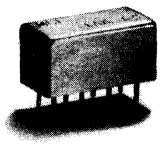
Select the products that will solve you application. You'll quickly see how our units can be applied to your present designs at considerable savings. For technical and price information contact Harvey Lasker at our factory or our local sales representative listed in Yellow Section of this Catalog. Convince youself of our rapid delivery, product performance and reliability. Place your order now.

POWER SPLITTERS AND TRANSFORMERS

VERY HIGH LEVEL DOUBLE BALANCED MIXERS (+23dBmLO)



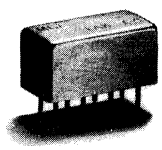
RAY SERIES

Miniature size, provides frequency coverage from 15 HKz to 500 MHz. Features 6.5 dB conversion loss, 40 dB isolation, temperature range −54°C to + 100°C. Offers extra increased dynamic range, 1 dB compression point at +15 dBm RF input. Small quantity prices start from $31.95 each.

ZAY SERIES

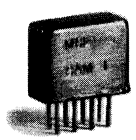
Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Double shielded for tough EMI requirements. Frequency coverage from 15 KHz to 500 MHz. Features 6.5 dB conversion loss, 40 dB isolation. Offers extra increased dynamic range, 1 dB compression point at +15 dBm RF input. Small quantity prices start from $41.95.

TWO-WAY IN PHASE POWER SPLITTERS



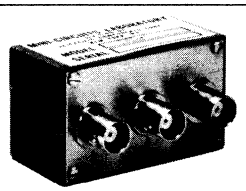
PSC-2 SERIES

Miniature size, provides frequency coverage from 2 KHz to 400 MHz. Low insertion loss .5 dB, high isolation 40 dB, amplitude balance typically .05 dB, phase balance typically less than 1 degree. Temperature range is from −54°C to +100°C. Economically priced from $9.95 in small quantities.



MSC-2 SERIES

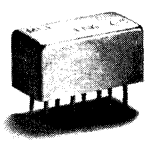
Micro-miniature size, requires same PC board area as a TO-5 transistor case. Model MSC-2-1 covers 0.1 to 450 MHz. Premium performance of low insertion loss .5 dB, high isolation 35 dB, amplitude balance less than .05 dB, phase balance less than 1 degree. Ruggedly constructed for military applications. Priced at $15.95 each in small quantities.



ZSC-2 SERIES

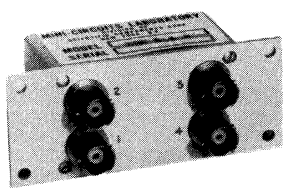
Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Frequency coverage from 2 KHz to 400 MHz. Low insertion loss .5 dB, high isolation 40 dB, amplitude balance .05 dB, phase balance 1 degree. Temperature range −54°C to +100°C. Small quantity prices start from $24.95 each.

THREE-WAY IN PHASE POWER SPLITTERS



PSC-3 SERIES

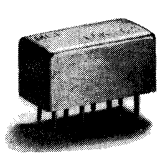
Miniature size, provides frequency coverage from 10KHz to 200MHz. Low insertion loss, .5dB, high isolation 40dB, amplitude alance typically .05dB, phase balance typically less than 1 degree. Temperature range is from -54°C to +100°C. Economically priced from $19.95 in small quantities.



ZSC-3 SERIES

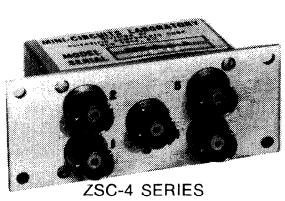
Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Frequency coverage from 10KHz to 200 MHz. Low insertion loss .5dB, high isolation 40dB, amplitude balance .05dB, phase balance 1 degree. Temperature range -54°C to +100°C. Small quantity prices start from $34.95 each.

FOUR-WAY IN PHASE POWER SPLITTERS



PSC-4 SERIES

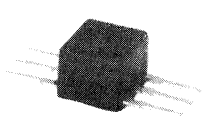
Miniature size, model PSC-4-1 covers 0.1 to 200 MHz. Low insertion loss .5 dB, high isolation 40 dB, amplitude balance typically .05 dB, phase balance typically less than 2 degrees. Temperature range is from −54°C to +100°C. Economically priced at $24.95 in small quantities.



ZSC-4 SERIES

Cast aluminum case, BNC, TNC, SMA (3mm) connectors. Frequency coverage from 2KHz to 200 MHz. Low insertion loss .5 dB, high isolation 40 dB, excellent amplitude and phase balance. Temperature range is from −54°C to +100°C. Small quantity prices start from $39.95 each.

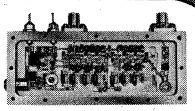
RF TRANSFORMERS

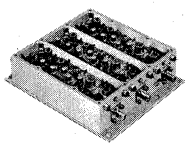


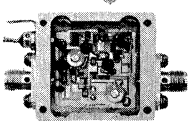
T SERIES

Ultra miniature size, DIP package, provides frequency coverage from 20KHz to 500 MHz. Low insertion loss .4dB, .5 watt rating, typical VSWR 1.3 to 1. Economically priced from $2.95 in small quantities.

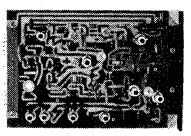
RHG for IF Amplifiers

LOGARITHMIC I F AMPS 

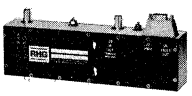
MATCHED I F AMPS 

IC HYBRID I F AMPS 

CATALOG I F AMPS

CUSTOM I F AMPS 

LIMITING I F AMPS

LINEAR I F AMPS 

LOW INTERMOD I F AMPS

Over the years the industry has come to depend upon RHG for a steady stream of innovations and improvements in its various product lines.

This year is no exception, and in the IF Amplifier line alone RHG is offering

- A new line with "IF output only" at $295.00
- A new line of Hybrid IC Lin & Log IF Amps
- A new line of constant phase shift limiters
- A new line of IC preamps in <1 cubic inch
- A new line of highly accurate & super stable log amps
- 33 new features/improvements/reduced prices

WRITE FOR DETAILED TECHNICAL DESCRIPTION AND LISTING OF STANDARD MODELS.

RHG **RHG ELECTRONICS LABORATORY · INC**

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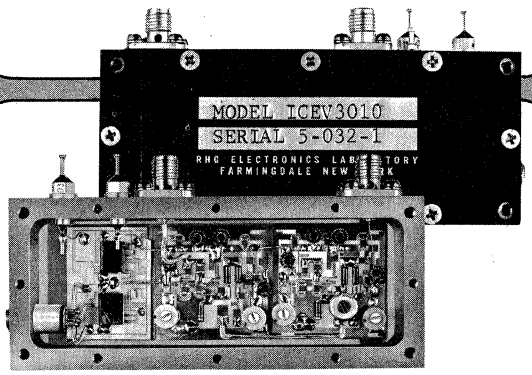
for Reliability, Innovation and Service

THE NEWEST DESIGNS
THE WIDEST SELECTION

Linear & Logarithmic IF Amplifiers



New!

HYBRID IC MODELS

$3\frac{1}{2}$" x $1\frac{7}{16}$" x $\frac{5}{8}$"

RANGE OF SPECIFICATIONS

	LINEAR	LOGARITHMIC
Center Frequency	30 to ~~70~~ 160 MHz	30 to ~~70~~ 330 MHz
Bandwidth	to 20 MHz	to 20 MHz
Risetime	to .05 μsec	to .05 μsec
Output	IF and Video	DC Coupled Video
Noise Figure	<4 db	<10 db
Dynamic Range	40 db	80 db

Over the years the industry has come to depend upon RHG for a steady stream of innovations and improvements in its various product lines.

This year is no exception, and in the IF Amplifier line alone RHG is offering

- A new line with "IF output only" at $295.00
- A new line of Hybrid IC Lin & Log IF Amps
- A new line of constant phase shift limiters
- A new line of IC preamps in <1 cubic inch
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- 33 new features/improvements/reduced prices

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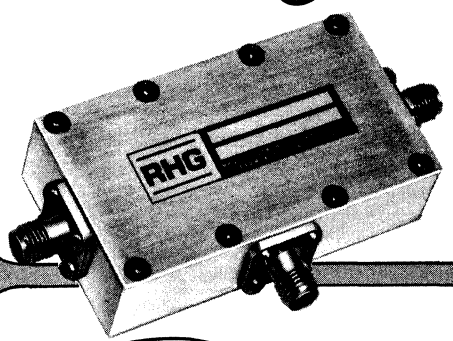
New Multi-Octave Double Balanced Mixers



Now Available
RF to 18 GHz
IF to 2.3 GHz

0.5 to 12 GHz COVERAGE IN A SINGLE MIXER

UNIQUE DOUBLE BALANCED MICROWAVE CONFIGURATION*

Excellent noise performance is maintained over several octaves along with low IM distortion and high isolation.

MULTI-OCTAVE • OCTAVE MODELS

Model No.	Freq. (GHz)	NF(db)	Price
DM 1-4	1.0 to 4.0	7.5	$325
DM 1-8	1.0-to 8.0	8.5	345
DM 1-12	1.0 to 12.0	10.0	425
DM .5-12	0.5 to 12.0	10.0	450
DM 1-18	1.0 to 18.0	10.0	595
DM 1-2	0.8 to 2.2	7.2	295
DM 2-4	1.8 to 4.2	7.5	295
DM 4-8	3.7 to 8.2	8.2	325
DM 8-12	7.8 to 12.2	10.0	345
DM 12-18	11.8 to 18.2	10.0	495

NOTES:
1. LO-RF isolation 20 db.
2. Based on 1.5 db IF N.F.
3. RF & LO VSWR: 2.0:1.
4. LO injection: +5 to +10 dbm.

Mixers are available with or without built-in low noise preamplifiers — one group of hundreds of standard RHG waveguide and coaxial mixer-preamplifiers.

Write for technical performance curves and detailed data sheets.

*U.S. Pat. #3,652,941

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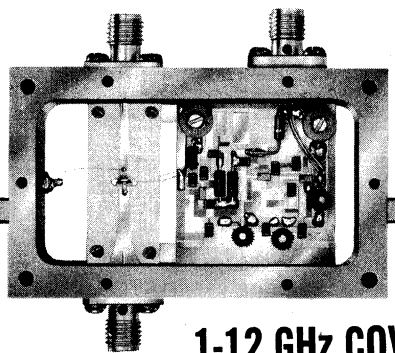
Multi-Octave Double Balanced Mixers*

Now with Built-In IC Preamplifiers



Now Available
Series DM 1-18/10
1-18 GHz Coverage

1-12 GHz COVERAGE IN A SINGLE MIXER

LOW INTERMODULATION DISTORTION
HIGH ISOLATION
IF CENTER FREQUENCIES TO 200 MHz
IF BANDWIDTHS TO 200 MHz

RF BAND	MODEL NUMBER	IF FREQ/BW	PRICE
1.0 to 12.0 GHz	DM1-12/10A	60/10	$775
	DM1-12/10B	60/20	$775
	DM1-12/10C	30/10	$775
	DM1-12/10D	70/10	$775
	DM1-12/10HH	10 to 200	$850

NOTES:
1. LO-RF Isolation 20 db nominal
2. Noise Figure <9 db to 8 GHz
   <11 db to 12 GHz

Also Available:
- A wide variety of double balanced mixers providing octave and multi-octave coverage with and without preamps
- IC preamps with output capability to +20 dbm
- Gain and phase matched IC preamps with gain control

Write for technical performance curves and detailed data sheets.

*U.S. Pat. #3,652,941

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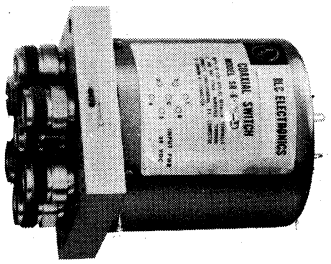
for Reliability, Innovation and Service

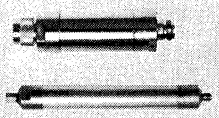
PRECISION COAXIAL COMPONENTS

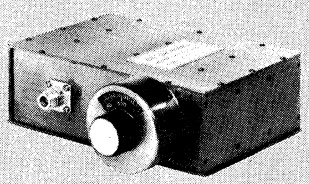
COAXIAL SWITCHES

- DC — 18 GHz
- SPDT, Multiposition, and Transfer Designs
- Failsafe or latching
- Isolation to 100 db
- Options include indicators, DC or AC operating voltage, various connector types, miniature construction
- Break-before-make or Make-before-break
- Remote or Manual
- 1 Million Cycles minimum life



COAXIAL FILTERS

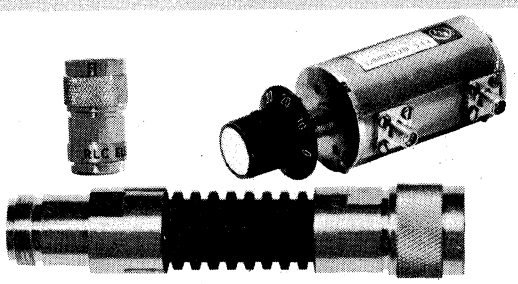




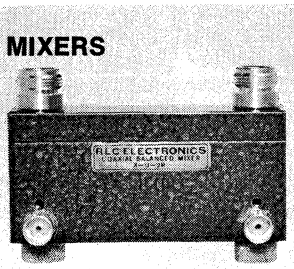
- DC — 18 GHz
- Low Pass, High Pass, Band Pass, and Band Reject Designs
- mw thru 5 KW designs available
- Fixed tuned and tunable versions
- Options include miniature construction, precision designs, various connector types

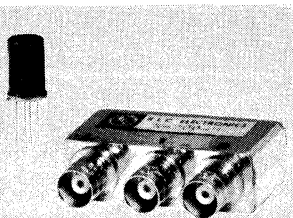
ATTENUATORS and TERMINATIONS

- DC — 12.4 GHz
- Low, medium, and high power designs available
- Fixed, turret attenuators, and continuously variable
- Options include miniature construction, precision designs, various connector types



MIXERS

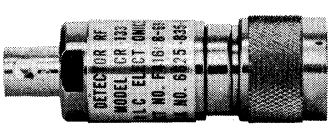




- Double balanced designs thru 2,000 MHz
- Balanced mixers for octave coverage thru 8,000 MHz
- IF output available in single, parallel, or push/pull configuration
- Low conversion loss
- Options include miniature construction, various connector types including circuit board tabs

CRYSTAL DETECTORS

- 1 unit covers 10-12,400 MHz. Usable to 18 GHz
- Available in matched pairs
- Negative or positive output polarity
- Various connector types offered



OTHER COMPONENTS

- Directional Couplers
- Hybrids
- Line Stretchers
- Custom Assemblies

Send for complete 80 page catalog; includes specs, typical data, outline dimensions, and prices.

RLC ELECTRONICS INC.
83 Radio Circle, Mt. Kisco, N.Y. 10549
Phone: 914/241-1334

UNITRODE

MICROWAVE PRODUCTS

The Unitrode fused-in-glass process results in a highly-reliable, voidless, hermetic package and is now available for both high and low power PIN diodes. Our unique construction assures the lowest possible thermal resistance and series resistance compared to diodes of conventional construction.

Our process utilizes symmetrical full-faced metallurgical bonds to both surfaces of the silicon chip and results in peak and average power dissipation capability never before possible in PIN diodes. Also, the monolithic construction greatly minimizes the normal parasitic inductance and capacitance found in conventional diodes which employ straps, springs, whiskers, and ceramic packages.

Diodes of the Unitrode construction have stability and reliability proven by millions of device hours in systems of all types. Also, environmental performance is unparalleled as they can withstand thermal cycling from $-195°C$ to $+300°C$ and exceed all military environmental specifications for shock, vibration, acceleration, moisture resistance and solderability.

Long carrier lifetime permits low distortion of RF signals and consequently results in low harmonic generation and intermodulation. Although switching time is dependent upon carrier lifetime, it is possible to obtain speeds on the order of 10% of the lifetime through the proper choice of bias and driver conditions.

Each series offer 4 or 5 standard packages all built from our basic diodes (style A), and offers a tradeoff of series resistance, capacitance, lifetime and parallel resistance. High and low voltage diodes are available in each series.

Series Type Number	Breakdown Voltage Range	Total Capacitance (0V, 1 GHz)	Series Resistance (100mA, 1 GHz)	Parallel Resistance (100V, 1 GHz)	Average Thermal Resistance†	Average Power Dissipation*	Peak Power Dissipation+	Carrier Lifetime ($I_F = 10$ mA)
	V_B (Volts)	C_T max (PF)	R_S max (Ω)	R_P min (kΩ)	θ_A max (°C/W)	P_A max (W)	P_P max (kW)	τ(min) μsec
UM 4000	100-1200	3.0	0.5	1	6	25	100	5.0
UM 4300	100-1000	2.2	1.5	1	8	18	500	5.0
UM 4900	100-1000	3.0	0.5	1	4	37	300	5.0
UM 6000	100-1000	0.5	1.7	15	25	6	25	1.0
UM 6100	100-800	0.7	1.2	12	25	6	15	0.9
UM 6200	100-600	1.1	0.4	10	25	6	10	0.6
UM 6600	100-600	0.4	2.5	10	35	4	13	1.0
UM 7000	100-1600	0.9	1.0	10	15	10	60	2.5
UM 7100	100-800	1.2	0.6	8	15	10	35	2.0
UM 7200	100-600	2.2	0.25	7	15	10	20	1.5
UM 7300	100-1000	0.7	3.5	10	20	7.5	100	2.5
UM 7900	100-1000	0.8	1.0	10	10	15	60	2.5

NOTES:

† Junction to pin

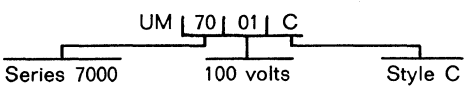
* With one pin maintained at 25°C

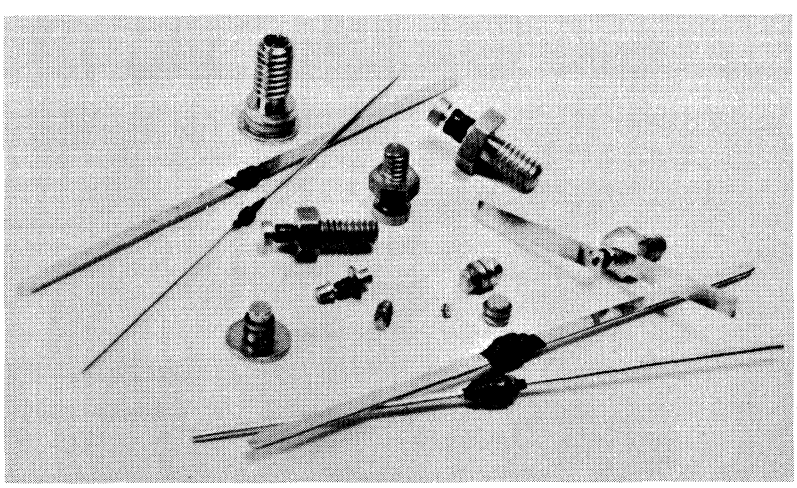
\+ For 1 Microsecond Pulse Width

Ordering Instructions

Part numbers of Unitrode Pin Diodes consist of the letters UM followed by four digits and one or two letters. The first two digits indicate the diode series, the next two digits specify the minimum breakdown voltage in hundreds of volts. The remaining letters denote the package style. Reverse polarity (anode on stud end) is available in C and D Styles and denoted by adding second letter R.

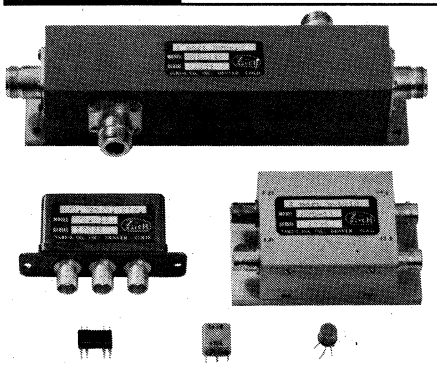
For Example:





Z-MATCH

WIDE BAND HYBRID POWER COMBINERS/DIVIDERS



Hybrids can combine vectorially two signals from an antenna or other source, can function as directional couplers, and may be used as the input and output coupling means in balanced mixers and phase detectors. Z-Match hybrids fall into two basic categories: (1) balun devices, which are essentially well balanced, DC isolated wide band transformers with impedance ratios of 4:1 (Ref. Figures 5 - 6 with N = 2) and (2) combinations of two or more transformers to comprise hybrids with equal 50 - 75 ohm impedances on all ports (Ref. Figures 5 - 6 with N = 1).

Combinations or tandem arrangements of the models listed in the table may be used to form 2, 4, 8, —— 2^n way divider/combiners for equal, isolated signal distribution or multicoupler systems. The isolation properties of a hybrid minimize oscillator pulling or intermodulation while combining signals vectorially with small (3 dB in a single 2-way) signal loss.

All models listed in the table below are capable of meeting the specified limits over a temperature range of −55 to +100°C. and are designed for military environments. Additional information as well as data on 90° hybrids is given in Bulletin 111.

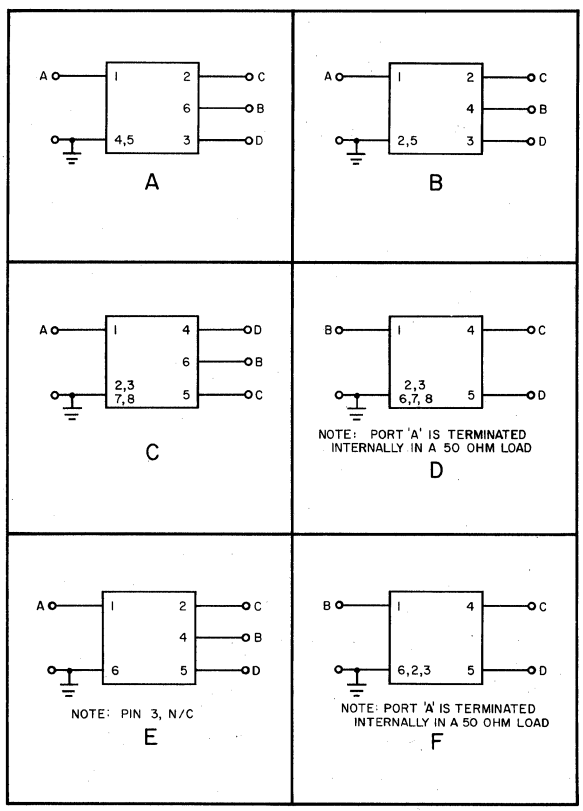


FIGURE 4
BLOCK DIAGRAMS

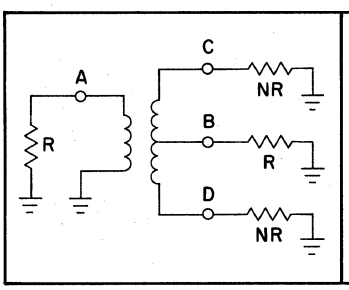


FIGURE 5
TRANSFORMER EQUIVALENT TO A HYBRID

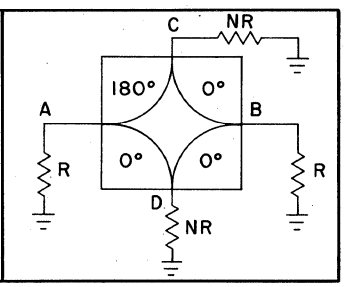


FIGURE 6
HYBRID FUNCTION DIAGRAM

Note:
As a power divider; with a signal input at Port A phase C-D = 180°. Port B is isolated.

With a signal input at Port B, phase C-D = 0°. Port A is isolated.

As a combiner these are reciprocal relationships, i.e., outputs may be used as inputs with appropriate sum or differences appearing as indicated.

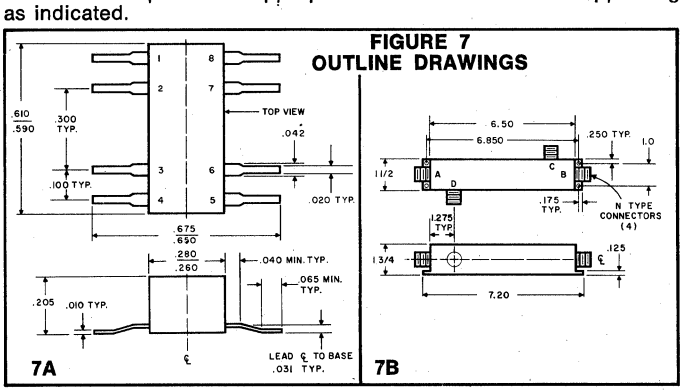


FIGURE 7
OUTLINE DRAWINGS

HYBRID SPECIFICATIONS

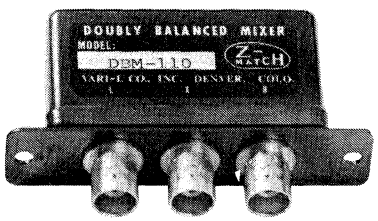
MODEL — FREQUENCY RANGE, MHz, MIN.	REF. FIGS. 5 - 6 N=	ISOLATION, ALL PORTS, TYPICAL	OUTLINE DWG., FIGURE	PIN CONN. FIG.	IMPEDANCE PORTS A, B, OHMS	PRICE 1 - 9
HYB-1 .250 - 500	2	25 dB	1 (HF)	4A	50 - 75	**$24.50**
HYB-2 .250 - 300	2	25 dB	1 (HF)	4A	50 - 75	**20.80**
HYB-3 .100 - 200	2	25 dB	1 (HF)	4A	50 - 75	**20.80**
HYB-4 2.5 - 250	2	25 dB	1 (HF)	4A	50 - 75	**19.00**
HYB-5 3.5 - 250	2	25 dB	1 (HF)	4A	50 - 75	**19.00**
HYB-6 .002 - 15	2	25 dB	1 (HF)	4A	50 - 75	**24.50**
HYB-7 .010 - 100	2	25 dB	1 (HF)	4A	50 - 75	**22.50**
***HYB-8** .100 - 200	2	25 dB	1 (DP)	4B	50 - 75	**20.80**
***HYB-9** .25 - 500	2	25 dB	7A	4C	50 - 75	**24.50**
***HYB-10** 1 - 200	1	25 dB	7A	4D	50	**35.75**
***HYB-11** .100 - 200	2	25 dB	1 (TO) (6)	4E	50 - 75	**20.80**
***HYB-12** 1 - 100	1	25 dB	1 (TO) (6)	4F	50	**34.50**
***HYB-13** .01 - 50	1	35 dB	See Bul. 111	See Bul. 111	50	**160.00**
HYB-14 2 - 2000	1	35 dB	7B	7B	50	**190.00**
HYB-15 .5 - 150	1	30 dB	1 (CA)		50	**45.00**

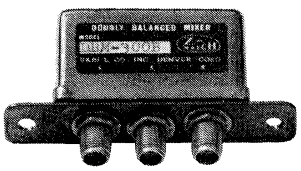
Notes: Model HYB-14 is rated at 25 watts max., with appropriate 50 ohm, 25 watt load. All other models are rated at 1 watt max. except those with *, which are rated at .5 watt max.

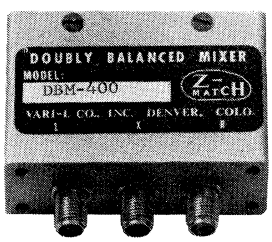
VARI-L CO., INC. • 3883 MONACO PARKWAY • DENVER, COLORADO 80207 • (303) 321-1511 • TWX 910-931-0590

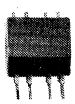
Z-MATCH DOUBLY BALANCED MIXERS

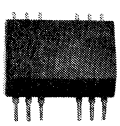
See pages 1786-1788

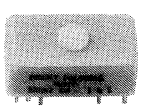












Wide Bandwidth

High Isolation

Low Insertion Loss

Low Noise Figure

Flat Conversion Efficiency

Low Intermodulation Products

Mixing two signals to produce a sum and a difference frequency requires a square-law device, and a diode has long been used for this purpose. Because it departs from true square-law behavior over much of its range, it produces products other than those desired, and it also feeds energy through from one port to another. The balanced mixer was developed to overcome these shortcomings, and its advantages are so numerous that it has become a standard component in most high-performance receivers. It is also valuable in the design of such high-reliability items as aircraft navigational equipment, microwave links, spectrum analyzers, etc. It would be out of the question to meet modern military equipment specifications, particularly as regards oscillator radiation from the antenna and intermodulation distortion, without the doubly balanced mixer. These advantages would also be desirable in equipment such as television receivers, CATV distribution circuits, and amateur communications receivers, but high cost has been a deterrent to using balanced mixers in such service. In recent months Vari-L Co., Inc. has been making strides toward a marked cost reduction in the device, and we invite inquiries from set designers who might like advance information.

NEW HIGH LEVEL DOUBLY BALANCED MIXERS

Recently balanced mixers have been developed containing networks which greatly improve their ability to handle, linearly, high RF signal levels. These designs (see Type 1 Mixers, Page 6) have lower harmonic spurious outputs as well as improved odd order intermodulation production. Other characteristics parallel the low level types except that higher local oscillator drive levels are recommended.

APPLICATIONS:
MODULATOR

Because one port is coupled to DC, the doubly balanced mixer may be used as a pulse modulator with unlimited pulse duration. RF input is made to port L, modulation to port X, and the output from port R. Total current should not exceed 50 ma. The modulator has a 35 dB on/off ratio at f_{max} (greater at the lower frequencies) and a turn-on/turn-off time of less than one nanosecond. As an AM modulator, with the X port used for the modulation-signal input, the mixer has excellent carrier rejection at high frequencies. The carrier may be reinserted after the modulator, or will feed through the mixer in controlled amounts if a DC bias (suitably isolated from the modulation source) is introduced into the X port.

CURRENT-CONTROLLED ATTENUATOR

By the use of a DC bias as described above, the mixer can function as a current/voltage controlled attenuator. With zero current into the X port the attenuation of an RF signal of frequency up to the specified f_{max} will be at least 35 dB, reducing to approximately 3 dB when the bias current is increased to 10 ma. Response time is less than one nanosecond. The signal is introduced to the R port and the output taken from the L port.

PHASE DETECTOR

Because the X port is DC coupled, it is possible to extract a DC voltage as a function of the phase difference between two signals. Minimal I/f noise is introduced, because of the inherent low-noise quality of the diodes, and their superior balance makes a DC adjustment of the phase detector unnecessary. The DC output is approximately 0 VDC when the L and R port signal phase relationship is $\phi = 90°$, and approximately $\pm.4$ VDC for $\phi = 0$ or 180° phase conditions.

CONSTRUCTION

Z-match mixers are packaged in several case styles allowing the design engineer maximum layout flexibility. Most types are encapsulated to withstand severe environments and handling. High-rel screened diodes are employed throughout, as well as approved design tested materials. Complete details are included on all types in Bulletin 106.

Figures 8 and 9 are performance curves which are useful in selecting a mixer for a given application. See also Fig. 12, Vol.2•626.

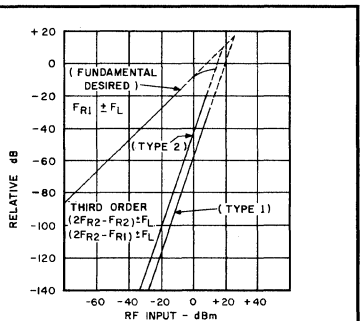


FIGURE 8
TYPICAL THIRD ORDER INTERMODULATION PERFORMANCE

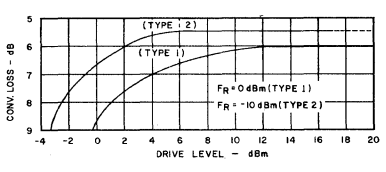
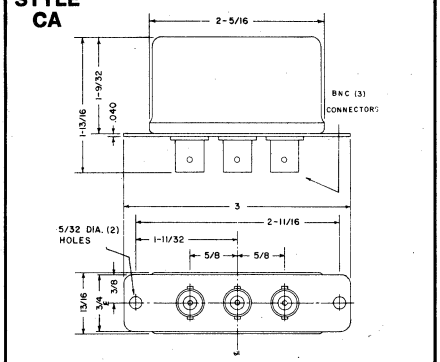


FIGURE 9
GENERAL PURPOSE DESIGN CURVE

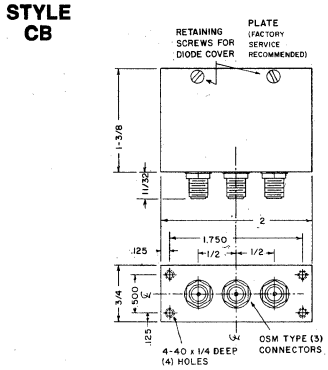
Z-MATCH

DOUBLY BALANCED MIXERS (CONT.)

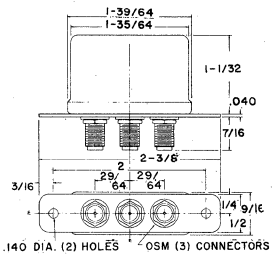
STYLE CA



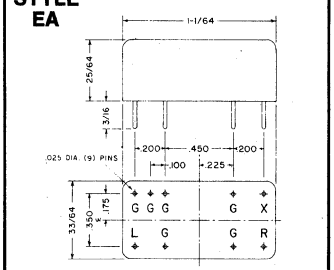
STYLE CB



STYLE CC



STYLE EA



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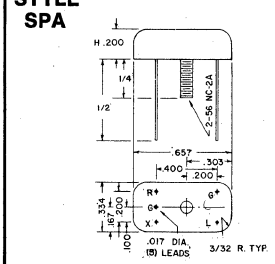

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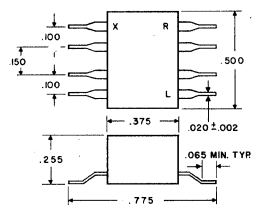


STYLE EB

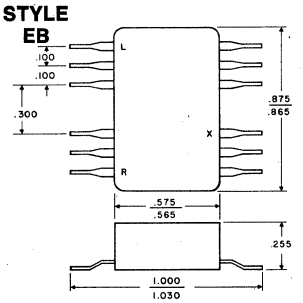


FIGURE 10
MIXER OUTLINE DRAWINGS

DOUBLY BALANCED MIXER SPECIFICATIONS

MODEL ( ) DENOTES TYPE*	OVERALL FREQUENCY RANGES (MHz)	FREQUENCY BANDS (MHz)	CONV. LOSS SSBNF (dB, Max.)	ISOLATION (dB, MIN.) LO-RF	LO-IF	RF-IF	PACKAGE STYLE (See Outline)	Schematics Fig.	PRICE 1-9	SPECIAL NOTES
DBM-152 (2)	R&L: 002-15 X: DC-15	.002-1 1-15	5.5 5.5	50 50	40 40	25 20	EA	11B	$40.00	Fully Encapsulated High Rel. Plastic Type
DBM-162 (2)	R&L: 002-15 X: DC-15	.002-1 1-15	6.0 6.0	45 45	35 35	25 20	EA	11B	$35.00	Lower Spec. Equal of DBM-152
DBM-153 (2)	R&L: .01-50 X: DC-50	.01-1 1-35 35-50	8.5 5.0 5.5	40 40 40	35 35 30	25 25 20	EA	11B	$30.00	Fully Encapsulated High Rel. Plastic Type
DBM-163 (2)	R&L: .01-50 X: DC-50	.01-1 1-35 35-50	8.5 5.5 6.0	35 35 35	30 30 25	25 20 20	EA	11B	$25.00	Lower Spec. Equal of DBM-153
DBM-151 (2)	R&L: .05-200 X: DC-200	1-100 .05-200	6.5 7.5	40 35	35 30	25 20	EA	11B	$30.00	Fully Encapsulated High Rel. Plastic Type
DBM-161 (2)	R&L: .05-200 X: DC-200	1-100 .05-200	6.5 8.0	35 30	30 25	20 20	EA	11B	$25.00	Lower Spec. Equal of DBM-151
DBM-154 (2)	R&L: .05-200 X: DC-200	1-100 .05-200	6.5 7.5	40 35	35 30	25 20	EB	11B	$25.00	Plastic Dip, Equal of DBM-151
DBM-150 (2)	R&L: 5-500 X: DC-500	10-100 5-250 5-500	6.5 7.5 8.5	40 35 30	35 30 25	25 20 20	EA	11B	$30.00	Fully Encapsulated High Rel. Plastic Type
DBM-160 (2)	R&L: 5-500 X: DC-500	10-100 5-250 5-500	6.5 7.5 9.0	35 30 30	30 25 20	25 20 15	EA	11B	$25.00	Lower Spec. Equal of DBM-150
DBM-155 (2)	R&L: .2-600 X: DC-600	1-100 1-250 .2-600	6.5 7.0 8.0	45 35 30	35 30 25	25 20 20	EC	11B	$25.00	Plastic Dip, Equal of DBM-172
DBM-156 (2)	R&L: 5-1000 X: DC-1000	10-500 5-1000	6.5 7.5	35 30	25 20	20 15	EC	11B	$35.00	Plastic Dip, Very Wide Band VHF General Purpose
DBM-157 (1)	R: .5-400 L: 5-600 X: DC-400	1-100 .5-400	6.5 8.0	45 35	30 25	25 20	EB	11B	$50.00	Plastic Dip, Very High Level, Low Intermodulation Type
DBM-170 (2)	R&L: .2-700 X: DC-700	1-100 1-250 .5-500 .2-700	6.5 7.0 7.5 8.0	50 40 35 30	35 30 25 25	30 25 20 20	SPA "H" .200	11C	$60.00	High Isolation Very Wide Band Shielded
DBM-171 (2)	R&L: .2-600 X: DC-600	1-100 1-250 .5-500 .2-600	6.5 7.0 7.5 8.0	45 35 30 30	35 30 25 25	20 25 20 20	SPA .200	11C	$45.00	Best General Purpose Shielded PC Type
DBM-172 (2)	R&L: .2-500 X: DC-500	1-100 1-250 .5-400 .2-500	6.5 7.0 7.5 8.5	40 35 30 30	35 30 25 25	30 25 20 20	SPA .200	11C	$40.00	Lower Spec. Equal of DBM-171
DBM-174 (2)	R&L: .2-400 X: DC-400	1-100 1-250 .2-400	6.5 7.5 8.5	30 30 25	25 20 20	20 20 20	SPA .200	11C	$30.00	Lowest Cost Shielded Type

Z-MATCH DOUBLY BALANCED MIXERS (CONT.)

DOUBLY BALANCED MIXER SPECIFICATIONS (Continued)

MODEL ( ) DENOTES TYPE*	OVERALL FREQUENCY RANGES (MHz)	FREQUENCY BANDS (MHz)	CONV. LOSS SSBNF (dB, Max.)	ISOLATION (dB, MIN.) LO-RF	LO-IF	RF-IF	PACKAGE STYLE (See Outline)	Schematics Fig.	PRICE 1-9	SPECIAL NOTES
DBM-175 (2)	R&L: .2-600 X: DC-600	1-100 1-250 .5-500 .2-600	6.5 7.0 7.5 8.0	45 35 30 30	35 30 25 25	30 25 20 20	SPA .250	11C'	$70.00	Very High Rel., Encapsulated NASA Approved
DBM-181 (2)	R&L: 300-1750 X: DC-500	300-1250 1250-1750	8.0 10	35 25	25 10	20 10	SPA .350	11C	$80.00	UHF Shielded PC Type
DBM-158 (2)	R&L: 500-1500 X: DC-1000	800-1250 500-1500	7.0 7.5	35 30	30 25	20 10	EC	11B	$50.00	Plastic Dip, General Purpose UHF Type
DBM-159 (1)	R&L: 750-2300 X: DC-1000	1000-1500 1000-2000 750-2300	7.5 9.0 10.5	30 25 20	20 20 20	20 15 10	EB	11B	$70.00	Plastic Dip, UHF Very High Level, Low Intermodulation Type
DBM-100B (2)	R&L: .2-600 X: DC-600	.5-100 .5-250 .2-500 .2-600	6.5 7.0 8.0 8.5	45 40 30 30	35 30 25 25	25 20 20 20	CA	11A	$45.00	Low VSWR, Highest Performance Mixer of its Type
DBM-100E (1)	R&L: .5-500 X: DC-500	.5-30 30-100 100-500	7.0 7.5 9.0	60 55 35	45 40 30	30 25 25	CA	11A	$85.00	Very High Level, Low Intermodulation Type
DBM-110 (2)	R&L: 5-600 X: DC-600	10-100 10-250 10-500 5-600	7.0 7.5 8.0 8.5	40 30 30 30	35 30 25 25	25 20 20 20	CA	11A	$38.00	High Performance Low Cost
DBM-111 (2)	R&L: .05-200 X: DC-200	1-100 .05-200	6.5 7.5	40 35	35 30	25 20	CA	11A	$38.00	Low Frequency Companion to the DBM-110
DBM-200 (2)	R&L: 5-1000 X: DC-500	10-100 10-250 250-500 5-1000	6.5 7.0 8.0 9.5	40 35 35 30	40 35 30 25	30 25 25 20	CA	11A	$65.00	High Level, Low VSWR Ultra-high Performance up to 1GHz
DBM-300B (2)	R&L: 300-1500 X: DC-500	300-1000 1000-1500	8.0 7.0	35 30	30 25	25 10	CC	11A	$125.00	High Performance, Optimumized for Tacan
DBM-300A (2)	R&L: 300-2000 X: DC-750	300-1000 1000-2000	8.0 9.5	35 30	30 20	25 10	CC	11A	$175.00	High Performance Optimumized for L-Band
DBM-400 (2)	R&L: 10-3000 X: 10-1500	30-500 50-1800 10-2800 2800-3000 See Note 1	7.0 8.5 9.0 9.5	40 35 30 25	40 30 20 20	20 20 20 20	CB	11A	$275.00	Best High Level Full Spectrum Miniature Mixer Available
DBM-400A (2)	R: 100-3000 L: 10-3000 X: DC-1000						CB	11A	$295.00	DC Coupled Equal of the DBM-400
DBM-600 (2)	R&L: 10-5000 X: 10-1500	50-4000 10-50 4000-5000	7.5 8.5 10.0	20 35 20	20 25 15	20 35 15		11A	$350.00	Higher Frequency Equal of DBM-400

PORT IDENTIFICATION: L: LO-PORT; R: RF PORT; X: IF PORT. All measurements made in a 50 ohm system with LO power of +7 dBm (5 mW). MAX. input power (total: 50 mW. Rated conv. loss and LO-RF figures maintained over a range from −55 to +100°C. Notes for models DBM-400 and DBM-400A: 1. Conversion loss figures apply to RF and/or LO frequencies in the ranges shown and an IF output frequency of 1.0 GHz (750 MHz for DBM-400A) or lower. The X port response extends to 1.5 GHz (1.0 GHz for DBM-400A) with approx. 1 dB increase in conversion loss. 2. (DBM-400 only) for UP conversion with IF frequencies above 1.5 GHz, interchange R and X ports. (R port is now IF output.) Apply the lower frequencies (below 1.5 GHz) to the X port.

* Type (1) High Level — Low Intermodulation Production
Type (2) Medium Level — Medium Intermodulation Production

GENERAL SPECIFICATIONS — ALL MODELS

TYPE	MAXIMUM TOTAL INPUT POWER	"X" PORT DC CURRENT (MAX.)	RF LEVEL FOR 1 dB CONVERSION COMPRESSION	NOMINAL LEVEL - LO
(1)	200 mW	100 mA	+8 dBm	+17 dBm
(2)	50 mW	50 mA	+2 dBm	+ 7 dBm

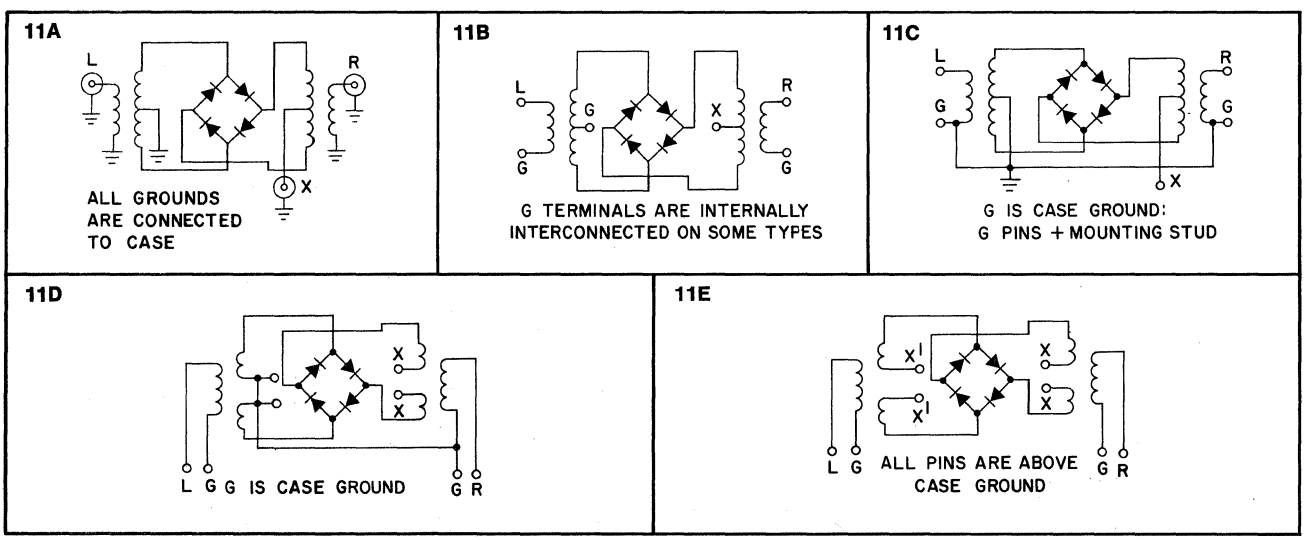


FIGURE 11 MIXER SCHEMATICS

Z-MATCH DOUBLY BALANCED MIXERS (CONT.)

HARMONICS OF f_R										
	$7f_R$	100 (100)	80 (90)	100 (100)	80 (90)	100 (95)	80 (100)	100 (100)	80 (80)	100 (95)
	$6f_R$	100 (100)	100 (90)	100 (95)	100 (90)	100 (95)	100 (95)	100 (100)	100 (90)	90 (100)
	$5f_R$	95 (80)	75 (80)	90 (85)	70 (70)	90 (90)	65 (65)	85 (90)	65 (65)	80 (80)
	$4f_R$	95 (85)	80 (80)	95 (95)	85 (85)	95 (95)	80 (85)	100 (100)	80 (85)	90 (90)
	$3f_R$	65 (65)	60 (60)	65 (65)	60 (55)	65 (70)	55 (50)	65 (75)	55 (45)	65 (70)
	$2f_R$	70 (70)	65 (65)	75 (80)	65 (65)	80 (80)	65 (60)	80 (75)	65 (65)	85 (70)
	f_R	25 (25)	0 (0)	40 (35)	10 (10)	50 (40)	15 (40)	60 (45)	20 (30)	60 (50)
	0		40 (25)	40 (35)	45 (25)	60 (50)	35 (35)	65 (55)	50 (40)	75 (55)
HARMONICS OF f_L										
		0	f_L	$2f_L$	$3f_L$	$4f_L$	$5f_L$	$6f_L$	$7f_L$	$8f_L$

FIGURE 12
TYPICAL MID-BAND HARMONIC INTERMODULATION PRODUCT ATTENUATION

Figures to the left are for Type 1 mixers, and figures to the right (in parentheses) are for Type 2. Values shown in the table are obtained with clean, filtered input signals to the mixer. Suppression values given indicate the product amplitude in dB below the $f_L \pm F_R$ output level, using an f_R level for Type 1 mixers of 0 dBm and for Type 2 mixers of −10 dBm. The LO drive level is as shown in Figure 9, Page 5. This table should be treated as a design guide only; values given are normally within 10% of actual performance for models listed for service below 1 GHz and within 20% for models designed to operate above 1 GHz.

ALTERNATE MIXER STYLES

The mixers shown in the table below were designed at customer request to replace existing packages. This list of exact replacements gives specifications for units which are completely tooled in our shop and are available on a 2-3 week basis on special order. All are Type 2 units. (See explanation at end of table in Vol.2•625.)

ALTERNATE PACKAGED MIXER SPECIFICATIONS

MODEL	OVERALL FREQUENCY RANGES (MHz)	FREQUENCY BANDS (MHz)	CONV. LOSS SSBNF (dB, MAX.)	ISOLATION (dB, MIN.) LO-RF	LO-IF	RF-IF	PACKAGE STYLE (SEE OUTLINE)	SCHEMATIC DIAGRAM	PRICE 1 - 9
DBM-151A	R&L: .05 - 200 X: DC - 200	1 - 100 .05 - 200	6.5 7.5	40 35	35 30	25 20	ED	11B	**$25.00**
DBM-151B	R&L: .05 - 200 X: DC - 200	.05 - 30 30 - 200	6.5 8.0	45 35	35 25	30 20	SPB	11E	**40.00**
DBM-150A	R&L: 5 - 500 X: DC - 500	10 - 100 5 - 250 5 - 500	6.5 7.5 8.5	40 35 30	35 30 25	25 20 20	ED	11B	**25.00**
DBM-150B	R&L: 5 - 500 X: DC - 500	10 - 100 100 - 200 5 - 500	7.0 8.0 9.0	45 35 30	40 25 25	20 20 20	SPB	11D	**40.00**
DBM-172A	R&L: .2 - 500 X: DC - 500	1 - 100 1 - 250 .5 - 400 .2 - 500	6.5 7.0 7.5 8.5	40 35 30 30	35 30 25 25	30 25 20 20	SPC	11C	**35.00**
DBM-172B	R&L: .2 - 500 X: DC - 500	1 - 100 1 - 250 .5 - 400 .2 - 500	6.5 7.0 7.5 8.5	40 35 30 30	35 30 25 25	30 25 20 20	SPD	11C	**35.00**

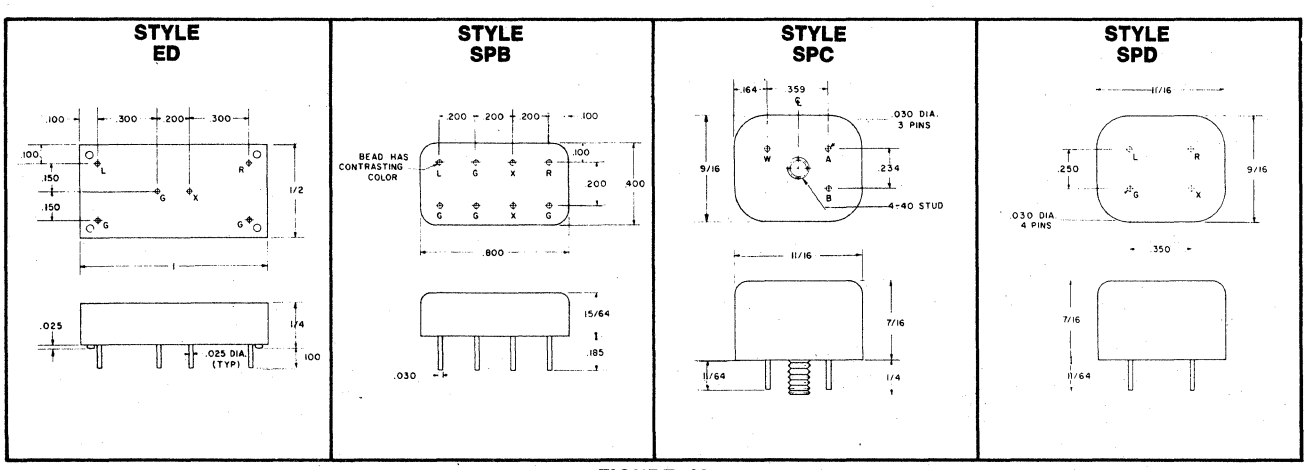
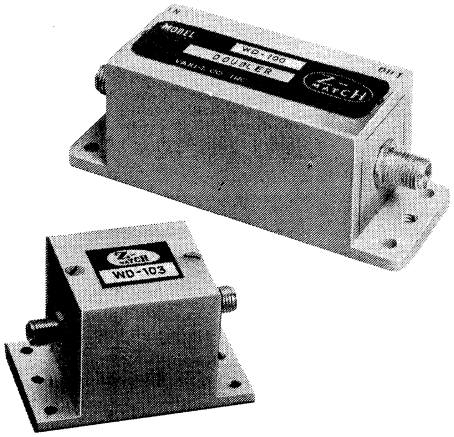


FIGURE 13
ALTERNATE MIXER OUTLINE DRAWINGS

WIDE BAND FREQUENCY DOUBLERS



Models WD-100, 101, 102 and 103 were developed as components of laboratory equipment to double the frequency of high-level sweep generators, thus extending their range of usefulness. Since the output of the doubler is of relatively high level, the signal obtained is comparable to that of an expensive BWO unit, and a set-up can be made with existing equipment and appreciable savings are effected. The units, being quite small and compact, are often used as part of the local oscillator source for receivers, so they are recommended both as components of larger equipment and as laboratory test devices. The doublers are housed in extruded aluminum cases and are fitted with 3.6 mm. input and output connectors and have 50 ohm input and output impedances. The circuit employs a custom-designed Z-Match input transformer and carefully matched Schottky barrier diodes. The output circuit (Model WD-100 only) is isolated for DC by a special chip capacitor. The circuit elements and supporting structure are encapsulated in high-temperature polyurethane foam. Full electrical specifications are listed in the table below. Operating temperature range is −55 to +100°C. Complete specifications in Bulletin #102A.

DOUBLER SPECIFICATIONS

MODEL	FREQUENCY RANGE INPUT/OUTPUT	IMPEDANCE INPUT/OUTPUT	INPUT POWER NORMAL OPERATION	CONVERSION LOSS	FUNDAMENTAL +3rd HARM. SUPPRESSION	OUTPUT LEVEL VARIATION OVER THE BAND	FIG.	PRICE 1 - 9
WD-101	.5 - 600 MHz 1 - 1200 MHz	50 ohms 50	+5 to +20 dBm	13 dB max.	40 dB min.	±1.5 dB	15A	$90.00
WD-100	1 - 2 GHz 2 - 4 GHz	50 ohms 50	+5 to +20 dBm	15 dB max.	40 dB min.	±1.5 dB	15A	225.00
WD-102A	0.02 to 4.5 GHz 0.04 to 9.0 GHz	50 ohms 50	+10 to +20 dBm	14 dB max.	30 dB min.	±1.5 dB	15B	350.00
WD-103	.02 - 6.25 GHz .04 - 12.5 GHz	50 ohms 50	+10 to +20 dBm	15 dB max.	30 dB min.	±1.5 dB	15B	425.00

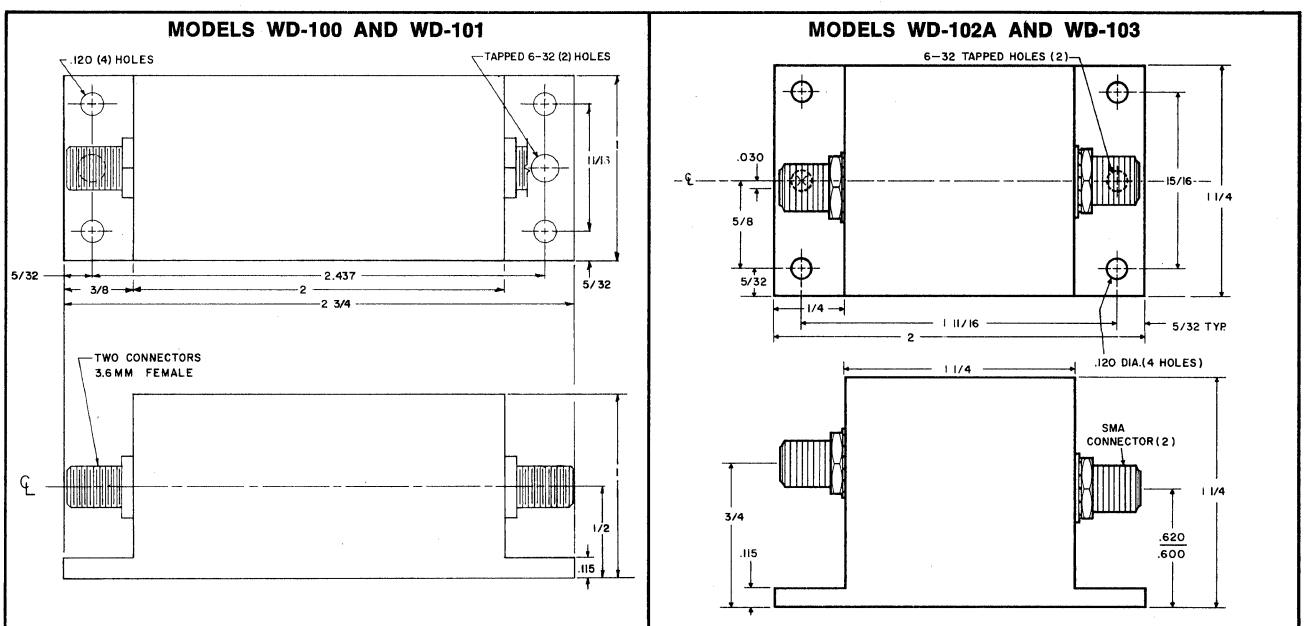


FIGURE 14 DOUBLER OUTLINE DRAWINGS

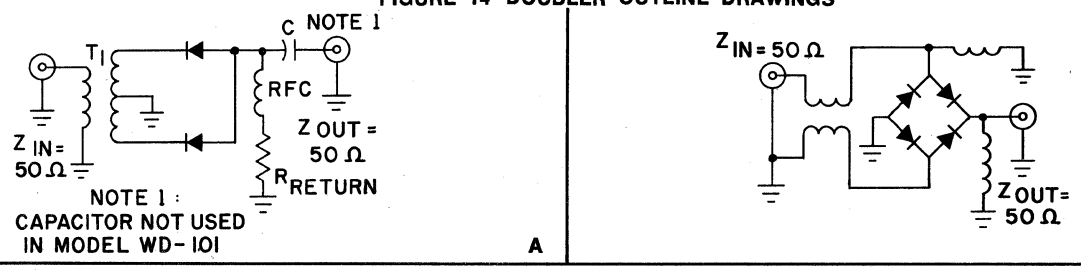


FIGURE 15 DOUBLER SCHEMATICS

Z-MATCH SWITCHES, PHASE DETECTORS, CHOKES

The new SS series of RF switches marks a significant breakthrough in switches exhibiting high isolation at all ports.

All types exhibit less than two nanoseconds switching speed, high level (+10 dBm for .1 dB compression) signal handling, and large on-to-off power ratios. Bulletin 109 details complete specifications on several types. Data on typical types is shown for reference below. All types are designed to meet MIL environments from −55 to +100°C.

(1) Fundamental feedthrough component at the output when a sine wave producing ±20 mA is used to switch the unit.

(2) Typically low repetition rate switching will produce very little feedthrough. For example, switching noise power at the output is −100 dBm maximum per 100 MHz of bandwidth when driven with a 3 KHz square wave, $T_r = T_f = .5\ \mu sec$ producing ±20 mA control current.

MODEL	TYPE	FREQ. RANGE MHz	ON-OFF RATIO dB MIN.	INSERTION LOSS dB MAX.	RF POWER HANDLING	ON-OFF CURRENT TYPICAL	SWITCHING SIGNAL ISOLATION TYPICAL (1)	PACKAGE*	PRICE 1 - 9
SS-12	SPST	1-20 20-100 100-600	60 45 30	2 2 5	+10 dBm	±20 MA	30 dB (2)	SPA H = .250	$90.00
SS-23	SPST	5-50 50-200 .5-500	80 50 30	2.5 2.5 4.5	+10 dBm	±20 MA	30 dB (2)	SPECIAL PC SEE BUL. 109	60.00
SS-26	SPDT	1-20 200-100 100-400	50 40 30	2 2 3	+10 dBm	±40 MA	25 dB	SPECIAL PC SEE BUL. 109	100.00
SS-30	SPST	.5-100 100-500	80 60	5 6.5	+10 dBm	±20 MA	30 dB (2)	CA	110.00

* See Pages 6 and 8 for outline dimensions

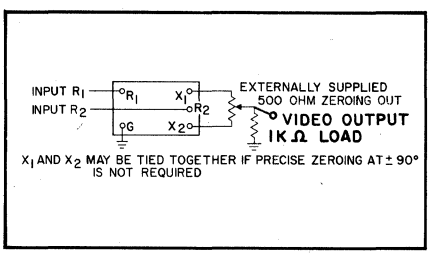
HIGH LEVEL PHASE DETECTOR

Model PD-100 is the first in a series of new high DC output phase detectors offering more than twice the voltage sensitivity previously obtainable with a balanced mixer approach. In addition, this new device will handle inputs up to +17 dBm linearly and provide precise zeroing for minor system balance by means of an accessory trim potentiometer. RF input ports impedance 50 ohms; temperature range specifications, −55 to +100°C; maximum total input powers, +17 dBm each R port.

(1) Output characteristic is nearly Z shaped, load for all specifications 1000 ohms resistive.

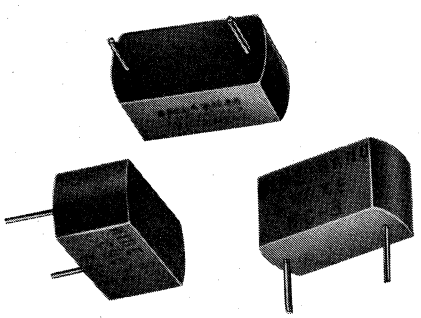
(2) PD-100 is offered in the SPA package .250 high — see mixer outlines.

(3) Model PD-101 is electrically the same as above, but is offered in style CA case with BNC connectors. See mixer outlines. Full specifications are contained in Bulletin 110.



MODEL	INPUT FREQUENCY RANGE	VIDEO BW OUTPUT PORT	-φ SENSITIVITY @ +10 dBm INPUTS	TYPICAL OPERATION RF INPUTS +10 dBm		PRICE 1 - 9
				RELATIVE φ	DC OUT	
PD-100 and PD-101	R_1, DC - 500 MHz R_2, .5 - 500 MHz	DC - 1.5 MHz	10 MV/Degree	φ = 0° φ = 90° φ = 180°	+1 Volt 0 Volts −1 Volt	$70.00

WIDEBAND R.F. CHOKE



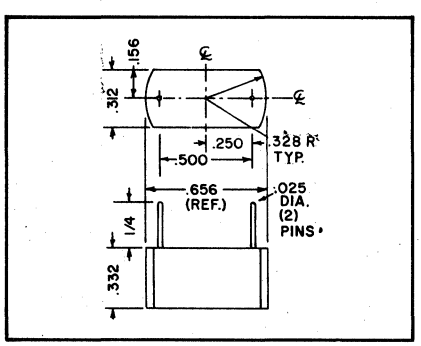


FIGURE 21
CHOKE OUTLINE DRAWING

An RF choke for VHF-UHF circuitry should present a constant high impedance over a wide band of frequencies and should be non-lossy. Ordinary chokes made by winding a few turns of wire on a powdered iron or ferrite core do not fulfill this requirement because their impedance peaks sharply, and even though the actual resonance is placed outside the band the high order of impedance change over the band can be troublesome.

The chokes described below have very low loss, are virtually non-resonant and have a constant impedance over a very wide range of frequencies. They all have DC resistance of less than .1 ohms and will handle up to 2 amperes of current. Despite their small size they are suitable for use in high-power transistor oscillators and amplifiers, where they serve as RF isolators in the DC supply. Additional applications which have been tested are offered in Bulletin 104.

A. DC isolation in wide band circuits employing Z-Match transformers.
B. RF decoupling.
C. Transient and RFI suppression.
D. DC burnout protection.

Price, 1-9, Models WC-1, WC-2, WC-3, WC-4: $10.50 each. General quantity discounts.

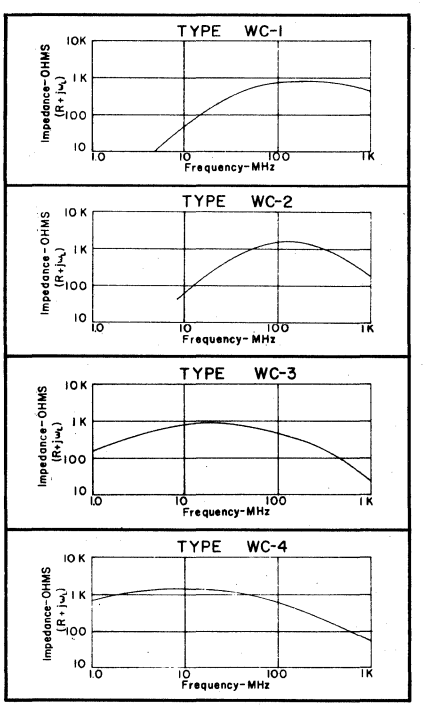


FIGURE 22
CHOKE IMPEDANCE CHARACTERISTICS

MICROWAVE

TEST EQUIPMENT
CUSTOM ASSEMBLIES
SYSTEM SWITCHES
FLEXIBLE WAVEGUIDES

waveline

These major companies have been joined to provide a greatly expanded range of microwave services.

MICROTECH
RIGID AND FLEXIBLE WAVEGUIDE

At it s modern, 30,000 square foot plant in Cheshire, Conn., Microtech manufactures a comprehensive, quality line of flexible waveguides, solid state pin diode switches and attenuators. Microtech's flexible waveguides include:

The seamless corrugated type, which can be bent to small radii, is highly stable and assures superior, RF leak-free operation.

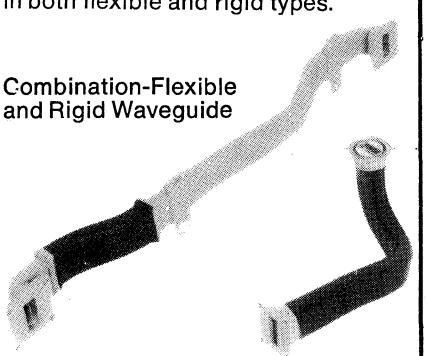
The soldered convoluted type, for maximum bending with minimum leakage, is excellent for misalignment applications where moderate vibration prevails. It is particularly efficient and economical in tight-bend radii installations.

The interlocked flexible type, the only flexible waveguide fully interlocked in all four walls, is the strongest type of flexible waveguide. It is excellent for high power applications and provides the added advantage of elongation and compression.

Microtech has deep engineering and manufacturing experience in combining flexible and rigid waveguides to achieve the optimum in a system.

Microtech designs and produces double ridged waveguide assemblies and components, which it supplies in both flexible and rigid types.

Combination-Flexible and Rigid Waveguide

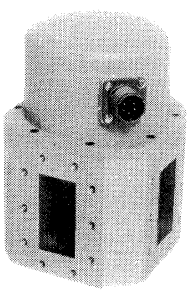


Flexible Waveguide

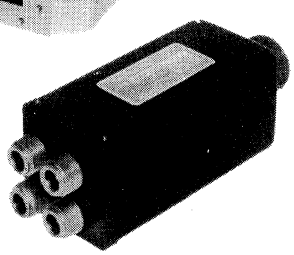
RAMCOR
WAVEGUIDE, COAXIAL SWITCHES AND ROTATING JOINTS

The broad quality line of Ramcor switches for waveguide and coaxial use in communications and radar, plus Ramcor's rotating joints and radiation detection devices, are now being manufactured at Waveline's modern facility in West Caldwell, N.J.

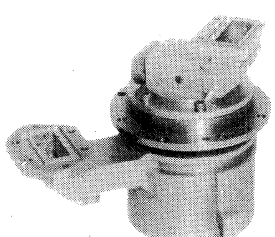
If you have a challenging switching problem, come to Waveline. You can choose from hundreds of types to meet your requirements. Switches range in size from a miniature 6 oz. coaxial unit to a massive 200 lb. water cooled WR650 waveguide unit. Or we can custom design one to help solve your switching problem.



Waveguide Switches



Coaxial Switches



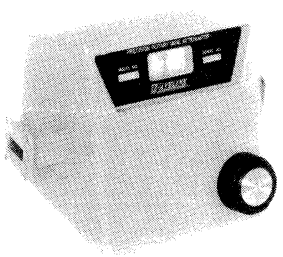
Rotary Joints

WAVELINE
TEST EQUIPMENT AND SPECIAL ASSEMBLIES

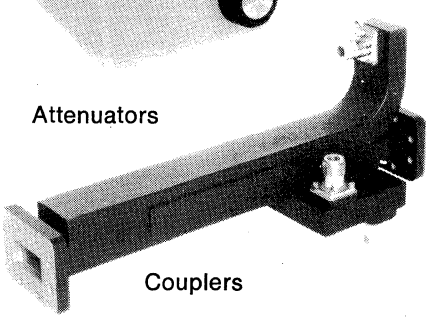
With our unique design capability and a full line of standard and special microwave equipment—test equipment, hardware, adapters, tuners, filters, detectors, transmission line components and forming ability—you have a great systems capability at your disposal. From custom designing through precise, quality controlled manufacture.

Yes, Waveline is changing. For the system designer, multiple product lines to choose from and a highly skilled organization whose comprehensive skills spread across the microwave field. Plus the Waveline mark of quality and service.

waveline



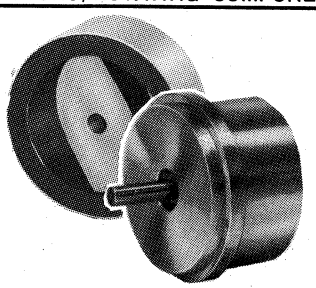
Attenuators



Couplers

For additional technical data on Ramcor and Waveline microwave products, write: Waveline, Inc., P.O. Box 718, West Caldwell, N.J. 07006. Phone: (201) 226-9100, TWX (710) 734-4324 / Microtech Division—Phone: (203) 272-3234

AEROFLEX *brushless* D.C. Torque Motors



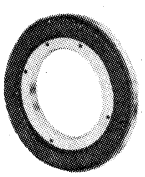
FEATURES:

- No commutator brush or contact friction
- Unlimited life
- Infinite resolution
- Direct Drive
- No radio noise or explosion hazard
- No motor ripple or "slot lock"

Wide Angle *brushless* D.C. Torque Motors (Partial Listing)

Basic Part Number	Peak Torque (oz. in.)	Peak Power (watts)	Continuous Torque (oz. in.)	Continuous Power at 25°C (watts)	Driving Voltage for Continuous Torque (volts D.C.)	Angular Excursion (degrees)	Torque Sensitivity (oz. in./amp.)	Back EMF (v/rad/sec)	Resistance at 25°C (ohms)	Electrical Time Constant L/R (sec)	Rotor Inertia (oz. in. sec²)	VISCOUS DAMPING Source Impedance (oz. in./rad/sec) Infinite	VISCOUS DAMPING Source Impedance (oz. in./rad/sec) Zero	Weight (oz.)	PANCAKE DIMENSIONS O.D. (inch)	PANCAKE DIMENSIONS Thick. (inch)	PANCAKE DIMENSIONS I.D. (inch)
TQ10Y-10	1.3	21	.5	2.4	12	120	2.5	.018	60	3×10^{-4}	1.6×10^{-5}	1.5×10^{-5}	1.1×10^{-3}	1	1.000	.350	.125
TQ10Y-1	6	110	1.5	7	34.5	120	7.6	.055	175	2×10^{-4}	4×10^{-5}	4×10^{-5}	2.4×10^{-3}	2	1.000	.700	.125
TQ10Y-2	6	103	1.5	7	26	120	5.8	.041	100	2×10^{-4}	4×10^{-5}	4×10^{-5}	3×10^{-3}	2	1.000	.700	.125
TQ10Y-4	6	85	1.5	5	5.6	120	1.6	.011	6	2×10^{-4}	4×10^{-5}	4×10^{-5}	3×10^{-3}	2	1.000	.700	.125
TQ18W-30	3	25	1.8	8	17	120	3.9	.027	36	5×10^{-4}	2.4×10^{-4}	3×10^{-4}	2×10^{-3}	3	1.718	.350	.187
TQ18W-37	3	20	1.9	8	15	120	3.5	.025	27	5×10^{-4}	2.4×10^{-4}	3×10^{-4}	2×10^{-3}	3	1.718	.350	.187
TQ18W-23	8	45	4	11	22.5	120	8.5	.060	48	8×10^{-4}	4.8×10^{-4}	3×10^{-4}	1×10^{-2}	4	1.718	.700	.187
TQ18W-35	8	35	4	9	4.6	120	2.2	.015	2.5	8×10^{-4}	4.8×10^{-4}	3×10^{-4}	1×10^{-2}	4	1.718	.700	.187
TQ18-25	5.6	25	3	7	20	50	9	.063	60	2×10^{-4}	3.2×10^{-4}	2×10^{-4}	1×10^{-3}	3	1.718	.350	.250
TQ18-26	5.6	25	3	7	13.4	50	5.6	.040	25	2×10^{-4}	3.2×10^{-4}	2×10^{-4}	1.1×10^{-3}	3	1.718	.350	.250
TQ18-28	10	47	5	12	7.6	50	3.3	.024	5	2×10^{-4}	5.8×10^{-4}	4×10^{-4}	1.6×10^{-2}	4	1.718	.600	.250
TQ18-1	18	75	8	14	51	50	30	.210	190	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	3.3×10^{-2}	4	1.718	.700	.250
TQ18-11	18	75	8	14	12.8	50	7.5	.053	12	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	3.3×10^{-2}	4	1.718	.700	.250
TQ18-47	18	80	8	16	20	50	10	.071	25	2×10^{-4}	6.7×10^{-4}	5×10^{-4}	2.9×10^{-2}	4	1.718	.700	.250
TQ25W-2	15	60	8	17	32.0	120	15	.106	60	2×10^{-3}	9×10^{-4}	1×10^{-4}	2.6×10^{-2}	4	2.500	.500	.250
TQ25W-4	15	60	8	17	52.8	120	25	.175	165	2×10^{-3}	9×10^{-4}	1×10^{-4}	2.6×10^{-2}	4	2.500	.500	.250
TQ25W-1	33	130	16	30	33.8	120	18	.130	38	3×10^{-3}	2.1×10^{-3}	2×10^{-4}	6×10^{-2}	7	2.500	1.000	.250
TQ25-6	30	63	10	7	8.3	50	12	.085	10	3×10^{-3}	1.5×10^{-3}	2×10^{-3}	1.6×10^{-1}	6	2.500	.500	.250
TQ25-9	30	70	15	17	9.5	50	8.5	.060	5.4	2×10^{-3}	1.5×10^{-3}	2×10^{-3}	9.4×10^{-2}	6	2.500	.500	.250
TQ25-2	80	150	25	14	14.8	50	27	.190	16	5×10^{-3}	4.4×10^{-3}	5×10^{-3}	3.2×10^{-1}	12	2.500	1.000	.250
TQ34W-1	40	90	30	37	25.7	120	21	.150	18	3×10^{-3}	4.2×10^{-3}	5×10^{-3}	1.8×10^{-1}	13	3.313	.625	.250
TQ34W-10	40	90	30	36	40	120	33	.240	44	3×10^{-3}	4.2×10^{-3}	5×10^{-3}	1.8×10^{-1}	13	3.313	.625	.250
TQ34W-12	80	180	60	83	38.6	120	28	.200	18	4×10^{-3}	8.4×10^{-4}	1×10^{-2}	3×10^{-1}	21	3.313	1.125	.250
TQ34-14	80	150	28	17	47.3	50	80	.570	135	1×10^{-3}	9.1×10^{-3}	1.5×10^{-2}	3.4×10^{-1}	16	3.375	.600	.250
TQ34-4	130	220	40	20	22.2	50	45	.310	25	1×10^{-3}	9.1×10^{-3}	1×10^{-2}	5.6×10^{-1}	16	3.375	.725	.250
TQ40W-4	150	270	60	45	8.5	120	12	.090	1.7	2×10^{-3}	2×10^{-2}	1×10^{-2}	6.3×10^{-1}	30	4.000	.850	.375
TQ40W-11	150	250	60	40	14.5	120	22	.160	5.2	2×10^{-3}	2×10^{-2}	1×10^{-2}	6.8×10^{-1}	30	4.000	.850	.375
TQ40W-1	260	250	120	50	14.1	120	34	.250	4.0	3×10^{-3}	4×10^{-2}	2×10^{-2}	1.9	51	4.000	1.500	.375
	Lb. Ft.		Lb. Ft.			Lb. Ft./Amp.					Lb. In. Sec²	Lb. In./Rad./Sec.		Lb.			
TQ52W-1	1.5	152	1.1	75	21.3	90	.31	.42	6.2	6.5×10^{-3}	6.9×10^{-3}	6.3×10^{-4}	2.6×10^{-1}	5	5.125	1.500	.750
TQ52-2	2.6	250	1.0	40	21.9	20	.57	.79	12	3×10^{-3}	8.8×10^{-3}	1.2×10^{-3}	4.5×10^{-1}	5	5.187	1.250	.984
TQ56-1	4.2	270	1.5	36	16.2	20	.70	.95	7.3	6×10^{-3}	1.8×10^{-2}	4.4×10^{-2}	1.06	10	5.625	2.000	1.000
TQ64W-5	4.2	230	2.4	91	14.5	90	.39	.53	2.3	6×10^{-3}	3×10^{-2}	2.5×10^{2}	1.06	16	6.235	2.300	1.187
TQ64-1	4.5	230	3.3	127	14.7	30	.39	.53	1.7	7×10^{-3}	5×10^{-2}	5.6×10^{-2}	1.25	16	6.375	2.300	1.187
TQ74W-5	4.2	300	1.5	39	24.2	110	.96	1.2	15	8×10^{-3}	5×10^{-2}	1.2×10^{-2}	5.8×10^{-1}	10	7.310	1.440	1.000
TQ74W-6	7.8	350	5.1	150	18.2	110	.62	.86	2.2	7×10^{-3}	1.5×10^{-1}	6×10^{-3}	2.4×10^{-1}	27	7.310	3.440	1.000
TQ74-4	3.3	170	1.6	43	15.1	30	.33	.46	1.7	4×10^{-3}	2.6×10^{-2}	4.4×10^{-2}	1.25	8	7.375	1.160	.812
TQ74-2	7.0	350	4.5	150	20.1	30	.66	.89	2.95	6×10^{-3}	5×10^{-2}	6×10^{-2}	2.4	19	7.380	2.290	.812
TQ82W-1	4.0	450	2.5	174	31.3	120	.48	.7	6.4	2.8×10^{-2}	3×10^{-2}	2×10^{-2}	1.2	12	8.190	1.380	.820
TQ120-2	22	375	18	178	20.2	40	2.05	2.1	2.3	1.5×10^{-2}	3.2×10^{-1}	2×10^{-1}	2.2×10^{1}	49	12.500	2.250	1.380
TQ140W-1	18	580	17	500	51	120	1.70	2.3	5.2	4×10^{-2}	6×10^{-1}	1.5	1.2×10^{1}	60	14.000	3.000	1.500

Full Rotation *brushless* D.C. Torque Motors



A torque delivery system designed to achieve maximum power efficiency within a minimum of space, weight and power. It consists of a permanent magnet brushless DC torquer mechanically coupled with a brushless resolver.

(Partial Listing)

Characteristics	TFR47-5P	TFR47-3P	TFR47-4P	TFR90-1P	TFR120-2P
Peak Torque	1.2 lb. ft.	4.1 lb. ft.	7.8 lb. ft.	16 lb. ft.	45 lb. ft.
Power	180 watts	240 watts	350 watts	180 watts	450 watts
Resistance	16 ohms	13 ohms	13 ohms	0.3 ohms	5.6 ohms
Size	4.625 in. O.D. x .62 in. Thick	4.625 in. O.D. x 1.75 in. Thick	4.625 in. O.D. x 2.25 in. Thick	9.00 in. O.D. x 2.50 in. Thick	12.00 in. O.D. x 3.25 in. Thick

Wide Angle *brushless* DC Tachometers

Basic Part Number	Output Sensitivity (v/rad/sec)	Resistance at 25°C (Ohms)	Rotor Inertia (oz. in. sec²)	Pancake Dimensions O.D. (inch)	Pancake Dimensions Thick. (inch)	Pancake Dimensions I.D. (inch)
TG10Y-58	.03	210	1.6×10^{-5}	1.000	.350	.125
TG10Y-59	.06	390	4×10^{-5}	1.000	.700	.125
TG18W-56	.09	550	2.4×10^{-4}	1.718	.350	.187
TG18W-57	.24	1025	4.8×10^{-4}	1.718	.700	.187
TG18-54	.17	520	3.2×10^{-4}	1.718	.350	.250
TG18-55	.39	980	6.7×10^{-4}	1.718	.700	.250
TG25W-9	.7	920	2×10^{-3}	2.500	1.000	.250
TG25W-10	.5	500	1.5×10^{-3}	2.500	.500	.250
TG34W-5	1.0	1000	4.2×10^{-3}	3.313	.625	.250
TG34-41	1.5	825	9.1×10^{-3}	3.375	.725	.250
TG40W-5	1.2	335	2×10^{-2}	4.000	.850	.375
TG40W-3	2.5	535	4×10^{-2}	4.000	1.500	.375
TG52W-5	5.0	1100	1.1×10^{-1}	5.125	1.500	.750
TG52-7	3.7	360	1.4×10^{-1}	5.187	1.250	.984

For Commercial/Industrial Applications

Ask Aeroflex about the **Valueline**-Brushless, Wide Angle, Direct Drive, Low Cost, DC Torque Motors.

Available in a great variety of sizes and outputs, Valueline offers these designer benefits: • No gear trains required • System simplification • Precise positioning • Smooth, quiet output • Unlimited life

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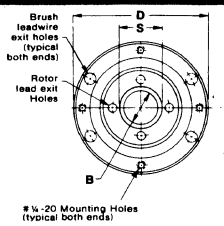
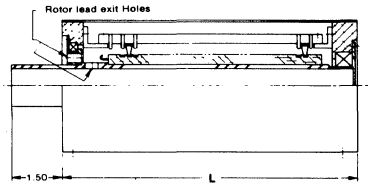
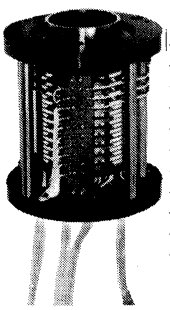
SLIP RING ASSEMBLIES



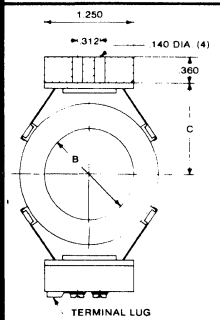


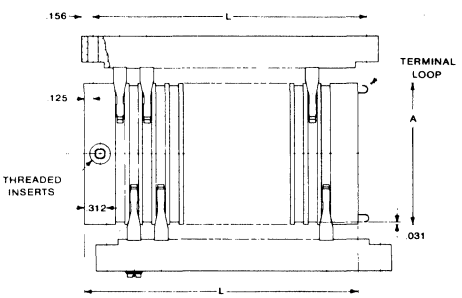


MODEL	"B" DIA.	"D" DIA.	"S" DIA.	MAX RPM	MIN LIFE 10^6	TQUE IN-LBS.
DAY-490	1.00	4.00	1.250	5000	50	.21
DAY-491	1.75	5.00	2.125	4000	40	.30
DAY-492	2.75	6.50	3.125	3000	30	.40
DAY-493	3.75	7.50	4.125	2500	25	.50
DAY-494	4.75	8.50	5.125	2000	20	.61
DAY-495	5.75	9.50	6.125	1500	15	.71
DAY-496	6.75	10.50	7.125	1500	10	.82
DAY-497	7.75	11.50	8.125	1000	10	.92
DAY-498	8.75	13.00	9.125	1000	10	1.02
DAY-499	9.75	14.00	10.125	750	7.5	1.12

NO. OF CIRCUITS	"L"
4-10	4.88
11-20	6.75
21-30	8.63
31-40	10.50
41-50	12.38

FRAME: Anodized Aluminum
RINGS: Coin Silver
BRUSHES: Silver Graphite
LEAFS: Beryllium Copper
CIRCUIT TERMINATION: Silver Lugs
CURRENT: 10 amp per circuit (20 amp available at extra cost)
VOLTAGE: 250V max. AC or DC
DIELECTRIC STRENGTH: 750 Vrms.
INSULATION RESISTANCE: 50 meg min
CONTACT RESISTANCE VARIATION: 10 milliohms max at max speed
OPERATING TEMP.: 0 to 250 F
HUMIDITY: 95% ° max.



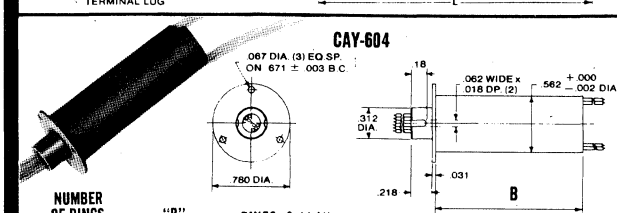


RINGS: Coin Silver
BRUSHES: Silver Graphite, two per ring
LEAFS: Beryllium Copper
INSULATION: Epoxy or Laminated Plastic
CURRENT: 10 amps per circuit standard (20 amps with 4 brushes per ring)
VOLTAGE: 250V max. AC or DC
DIELECTRIC STRENGTH: 750 Vrms.
CONTACT RESISTANCE VARIATION: 10 milliohms max
NO. OF CIRCUITS: 50 max

PART NO.	A	B	C
CAY-731	1.875	1.250	1.447
CAY-732	2.750	2.125	1.829
CAY-733	3.750	3.125	2.281
CAY-734	4.875	4.125	2.822
CAY-735	5.875	5.250	3.307
CAY-736	7.000	6.250	3.857
CAY-737	8.000	7.250	4.342
CAY-738	9.000	8.250	4.837
CAY-739	10.000	9.250	5.332
CAY-740	11.000	10.250	5.827

TO DETERMINE "L" DIMENSION USE THE FOLLOWING FORMULA:
"L" = .750 + .1875 x (No. of Rings)

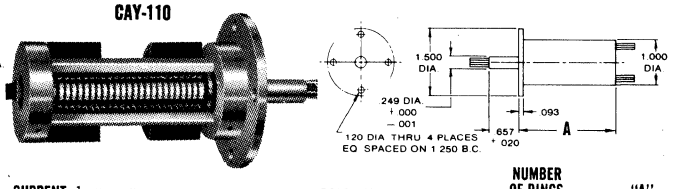
CAY-604



NUMBER OF RINGS	"B"
1 thru 12	.741
13 thru 24	1.137
25 thru 40	1.665

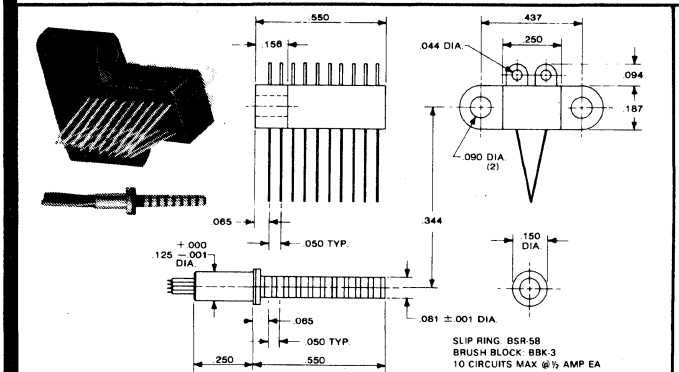
RINGS: Gold Alloy
BRUSHES: Gold Alloy Wire, Spring Temper
BALL BEARINGS: Stainless Steel, Shielded
SHAFT: Stainless Steel
HOUSING: Anodized Aluminum
TORQUE: 1 in. — oz. max
SPEED: 200 RPM max

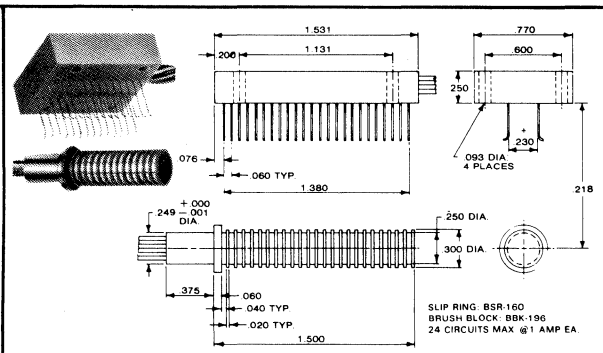
CAY-110

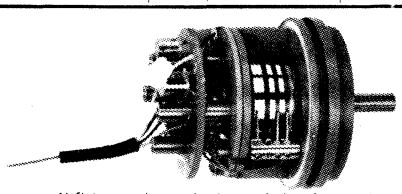


CURRENT: 1 amp max per ring
VOLTAGE: 100V max
DIELECTRIC STRENGTH: 500Vrms.
CONTACT RESISTANCE VARIATION: 20 milliohms max
LIFE: 5 x 10^6 revs, min
ROTATION: Bi-directional
LEADWIRE: #32 AWG, Teflon Insulated

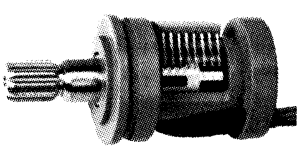
NUMBER OF RINGS	"A"
1 thru 12	1.48"
13 thru 24	2.20"
25 thru 30	2.56"







ENCODERS A wide variety of encoders is available: T/B, BCD, Gray, etc. Special encoders may require nominal tooling charges. Encoders can be supplied with built-in logic circuitry. Sizes: 8-33.



SWITCHES When close accuracy, repeatability and size are important, specify Airflyte rotary switches for timing and positioning applications. Successfully replaces snap action switches and cams. Pre-set to eliminate installation time. Zero hysteresis.

Airflyte encoders and rotary switches feature drum construction with solid gold alloy conducting segments embedded in epoxy and machined flush. Brushes are multi-strand, spring-temper gold alloy. As small as Size 5.

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standard motors modified to individual product needs

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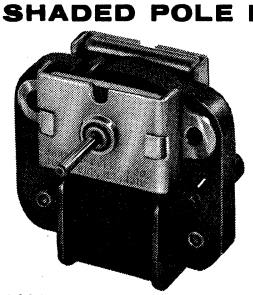
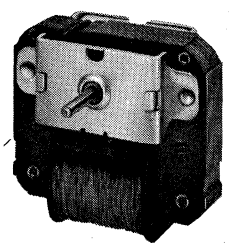
A-C SHADED POLE MOTORS—UNIDIRECTIONAL



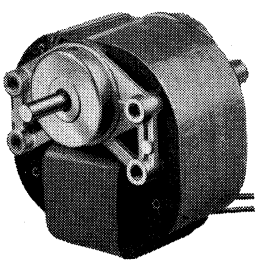
AYAA—DYAA—KYAA

Specifications:
Rated horsepower.....0007 to .0010
Depth (plus shaft)..... 1-1/8″ to 1-3/4″
Dimensions.....2-7/32″ x 2-1/4″
Remarks.....Exceptionally small and compact
Typical applications—Fan blades, blowers, reroll chart drives, phonographs, and gear trains



AYAF—DYAF—KYAF
OYAF—CYAF

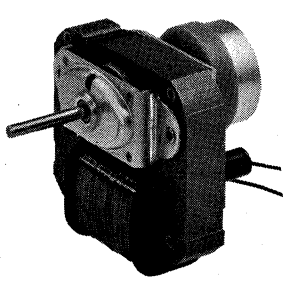
Specifications:
Rated horsepower.....0019 to .032
Depth (plus shaft).... 1-5/16″ to 2-1/2″
Dimensions.....2-21/32″ x 2-3/4″
Remarks.....High running torque
Typical applications—Fans for heaters, deodorizers, and electronic equipment; blowers and gear trains



AYAR—BYAR—CYAR—DYAR

Specifications:
Rated horsepower.....005 to .050
Depth (plus shaft)..1-29/32″ to 3-11/32″
Dimensions.....3-1/8″ x 3-1/4″
Remarks.....High-start or high-power rotors available
Typical applications—Pumps, humidifiers, vaporizers, combustion and industrial controls

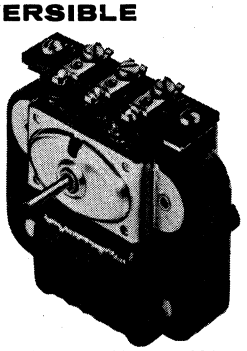
SPEED-REGULATED



DYAF

Specifications:
Rated horsepower.....up to .01
Speed range.....300 to 3200 rpm
Depth.....2-1/4″
Dimensions.....2-21/32″ x 2-3/4″
Remarks.....Speed is infinitely variable within speed range with close regulation at selected speed

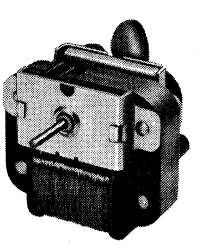
REVERSIBLE



AYAE—DYAE—KYAE

Specifications:
Rated horsepower.....00015 to .006
Depth (plus shaft).. 1-5/16″ to 1-15/16″
Dimensions.....3″ x 2-7/8″
Remarks.....For 1- or 2-phase operation and electronic control
Typical applications—Servomechanisms, remote switching and positioning devices, and pen drives

SYNCHRONOUS

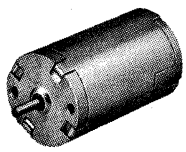


DYAJ—KYAJ—OYAJ

Specifications:
Rated horsepower.....0043 to .0108
Depth (plus shaft).....1-3/4″ to 2-1/4″
Dimensions.....2-3/8″ x 2-19/32″
Remarks.....Develop 30 times power of ordinary clock motors
Typical applications—Oscillographs, scoreboard timers, viscometers, facsimile recorders, X-ray timers, and microfilm cameras

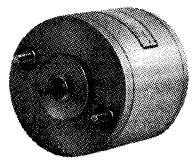
VARIABLE SPEED, SPEED-REGULATED D-C MOTORS

Type CYQM and FYQM speed regulated motors have variable or multiple speed settings with close regulation at the selected speed. Speed control circuit board and built-in tachometer generator permit speed adjustment while the motor is running for maximum accuracy.



FYQM

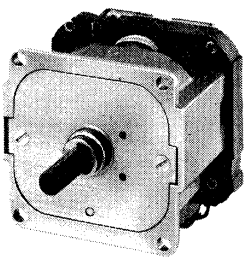
Voltage range.....3 to 30 v d-c
Regulated speed
range.....400 rpm to 4800 rpm
Torque.....up to 1.5 oz-in. at 3000 rpm
Maximum diameter.....1.29″
Available with Type BYQH gearhead.



CYQM

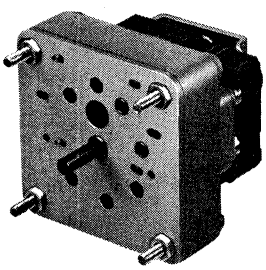
Voltage range.....6 to 32 v d-c
Regulated speed
range.....400 rpm to 4800 rpm
Torque.....up to 6 oz-in. at 1800 rpm
Maximum diameter.....2″
Available with Type CYQH gearhead.

A-C GEARMOTORS



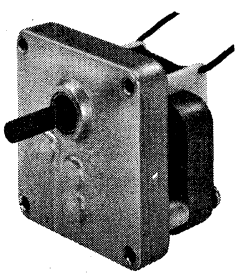
ENCLOSED-TYPE MYAZ

Specifications:
Torque output.....up to 15 lb-in.
Gear ratios.....from 2:1 to 2489:1
Remarks.....Compact package almost fits in a 2-1/2 in. cube



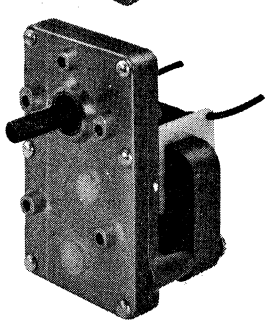
ENCLOSED-TYPE DYAZ

Specifications:
Torque output.....up to 85 lb-in.
Gear ratios.....from 4:1 to 30,000:1
Remarks.....Designed for overhanging or radial thrust loads



ENCLOSED-TYPE SYAZ 400

Specifications:
Torque output.....up to 50 lb-in.
Gear ratios.....from 12.3:1 to 2249:1
Remarks.....Compact design fits within a 3-in. cube

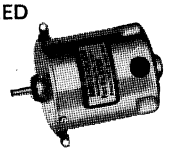


ENCLOSED-TYPE SYAZ 600

Specifications:
Torque output.....up to 50 lb-in.
Gear ratios.....from 18:1 to 848:1
Remarks.....Narrow profile

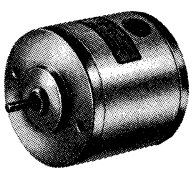
D-C MOTORS

UNGEARED



BYQM

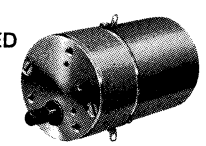
Voltage range.....3 to 30 v d-c
Governed speed.....,1200 to 4800 rpm
Torque.....up to .2 oz-in.
Maximum dia.....1.29″



CYQM

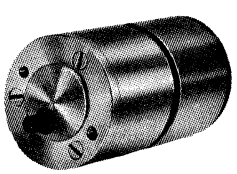
Voltage range.....6 to 32 v d-c
Governed speed.....1200 to 4800 rpm
Torque.....up to 2 oz-in.
Maximum dia.....2″

GEARED



FYQH

Voltage range.....3 to 30 v d-c
Speeds.....0.4 to 1900 rpm
Torque.....up to 3 lb-in.
Maximum dia.....1.38″



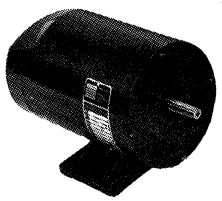
CYQH

Voltage range.....6 to 32 v d-c
Speeds.....0.3 to 1000 rpm
Torque.....up to 15 lb-in.
Maximum dia.....2″

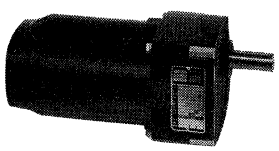
BARBER-COLMAN COMPANY
Motor Division
Dept. S, 12116 Rock Street, Rockford, Illinois 61101

BODINE

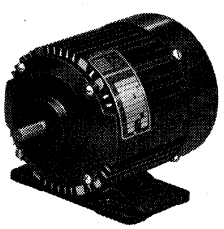
fhp motors– gearmotors & speed controls



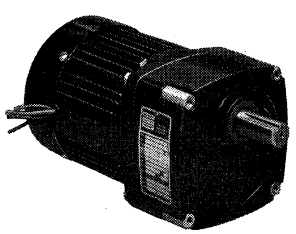
42A Permanent Magnet Motor Line: Standard TENV ratings are 1/8, 1/6, and 1/4 Hp at 2500 Rpm. Only 4.3″ in diameter. Available with NEMA Type C face mounting shields.



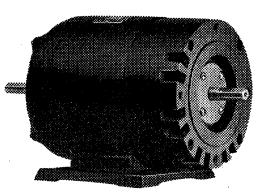
42A-E Permanent Magnet Parallel Shaft Gearmotor Line: Torques thru 350 Lb-in. Ratios thru 300:1. Helical steel gearing. High overhung and thrust load capabilities.



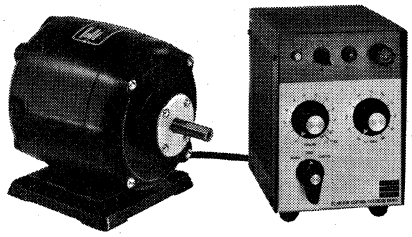
42R Induction Motor Line: TEFC ratings from 1/20 thru 1/4 Hp. All A-C winding types. Options include capacitor mountings, overload protectors, and special wiring provisions.



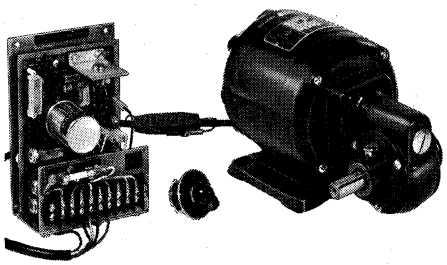
42R-E Induction Parallel Shaft Gearmotor Line: Torques thru 350 Lb-in. Ratios thru 300:1. Helical steel gearing. High overhung and thrust load capabilities.



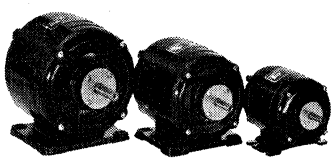
Torque Motors: Selected K-2 and N-line motors for holding, positioning, and winding applications. Intermittent and continuous duty. Standard ratings from 7 thru 92 Oz-in.



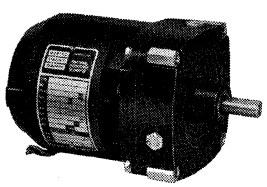
Encased Speed Controls: Nine models are stocked. Several with extended speed range or adjustable torque control.



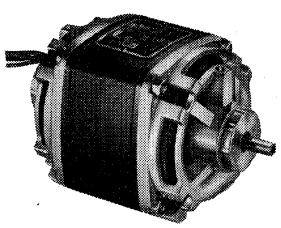
Chassis Speed Control Kits: Four models stocked. Unlimited adaptability. Adjustable torque control available. Permits maximum performance with matched Bodine drives.



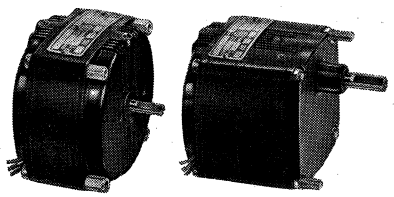
N-Line Motors: Three basic sizes; 3.36″, 4.50″ and 5.68″ in diameter. Stock ratings from 1/125 thru 1/4 Hp. All popular windings are available.



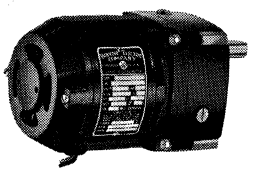
N-1S Gearmotors: Special purpose gearmotors for applications not requiring the ruggedness of the N-1D. Parallel in-line shaft. Only 3.41″ square. 100 lot minimum order.



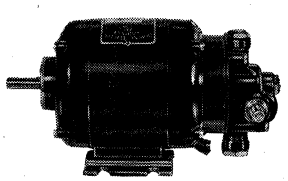
K-4 Motors: Special purpose motors for high volume applications. Standard ratings from 1/60 thru 1/20 Hp. Only 2.88″ square. 500 lot minimum order upon application approval.



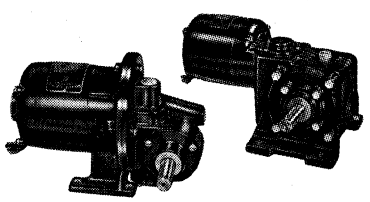
K-2 Line Motors and Gearmotors: Permanent-split capacitor instrument designs. Normal slip, high slip, and synchronous windings. Gearmotor torques thru 120 Oz-in. Only 2.405″ square.



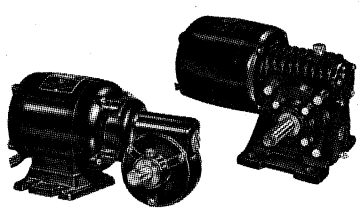
N-1D Gearmotors: Parallel shaft helical and spur gearing. Ratings thru 40 Lb-in. Ratios thru 900:1. Only 3.41″ square.



N-1R Gearmotors: Single and double reduction right angle worm gearmotors. Stock ratings thru 5 Lb-in. Many ratios available for a wide range of speed selection.



Double Reduction Right Angle Worm Gearmotors: Provide high torques at low speeds. Stock ratings over 200 Lb-in. Ample reserves for overloads.



Single Reduction Right Angle Worm Gearmotors: 6 frame sizes with stock ratings over 200 Lb-in. Ratios thru 60:1. Ample reserves for overloads.

There are more than 3,500 standards in the Bodine line. From 1/2000 thru 1/4 Hp. Torques from 0.3 Oz-in. thru 350 Lb-in. Custom or specials? Yes . . . designed and built for your needs and available in small quantities, too. Over 340 STOCK motors, gearmotors, and speed/torque controls are available off-the-shelf from Bodine distributors. Call 312-478-3515 . . . or write for Catalog S: Bodine Electric Co., 2542 W. Bradley Place, Chicago, Illinois 60618.

BODINE ELECTRIC COMPANY

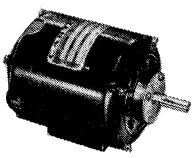
BODINE MOTORS
GEARMOTORS
SPEED CONTROLS

TACH-GENERATORS ★ DC-AC CONVERTERS
FHP MOTORS ★ GEAR MOTORS
DYNAMOTORS ★ FREQUENCY CHANGERS

Carter Motor®

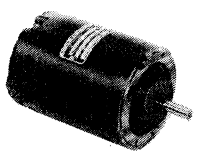
Universal, DC shunt, compound, variable speed, split series and PM types offer a wide choice in Classic and Regent models. Ball bearing, high quality construction, Line-O-Life brushes. Base, face or flange mountings on most models. Long life, quiet operation. Available with PM DC tach generator mounted directly to motor. Shaft, base or electrical modifications available promptly at moderate cost.

Ideal power for machine tools, grinders, tape transports, lab stirrers, SCR motor controllers; welding and flame cutting machines. For over 40 years Carter products have powered leading manufacturers' equipment. The wound field motors have UL component recognition and reflect this experience in outstanding performance, quality and value. Write for latest catalogs.



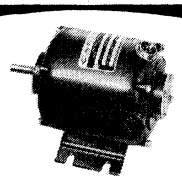
CARTER CLASSIC MOTORS

Standard catalog models; AC/DC universal 1/35 to 1/7 HP, 6 to 230 v. Shunt models 1/40 to 1/20 HP, 6 to 115 v. DC. PM/DC models 1/100 to 1/20 HP, 6 to 115 v. DC. Speeds 1800 to 10.000 RPM. Face, flange, pad or base mount. 3 5/16" dia., 4½" or 4⅞" length.



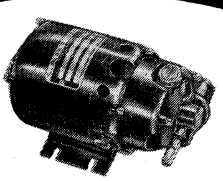
CARTER REGENT MOTORS

Standard catalog models; AC/DC universal ¼ to 1 hp, 12 to 230 v. input. Shunt models 1/15 to ¼ HP, 12 to 115 v. DC. Speeds 1800 to 10,000 RPM. High starting torque. Ventilated or enclosed. Base, face or resilient mount. 3⅞" dia., length 6 3/16", 6 11/16", or 7 3/16".



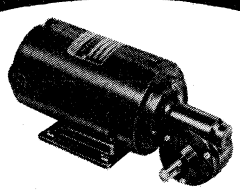
CLASSIC TACHOMETER GENERATORS

Ceramic magnet DC models for slow speed industrial applications. Tach output generates up to 15 watts at 3600 RPM. Connect direct to DC meter calibrated in RPM, FPM, GPH, or other required rotational speed or volume measurement. DC outputs 25, 50, or 60 v. per 1000 RPM. Other voltages available. 3 5/16" dia., 4½" long, plus 5/16" dia. shaft.



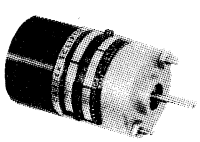
CARTER CLASSIC GEARMOTORS

Single and double reduction types, standard and heavy duty models. Outputs 1 to 500 RPM, torque ratings 1 to 16 inch pounds. Output shaft positions can be shifted. Mountings and shaft centers interchangeable with most existing mountings. Universal, shunt and DC/PM types available. 6 1/16" L x 3 5/16" dia.



CARTER REGENT GEARMOTORS

Single reduction models deliver up to 22 in. lbs. torque. 115 v. input, AC/DC universal and DC shunt types. Precision cast 2 piece gear box. Replaceable hardened and ground steel worms. Size 3⅞" dia. x 9 1/16" L. Speeds 45 to 500 RPM.

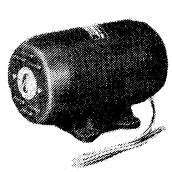


ECLIPTIC TACH-GENERATORS

Precision PM/DC type. Linear output voltage converts RPM into electrical voltage for remote indication. For adjustable speed drives; textile machines, motor controllers, machine tools, etc. Approx. size 1.3" x 2⅛" L., plus shaft. DC outputs, 2.5, 5, 10, 12, 20 v. p/1000.

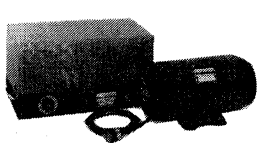
CARTER DC-AC CONVERTERS

Dependable sine wave AC from DC input. Not damaged by transients or overloads. Models for 12 to 264 v. DC input, 115 v. AC, 50 or 60 HZ output, 20 to 2000 watt capacity. Manual frequency control, standby-load starting, and other features available.



CARTER DYNAMOTORS

For 2-way radio, railroad and marine radio-phone, industrial communications, telephone emergency power, etc. Models for 12 to 264 v. DC input, delivering 6 v, or more up to 500 watt output. Size 12⅝" L. x 6¾" W. x 7¼" high.



FREQUENCY CHANGERS

Produces either 50 to 60 HZ 115 v. AC output from 25 to 400 HZ AC input. Excellent source for 50 HZ testing. Models for 20 to 2000 watt output. 3 phase output available on some models.

Carter rotary converters deliver dependable sine wave power. Least affected by electromagnetic pulses. Rugged conservative designs are not subject to sudden burn outs and withstand most transients, line surges, over and under voltage conditions without damage. Clean sine wave requires no filtering except for RF equipment. Stand-by models start automatically from batteries should AC power fail, and operate paging systems, control circuits for industry, utilities, etc.

Carter dynamotors provide DC to DC to operate marine and industrial radio telephones, communication systems, accessories on battery operated vehicles and lift trucks. Frequency changers deliver 25, 50 or 60 HZ output to operate standard 115 AC equipment from non-standard voltages and frequencies. Write for latest catalogs.

Carter Motor®

Carter Motor Company

2707 W. George Street, Chicago, Illinois 60618. Phone 312/588-7700

RAPID SYN
STEPPING & SYNCHRONOUS MOTORS AND DRIVERS

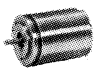
DESIGN IN HIGHER QUALITY — REDUCE COSTS!

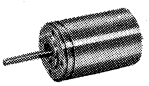
RAPID SYN steppers, synchronous motors and drivers are specified as standard components by leading manufacturers of computer peripheral equipment and numerically controlled machines. They meet highest standards of quality and performance. Quick service from large stocks. Prompt attention and technical assistance on specials. Heat sinks, dampers, gearheads, pulse sources, optical encoders, preset indexers and a wide range of solid state drivers are also offered from stock.

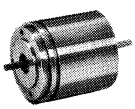
RAPID-SYN STEPPERS... RATINGS AND CHARACTERISTICS

Step Angle (x°)	Size	Model Number	Type	Res/ϕ (ohms)	Inductance in Milli-Henries	Rated Voltage (VDC)	Static Stall Torque (oz. in.)	Detent Torque (oz. in.)	Dynamic Torque (oz. in.)	Response (PPS)	Rotor Inertia (Gm. Cm.^{2})	Weight (oz.)	Length Max.
	23	23H-02	PM/4ϕ	80	73	28	30.0	1.0	20.0	700	30.0	17.0	2.000
	23	23H-05	PM/4ϕ	5	5.1	6	30.0	1.0	20.0	1000	30.0	17.0	2.000
	23	23H-501	PM/4ϕ	5	5.65	6	60.0	2.0	40.0	450	120.0	20.0	2.250
	23	23H-502	PM/4ϕ	20	30.5	12	60.0	2.0	40.0	425	120.0	20.0	2.250
	23	23H-503	PM/4ϕ	80	67	24	60.0	2.0	40.0	425	120.0	20.0	2.250
	23	23H-700	PM/4ϕ	3	10	6	90.0	4.0	65.0	480	200.0	30.0	3.250
1.8°	34	34H-02	PM/4ϕ	0.50	1.76	2	125.0	4.0	90.0	1100	375.0	45.0	2.500
*	34	34H-501	PM/4ϕ	20	65	14	140.0	6.0	100.0	500	550.0	50.0	2.437
	34	34H-507	PM/4ϕ	150	1025	35	140.0	6.0	100.0	500	550.0	50.0	2.437
	34	34H-508	PM/4ϕ	10	25	8	140.0	6.0	100.0	500	550.0	50.0	2.437
	34	34H-509	PM/4ϕ	4.50	20	5.5	140.0	6.0	100.0	500	550.0	50.0	2.437
	34	34H-510	PM/4ϕ	0.50	1.5	2.0	140.0	6.0	100.0	550	550.0	50.0	2.437
	34	34H-700	PM/4ϕ	0.70	4.0	3.0	280.0	10.0	200.0	800	1100.0	76.0	3.687
	34	34H-901	PM/4ϕ	1.1	6.13	4.5	500.0	15.0	250.0	600	1800.0	150.0	5.312
	23	23H-300	PM/4ϕ	3.0	12	6	35.0	3.0	24.0	425	120.0	30.0	3.25
5°	23	23V-300	VR/4ϕ	3.0	25	6	40.0	0	22.0	420	120.0	30.0	3.25
*	34	34H-300	PM/4ϕ	0.75	3.4	3	90.0	7	60.0	400	1200.0	75.0	3.687
	11	11RS-01	VR/4ϕ	100	45	28	2.3	0	1.20	750	2.5	5.0	1.400
7.5°	15	15RS-03	VR/4ϕ	55	47	28	8.0	0	5.0	1100	3.0	6.5	1.500
	20	20RS-01	VR/4ϕ	20	47	28	30.0	0	10.0	700	10.0	16.0	2.500
	8	08R-01	VR/4ϕ	100	65	28	1.0	0	0.6	1400	0.18	1.8	1.000
	8	08V-01	VR/3ϕ	60	30	28	1.3	0	0.50	1100	0.18	1.8	1.000
	11	11R-01	VR/4ϕ	55	43	28	5.8	0	3.25	1040	1.0	4.7	1.625
	11	11V-01	VR/3ϕ	80	56	28	2.75	0	1.75	630	1.0	4.7	1.625
	15	15R-01	VR/4ϕ	35	60	28	8.0	0	4.50	1170	0.7	6.5	1.500
	15	15V-01	VR/3ϕ	16	14	28	5.8	0	2.25	1000	0.6	6.5	1.500
15°	18	18R-01	VR/4ϕ	55	140	28	11.5	0	8.0	620	5.0	13.0	1.875
	20	20R-03	VR/4ϕ	35	75	28	18.0	0	6.6	625	3.5	16.0	2.500
	20	20R-07	VR/4ϕ	20	51	28	38.0	0	25.0	400	10.0	16.0	2.500
	20	20R-17	VR/4ϕ	10	16.7	28	40.0	0	30.0	700	10.0	16.0	2.500
	20	20V-01	VR/3ϕ	10	30	28	50.0	0	13.6	475	10.0	16.0	2.500
	20	20V-03	VR/3ϕ	20	51.9	28	40.0	0	10.0	400	10.0	16.0	2.500
	20	20V-04	VR/3ϕ	15	36	28	25.0	0	5.0	750	3.5	16.0	2.500
	8	08M-01	PM/4ϕ	65	35	28	1.0	0.10	0.35	700	0.3	1.75	1.000
	11	11M-01	PM/4ϕ	45	14	28	2.5	0.20	1.50	425	1.2	4.5	1.625
45°	15	15M-01	PM/4ϕ	30	17.9	28	8.1	0.30	4.80	300	5.0	10.0	2.100
	18	18M-01	PM/4ϕ	40	14	28	6.0	0.25	3.5	350	4.0	13.0	1.875
	20	20M-01	PM/4ϕ	12	13	28	15.0	0.40	8.7	300	15.0	16.0	2.500
	8	08P-02	PM/4ϕ	100	18	28	0.8	0.10	0.25	350	0.3	1.75	1.000
	11	11P-01	PM/4ϕ	60	22	28	2.5	0.20	1.10	240	1.2	4.3	1.625
90°	15	15P-03	PM/4ϕ	20	14.1	28	11.0	0.30	7.0	175	5.0	10.0	2.100
	18	18P-01	PM/4ϕ	20	20	28	8.0	0.25	6.0	260	4.0	13.0	1.875
	20	20P-03	PM/4ϕ	12	13	28	20.0	0.40	9.0	180	10.0	16.0	2.500

* Rated response with appropriate resistors in series with windings.


Size 8 — 3/4" Dia.


Size 11 — 1 1/16" Dia.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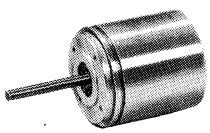
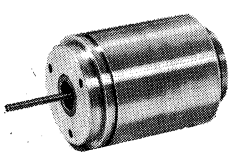
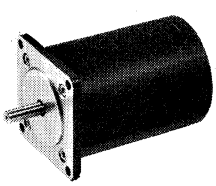
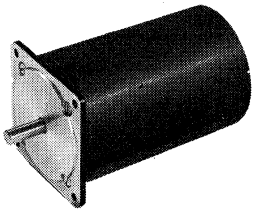

Size 18 — 1 3/4" Dia.


Size 20 — 2" Dia.


Size 23 — 2 7/32" Dia.

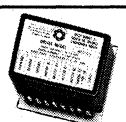
SYNCHRONOUS MOTORS... @ 120 VAC, 60 HZ... RATINGS AND CHARACTERISTICS

Speed (rpm)	Size	Model Number	Torque (oz. in.)	Res/ϕ (ohms)	Rated Current (amps)	Rotor Inertia (Gm. Cm^2)	Weight (oz.)	Phase Shift Comp. Res. Ohm/Watt	Phase Shift Comp. Cap. MFP/Volt.	Length Max.
72	23	23H-600	25	1100	.10	120	20	500/5	.75/330	2.250
72	34	34H-600	100	300	.30	550	50	400/25	2.25/330	2.437
200	23	23H-400	25	430	.20	200	30	—	—	3.250
200	34	34H-400	50	215	.30	1100	76	300/25	3.75/330	3.687


Size 34 — 3 3/8" Dia.

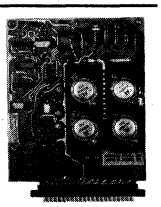
ELECTRONIC ANCILLARIES

Pulse Source


Driver

Preset Indexer

Adjustable Speed Drive

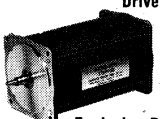

Accelerating Decelerating Drive

SPECIAL STEPPERS

Encoder Motor

Five Phase Stepper

Commercial Grade Stepper


Explosion Proof Stepper

Hard Vacuum Environment

Computer Devices

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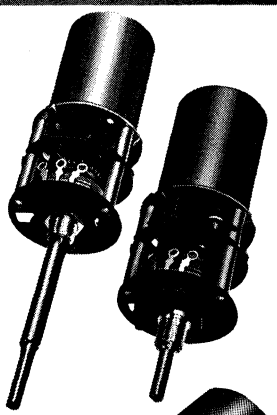
DEPENDABLE DALE® ELECTROMECHANICAL PRODUCTS

REVERSIBLE AC MOTOR DRIVEN POTENTIOMETERS



FOR USE IN ■ Home Entertainment Appliances ■ Instrumentation ■ Controls

FEATURES

■ Available with all standard potentiometers: Single, ganged or with power switch—dimensions change accordingly.

■ Magnetic clutch eliminates coasting and allows manual control independent of gear motor inertial load.

■ Long life expectancy ■ No lubrication in normal use ■ Operates in any position ■ Special terminal configurations available

SPECIFICATIONS

Operating Voltage: 6, 12, 24, 117 V.A.C., or any specified

Power Input: 5.5 Volt Amperes

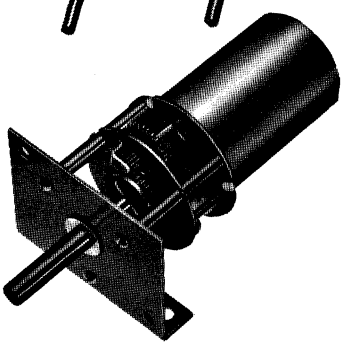
Output: Approximately 5.6 R.P.M.

Torque at Potentiometer Shaft: 10 in./oz. minimum (with decoupler); 21 in./oz. minimum (without decoupler).

Reversing: Accomplished by switching capacitor as shown in hysteresis motor circuit diagram below.

Dimensions: Length: 3.275" (not including shaft) Diameter: 1.531

REVERSIBLE AC GEARHEAD MOTORS



FOR USE WITH ■ Switches ■ Potentiometers ■ Projectors ■ Turret Drives ■ Ribbon Drives ■ Chart Drives ■ Turntable Drives ■ Business Machines ■ Displays ■ Light industrial and consumer product controls

SPECIFICATIONS

MECHANICAL

Overall Dimensions: Length: 3.275" (not including shaft) Diameter: 1.531"

Shipping Weight: .32 lbs.

Will meet normal industrial environmental requirements.

Mounting: Horizontal standard, vertical optional; bracket provided for chassis mounting and mounting control.

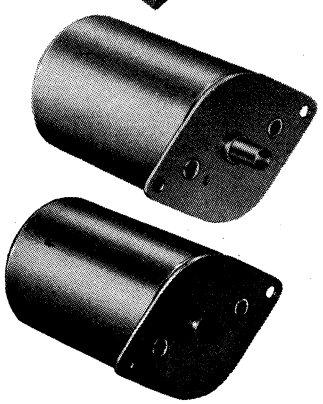
Output Torque: 14 in./oz. at 5.3 R.P.M.

ELECTRICAL

Operating Voltage: 117 volts AC, 60 cycles standard. Available from 6 to 117 volts AC, 60 cycles.

Capacitor size: Dependent on input voltage. (Capacitor not supplied.)

REVERSIBLE AC HYSTERESIS SYNCHRONOUS MOTORS



FOR USE IN ■ Low Power Driving Mechanisms ■ Control Circuits ■ Timers ■ Fans ■ Entertainment Appliances ■ Scanning Devices ■ Stirring Devices ■ Cassette Drives

FEATURES

■ Output shaft configuration can be specified. Standard units provided with gear.

■ Mounting arrangement can be varied to meet customer requirements.

■ Self-lubricating bearings.

■ Aluminum housing.

■ Long life expectancy.

■ Reversing accomplished by switching external capacitor as shown in circuit diagram.

SPECIFICATIONS

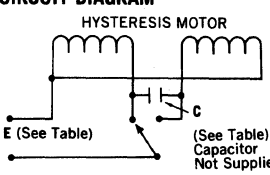
Operating Voltage: 6, 12, 117 V.A.C., or any specified.

Power Input: 5.5 Volt Amperes

Output: Approximately 1800 & 3600 R.P.M.

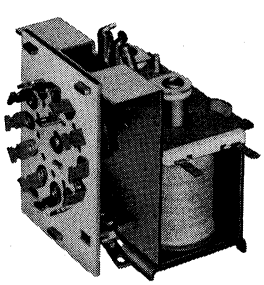
Torque: 0.1 in./oz. min.

CIRCUIT DIAGRAM



E VOLTAGE	C CAPACITANCE	C VOLTAGE
6	170 MFD	20
12	50 MFD	25
24	16 MFD	50
117	.47 MFD	300

AC & DC STEPPING RELAYS



FOR USE IN ■ Control Circuits ■ Television Controls ■ Hi-Fi, Stereo & Radio ■ Appliances ■ Telephone Devices ■ Coin Machines ■ Car Washes ■ Crystal Switching ■ Copy Machines ■ Medical Electronics ■ Computers ■ Coin-operated Laundry Equipment ■ Programmers

FOUR TYPES AVAILABLE ■ Uni-Directional A.C. & D.C. ■ Bi-Directional A.C. and D.C.

SPECIFICATIONS

ELECTRICAL

Operating Voltage: 6 V, 12 V, 24 V, 117 V (AC or DC)

Power Required: 2.5 watts with Plate Sequence Switch (Fig. A); 4.5 watts with Wafer Sequence Switch (Fig. B).

Contact Arrangement: Single Pole 4, 6, 10, 12 or 13 throw sequence. Auxiliary power switch operates at predetermined position of sequence.

Contact Rating: From Dry Circuit to 1 amp at 24 V.A.C. on Sequence Switch. Optional power switch 5 amps at 117 V.A.C.

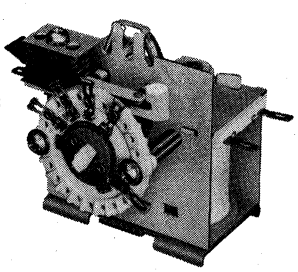
MECHANICAL

Overall Dimensions: Height: 2.200" Width: 2.190" Depth: 2.005"

Shipping Weight: 0.27 lbs. Uni-Directional; 0.40 lbs. Bi-Directional

Will meet normal commercial environmental requirements. Standard auxiliary power switch may be omitted.

Mounting: Vertical or horizontal using one screw and two locating tabs.



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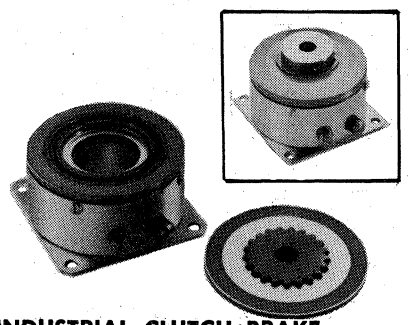
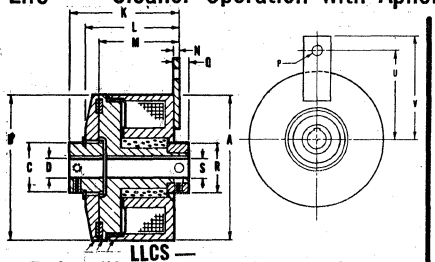
100-MILLION-CYCLE APILON®-FACED CLUTCH AND BRAKE

Longer Life • Cleaner Operation with Apilon® (Ceramic Type) Friction Faces

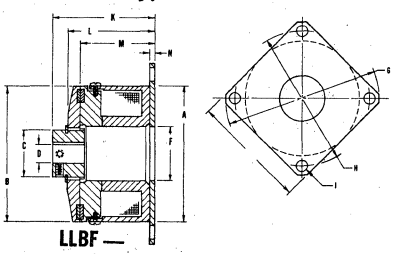


INDUSTRIAL CLUTCH/BRAKE
AVAILABLE WITH ANTIBACKLASH ARMATURE ASSEMBLY.



LLCS —

- Typical life of wear surfaces at least ten (10) times conventional material.
- Life expectancy approximately 120 million cycles (based on work performed per cycle of 144 in. oz. for Size 20 and 288 in. oz. for size 40).

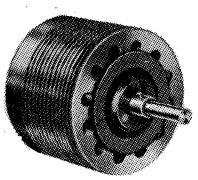


LLBF —

- Dust due to wear products substantially reduced.
- Physically and electrically interchangeable with most conventional units.
- Engineering available to establish life expectancy for specific application.

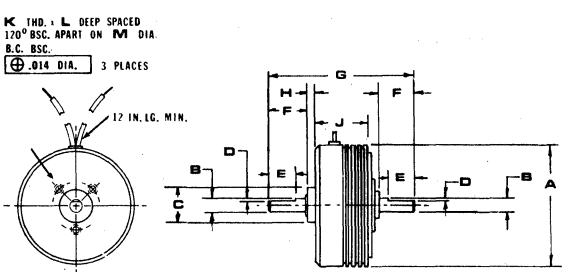
Model	Torque Watts		A	B	C	D	F	G	H	I	J	K	L	M	N	P	Q	R	S	U	V
	Lb.		.015	.015	.005	Std. with	.001	.001	.005	.010	.015	.015	.015	.015	.015	.010	.015	.015	Max. with	.015	.015
±	In.	D.C.	.015	.015	.005	Std. Keyway	.000	.001	.005	.010	.015	.015	.015	.015	.015	.010	.015	.015	Max. Keyway	.015	.015
10	3	4	1⅛	1⅛	⅝	3/16 x 1/16 x 1/32	.437	1.499	1.312	⅛	1⅛	1	.718	.625	1/16	5/32	3/16	7/16	1/4 x 1/16 x 1/32	¾	⅞
20	18	6	1 13/16	1 13/16	⅝	3/8 x 3/32 x 3/64	.750	2.436	2.125	3/16	1 13/16	1⅜	1.156	1.000	1/16	5/32	3/16	⅝	1/4 x 1/16 x 1/32	1 3/16	1⅜
30	35	8	2⅛	2⅛	⅝	3/8 x 3/32 x 3/64	1.000	2.874	2.500	3/16	2⅛	1 31/32	1.250	1.062	1/16	5/32	1/4	¾	3/8 x 1/16 x 1/32	1⅜	1 1/16
40	60	10	2⅝	2⅝	1 3/16	1/2 x 3/16 x 3/32	1.061	3.499	3.125	3/16	2⅝	1 25/32	1.437	1.250	1/16	5/32	1/4	1	3/8 x 1/8 x 1/16	1 1/16	1¾

HYSTERESIS CLUTCHES/BRAKES



HYB-HYSTERESIS BRAKES

A continuous slip device capable of providing precise, infinitely adjustable torque control. Units are basically direct current sensitive... having excellent reliability, repeatability and linearity. Described below are some of the infinite variations of Hysteresis Brakes manufactured. Also available are a similar wide variety of clutches.



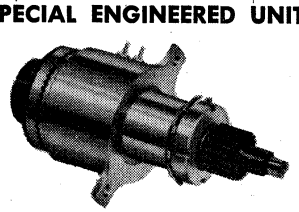
ENGINEERING SPECIFICATIONS

SIZE	A ±.015	B +.0000 −.0005	C +.0000 −.0005	D ±.005	E ±.015	F MIN.	G ±.015	H ±.005	J ±.015	K THD. 2B	L MIN.	M BSC.
10	1.250	.1875	.3750	.020	.375	.500	2.125	.050	.900	4-40	.125	.687
20	1.750	.1875	.5000	.020	.375	.500	2.030	.090	.765	4-40	.125	.687
30	1.953	.1875	.5000	.020	.375	.500	2.280	.090	1.000	4-40	.125	.687
35	2.093	.2500	.6250	.030	.500	.750	3.020	.090	1.200	6-32	.250	.937
40	2.875	.2500	.6250	.030	.500	.750	3.415	.090	1.540	8-32	.312	1.000
45	3.625	.3750	.8750	.062	.750	1.000	4.155	.125	1.530	8-32	.312	1.500
50	4.437	.5000	1.1250	.062	1.000	1.250	5.140	.150	2.000	10-32	.500	1.750
55	5.484	.5000	1.1250	.062	1.000	1.250	5.175	.150	2.060	10-32	.562	1.750

Information on sizes 70/85/120 rated at 750/1600/3000 oz. in. respectively, available on request.

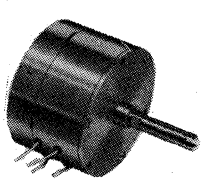
TECHNICAL DATA	10	20	30	35	40	45	50	55
Torque—Oz. In. Min. At Rated Voltage	4	8	20	35	60	125	210	425
Watts—Max. At Rated Voltage At 25°C.	4.0	4.0	4.5	7.0	7.0	7.0	7.0	7.0
Dissipation Capacity, Max. Avg.—Watts	5	10	15	20	50	80	120	150
Maximum Recommended Speed (Input)—RPM.[1]	3600	3600	3600	3600	3600	3600	3600	3600
Moment Of Inertia—Oz. In. Sec.^{2} x 10^{-3} (Input)	.144	.57	.58	1.4	1.64	12.7	30.6	91.3
Drag Torque—Oz. In. Max. (De-energ. & Degaussed)	.20	.20	.20	.30	.40	.70	1.0	1.0
Weight—Lb. Max.	.3	.60	.80	1.2	2.6	4.1	7.8	12.5

SPECIAL ENGINEERED UNITS



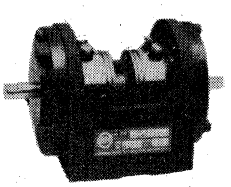
TOOTH TYPE CLUTCH

Special design to meet military reliability for airborne electronics. Specifications include operation in an explosive vapor, temperature, altitude, vibration, salt spray and humidity environments.



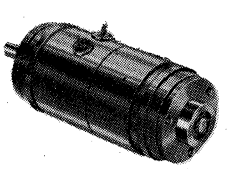
DUPLEX BRAKE

Compact Brake for use in a missile tape drive system. Hysteresis and friction brake with separate coils for excitation applied to a common shaft.



APILON®-FACED CLUTCH BRAKE PACK

Precision pre-aligned clutch/brake package eliminates installation problems. Ball bearing supported shafts permit direct coupling or belt drives. Packs available to house above Commercial Models 10, 20 and 40.



SUBMINIATURE CLUTCH & BRAKE

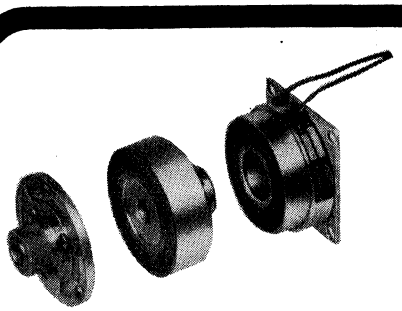
Ultra precision clutch and brake units, combine excellence in design, materials, workmanship and reliability. All units contain precision ball bearings fully protected from moisture and contamination by special seals. Units meet government specifications for environmental tests. Infinite variations of design and mountings are available.

Delevan Division — AMERICAN PRECISION INDUSTRIES INC.
270 QUAKER RD. / EAST AURORA, N. Y. 14052
TELEPHONE (716) 652-3600 TELEX 091-293
OTHER DIVISIONS OF AMERICAN PRECISION INDUSTRIES INC.
BASCO • DUSTEX • MOELLER INSTRUMENT CO. OXFORD CORP.

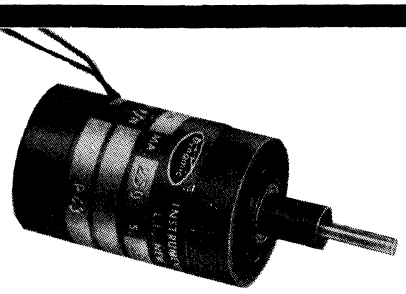
FRICTION-DISC ELECTRO-MECHANICAL

CLUTCHES OAC BRAKES

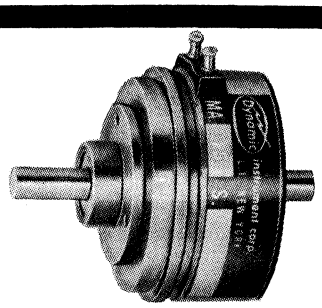
for MILITARY • AEROSPACE and INDUSTRIAL • COMMERCIAL



INDUSTRIAL TYPE
(Open Frame)



INDUSTRIAL TYPE
(Enclosed Frame)



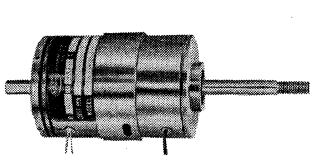
PRECISION
INSTRUMENT
TYPE

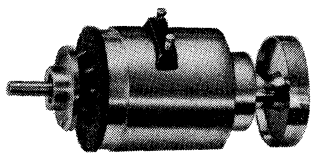
These clutches and brakes are manufactured for high volume utilization where cost is considered paramount. They are incorporated in copying machines, air conditioning equipment, sewing machines, automated machine tools, packaging equipment and a host of other devices. Write for our latest Industrial Catalog illustrating a wide range of models and sizes for immediate delivery.

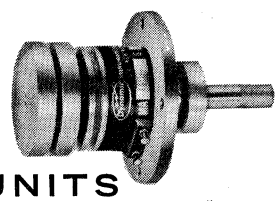
These types are hybrid or special units designed for particular applications. They would be incorporated when MIL-SPECS and close tolerances are not essential, but where having a complete "self-contained" unit is desirable. Some of their usages are found in cassette tape decks, analog devices, actuators, and electro-mechanical sensing devices, etc. Write for further information and let us help solve your particular clutch/brake application.

The units shown in the OAC Catalog 2D are manufactured primarily to satisfy the high standards of military requirements. (Similar to above illustration) Their above-standard quality is further emphasized by a high efficiency-to-size ratio. If precision is the need—then these are the instruments for you. Send or write for free catalog.

OMNI-ACTION CONTROLS OFFERS THE MOST COMPLETE LINE OF FRICTION ELECTRO-MAGNETIC CLUTCHES & BRAKES







SPECIAL APPLICATION UNITS

These units have been designed for applications ranging from use in radiation resistant tape drives for Orbiting Satelite recorders, film drives for Moon probe, and high speed aerial cameras, tape handlers for commercial computers to vibration-temperature sensors for sub-terrain seismology studies.

It should be further mentioned that OAC has found that the large portion of todays market is in special application units and has geared itself to producing specials in the shortest possible time commensurate with quality, let OAC assist you with your special applications.

SEND OR WRITE FOR CATALOG 2D

OMNI-ACTION CONTROL DIV.

DYNAMIC INSTRUMENT CORP.

115 E. BETHPAGE ROAD
PLAINVIEW, N. Y. 11803
516 - 694-6000

TWX 510-224-6482 CABLE ADDRESS "DYNINST" PLAINVIEW, N. Y.

Eastern Air Devices, Inc.

Dover, New Hampshire 03820 • Tel. (603) 742-3330 • TWX 510-297-4454

A single source for the full range of rotating components

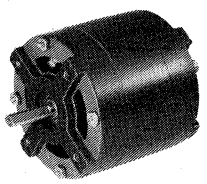
More than 30 years of experience in designing, testing and building high quality, high performance, high reliability rotating components goes into every motor, gearmotor, fan and blower produced by Eastern Air Devices. A wide range of standard models, plus a capacity for producing custom engineered designs, make EAD the perfect single source for any requirement for drives or heat removal units. Included are induction, hysteresis and reluctance synchronous, torque, and stepping motors; in-line gearmotors and right angle reducers; axial flow fans and centrifugal blowers. Shown on these pages are representative samples of the line. For detailed data, contact Eastern Air Devices indicating application specifications.

INDUCTION, TORQUE AND SYNCHRONOUS MOTORS

EAD AND HOLTZER-CABOT induction, torque and synchronous motors are single or 3-phase, 115 or 208 vac, 2 to 12-pole machines, offering up to ½ hp. 400 Hz models are also available. Typical applications include business equipment, computer peripherals, and other high performance devices.

SIZE 25

2⁹⁄₁₆ inch square or 2¾ inch diameter instrument motors for applications requiring high performance and high reliability in a small envelope size.



SIZES 34 and 44

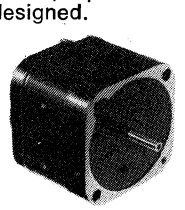
3⅜ and 4⅜ inches diameter, with single and multiple speeds at 50/60 Hz. Designed to meet high standards of performance and reliability in commercial applications such as data processing, copying and recording equipment.

DC MOTORS

A standard line of sub-fractional DC motors with outputs up to 1/40 hp and speeds up to 5,000 rpm. Many variations of DC motors are available from our expanded line of Holtzer-Cabot motors.

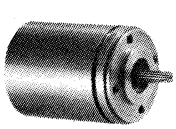
SERVO MOTORS

EAD AND HOLTZER-CABOT servo motors are available in both commercial and military designs for 60 or 400 cycle operation. Standard frame sizes are available with or without gearheads; special requirements can be custom designed.



TYPE L

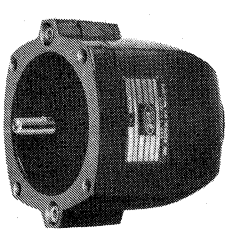
An AC induction motor having a low inertia rotor for fast starts, stops and reversals. Can be controlled by solid state or vacuum tube amplifiers. Available in 3 stack lengths, with impedances of 30 to 6500 ohms.



SIZES 10 to 23

A complete line of precision servo motors for commercial and military applications ranging from sizes 10 to 23. Available with gearheads, tachometers, generators and potentiometers.

TACHOMETER ALTERNATOR



SERIES J15

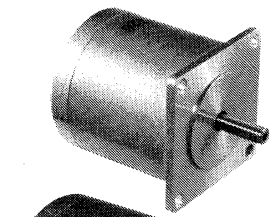
Output from 0 to 60 volts, with speeds from 0 to 12,000 rpm. Durable die cast construction, high output, low distortion and excellent linearity make this versatile and economical tachometer a natural for industrial automation applications. Conveyors, processing machinery and machine tools are only a few of the many applications where this rugged device has proved its usefulness and reliability.

Eastern Air Devices, Inc.

Dover, New Hampshire 03820 • Tel. (603) 742-3330 • TWX 510-297-4454

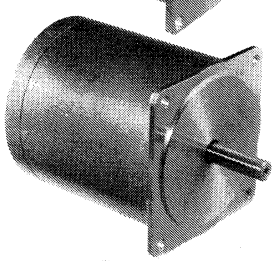
STEPPING MOTORS

EAD STEPPING MOTORS are of permanent magnet and variable reluctance designs with step angles of 1.8 to 90 degrees. They have exceptionally high torque values and stepping rates, and may be provided with electronic, mechanical or viscose damping features.



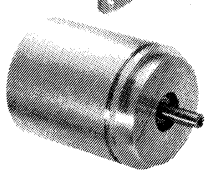
SIZE 23

2 7/32 inch diameter PM stepping motor with 1.8° step angle. Slew rates of 10,000 pps obtainable, with torque ratings from 50 to 100 oz.-in.



SIZE 34

3⅜ inch diameter PM stepping motor with 1.8° step angle. Slew rates of 20,000 pps obtainable. Torque rates: 150 to 450 oz.-in.

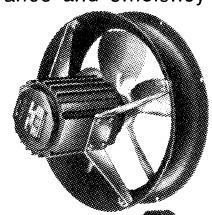


SIZES 8 to 20

VR and PM stepping motors having 7.5, 10, 15, 22.5, 30, 45, and 90 degree step angles, with a wide range of voltages and torque ratings.

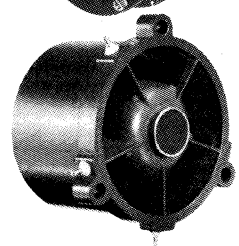
FANS AND BLOWERS

EAD FANS AND BLOWERS represent the accumulated design experience of building mechanical heat removal units for a multitude of applications, both commercial and military. EAD axial and vane axial fans, and centrifugal blowers have aerodynamic characteristics to produce the maximum air delivery. And because each is driven by an EAD motor, peak performance and efficiency can be achieved.



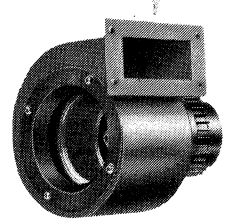
PROPELLER AND TUBE AXIAL FANS

Offered in sizes up to 12 inches in diameter, with air delivery up to 1500 cfm.



VANE AXIAL FANS

Available in 1½, 2, and 4¾ inch diameters, delivering from 3 to 500 cfm at high static pressures.

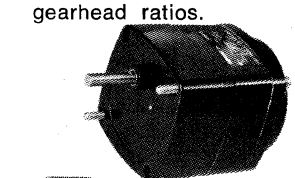


CENTRIFUGAL BLOWERS

Single and duplex blowers deliver from 3 to 1000 cfm at static pressures up to 10 inches of water.

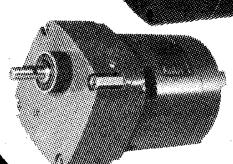
GEAR MOTORS

EAD AND HOLTZER-CABOT gearmotors have frame sizes up to 6½ inches diameter; electrical characteristics of 50, 60 and 400 Hz and DC; single phase, permanent split capacitor and polyphase; and single and dual voltage. They are available with a wide variety of standard mountings and gearhead ratios.



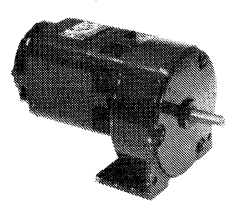
SIZE 25

2 1/16 inch square synchronous and non-synchronous gearmotors, with speeds from 1 to 600 rpm. Torque outputs are up to 140 oz.-in. for applications requiring long service life with quiet operation.



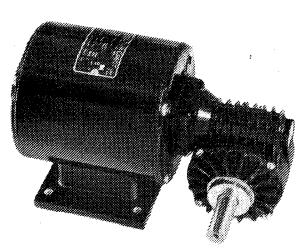
SIZE 34

3⅜ inch diameter synchronous and non-synchronous gearmotors with speeds from 2 to 150 rpm and torque outputs up to 25 lb.-in. Designed for applications requiring quiet operation and long life.



TYPE M IN-LINE GEARMOTOR

Rated for Class I service, this unit is available in 3 sizes developing up to 50 in.-lb. and speeds from 1 to 300 rpm. It is designed for service installations requiring a compact, in-line drive.



RIGHT-ANGLE GEARMOTORS

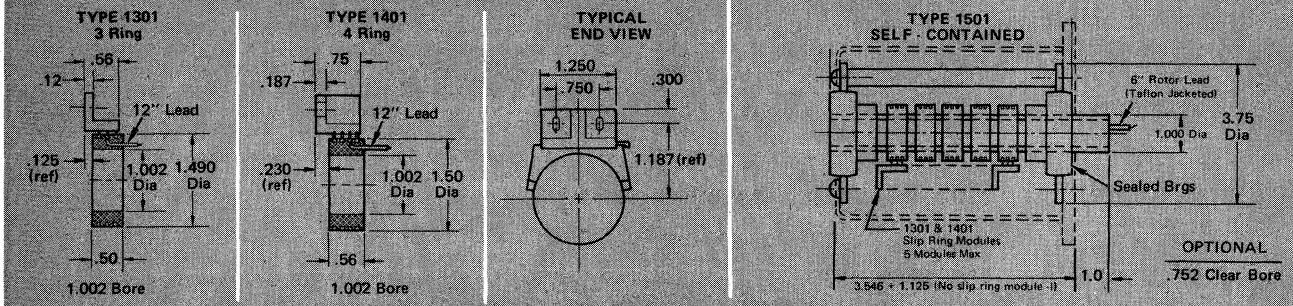
A complete line of single and double reduction right-angle gearmotors supplied with universal, direct-current and alternating-current induction drive motors. These units have output torque up to 90 in.-lb. and speed range from 1 to 500 rpm.

SLIP RING ASSEMBLIES

STANDARD MODELS FROM THE FABRICAST CATALOG with BORE SIZES THRU 8 INCHES

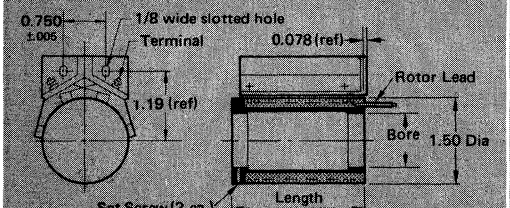
IMMEDIATE DELIVERY SLIP RING ASSEMBLIES

SLIP RING ASSEMBLIES – SEPARATE ROTORS AND BRUSH BLOCKS

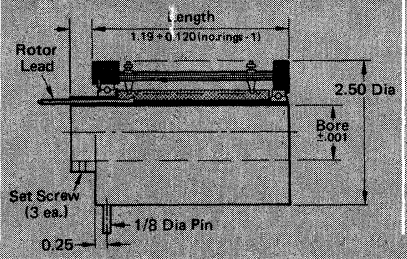


5 amp – 1000 VAC Hi-Pot – .010 ohm Dynamic Resistance – Coin Silver Rings – Silver Graphite Brushes

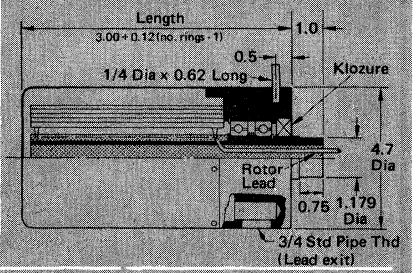
Slip Ring Assembly Type 1057
Separate Rotor and Brush Block
5 amp – 50 rings max – Bore 1.002 dia max



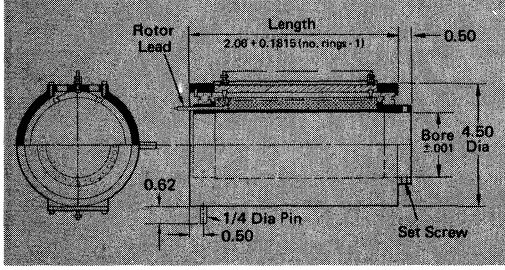
Slip Ring Assembly Type 1186
Self-contained – Shaft Mtg
5 amp – 50 rings max – Bore 1.002 dia max



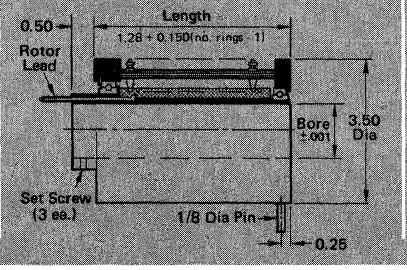
Slip Ring Assembly Type 1302
Self-contained – Sealed Housing
5 amp – 50 rings max – Solid Bore



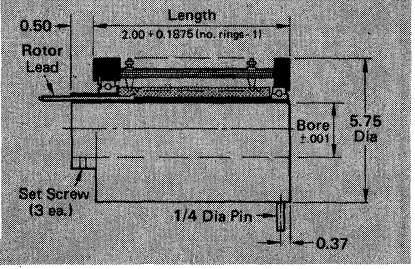
Slip Ring Assembly Type 1067
Self-contained – Shaft Mtg
5 amp – 100 rings max – Bore 2.502 dia max



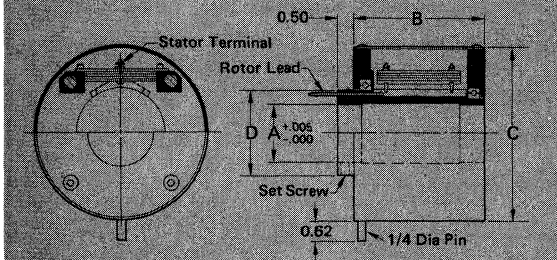
Slip Ring Assembly Type 4268
Self-contained – Shaft Mtg
5 amp – 100 rings max – Bore 1.752 dia max



Slip Ring Assembly Type 1390
Self-contained – Shaft Mtg
5 amp – 100 rings max – Bore 4.252 dia max



SELF CONTAINED COVERED STATOR TERMINAL SLIP RING ASSEMBLIES



TYPE	BORE DIA "A", inches		NO. RINGS MAX	CURRENT	LENGTH "B", inches	Housing Dia "C"	Sleeve Exten. Dia "D"
	Nominal	Range					
1292	SOLID	———	41	5 amp std 2 brushes per ring	.85 + .088 (no. rings - 1)	2.50	2.19
1294	SOLID	———	48		1.12 + .110 (no. rings - 1)	2.25	.87
1295	SOLID	———	200		7.50 + .150 (no. rings - 1)	5.00	2.50
1297	.500	.378 - .565	50		1.25 + .120 (no. rings - 1)	2.75	1.05
1298	1.000	.566 - 1.002	50		1.25 + .120 (no. rings - 1)	3.00	1.30
1272	1.000	1.000 - 1.750	100	10 amp or lo noise 4 brushes per ring	2.00 + .150 (no. rings - 1)	5.25	2.56
1273	2.000	1.750 - 2.625	100		2.00 + .150 (no. rings - 1)	6.25	3.50
1274	3.000	2.625 - 3.750	58		2.00 + .160 (no. rings - 1)	7.50	4.50
1275	4.000	3.750 - 4.750	48		2.00 + .186 (no. rings - 1)	9.00	6.00
1276	5.000	4.750 - 5.750	63		2.00 + .186 (no. rings - 1)	10.50	7.00
1277	6.000	5.750 - 6.750	58		2.00 + .1875 (no. rings - 1)	12.00	8.00
1278	8.000	6.750 - 8.750	58		2.00 + .1875 (no. rings - 1)	15.00	10.00
1282	1.000	1.000 - 1.250	16	50 amp std 100 amp 4 brushes per ring	3.00 + 1.050 (no. rings - 1)	8.00	2.56
1283	2.000	1.250 - 2.000	16		3.00 + 1.050 (no. rings - 1)	9.00	3.50
1284	3.000	2.000 - 3.125	9		3.00 + 1.120 (no. rings - 1)	10.00	4.50
1285	4.000	3.125 - 4.375	8		3.00 + 1.116 (no. rings - 1)	11.50	6.00
1286	5.000	4.375 - 5.375	10		3.00 + 1.116 (no. rings - 1)	12.50	7.00
1287	6.000	5.375 - 6.375	10		3.00 + 1.125 (no. rings - 1)	13.50	8.00
1288	8.000	6.375 - 8.375	10		3.00 + 1.125 (no. rings - 1)	16.00	10.00

PART NUMBER CODING – Specify fully when ordering

Type	Bore (inches)	No. Rings	Lead Length (inches)	Lead Type (Shielded - S, Unshielded - U)
X	X	X	X	X

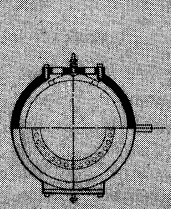
CHARACTERISTICS **HOUSING:** Bell, Bell Spacer and Cover type construction. All other characteristics same as for Self Contained Rigid Housing Slip Ring Assembly.

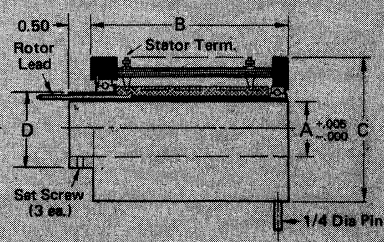
WRITE OR PHONE FOR THE FABRICAST CATALOG

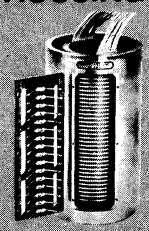
Fabricast, Inc. MANUFACTURERS OF SLIP RING ASSEMBLIES

2517 SEAMAN AVENUE, SOUTH EL MONTE, CALIF. 91733 Phone 213/443-3247 (S. El Monte/Los Angeles)

SELF CONTAINED RIGID HOUSING SLIP RING ASSEMBLIES







PART NUMBER CODING — Specify fully when ordering

Type — Bore (inches) — No. Rings — Lead Length (inches) — Lead Type (Shielded - S / Unshielded - U)

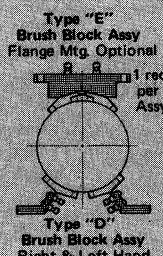
X —— X —— X —— X —— X

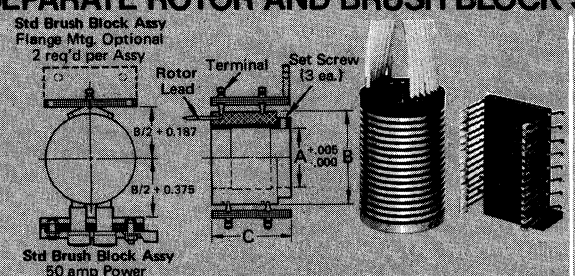
TYPE	BORE DIA "A", inches Nominal	BORE DIA "A", inches Range	NO. RINGS MAX	CURRENT	LENGTH "B", inches	Housing Dia "C"	Sleeve Exten. Dia "D"
4150	1.000	.000 - 1.002	64	5 amp std	1.19 + .120 (no. rings - 1)	2.50	1.30
4200	1.312	1.000 - 1.312	100	2 brushes	1.19 + .125 (no. rings - 1)	3.00	1.81
4237	1.750	1.312 - 1.752	78	per ring	1.19 + .130 (no. rings - 1)	3.37	2.31
4268	2.000	1.750 - 2.002	100		1.28 + .150 (no. rings - 1)	3.62	2.56
4350	2.750	2.250 - 2.752	100	10 amp std	1.75 + .150 (no. rings - 1)	4.50	3.50
4400	3.250	2.750 - 3.252	100	or lo noise	1.75 + .160 (no. rings - 1)	5.00	4.00
4462	3.750	3.250 - 3.752	100	4 brushes	1.75 + .160 (no. rings - 1)	5.50	5.00
4500	4.250	3.750 - 4.252	100	per ring	1.75 + .187 (no. rings - 1)	6.00	5.50
4600	5.250	4.250 - 5.252	79		1.75 + .165 (no. rings - 1)	7.00	6.00
4700	6.250	5.250 - 6.252	63		1.75 + .186 (no. rings - 1)	8.00	7.00
4800	7.250	6.250 - 7.252	58		1.75 + .187 (no. rings - 1)	9.00	8.00
4900	8.750	7.250 - 8.750	58		1.75 + .187 (no. rings - 1)	11.00	10.00
1271	1.000	.000 - 2.000	15	50 amp std	3.50 + 1.050 (no. rings - 1)	4.50	2.92
1291	3.000	2.000 - 3.252	9	50 amp std	4.50 + 1.120 (no. rings - 1)	6.50	5.00

CHARACTERISTICS

RPM: Rigid one piece housing eliminates bearing alignment problems.
RINGS: Coin Silver 5 amp rings.
Copper 50 amp rings.
BRUSHES: Silver Graphite
Fabricast Grade FAG 180 (80% AG — 20% C)
Two brushes per ring.
Brushes individually removable and replaceable.
NOISE: 10 Milliohms dynamic resistance max
5 Milliohms max with 4 brushes per ckt.
CURRENT: Noted in tabulated block.
Rating may be doubled with 4 brushes per ckt.
HI-POT: 1200 VAC 60 cycle for 15 seconds.
ROTOR: One piece steel sleeve.
Ring complement vacuum cast on sleeve as unit with epoxy dielectric.
ROTOR LEADS: 5 amp Leads — 20 ga per MIL-W-16878 type "E"
50 amp Leads — 8 ga per MIL-W-16878 type "B"
HOUSING: One piece steel tubing construction.
COVER: Easily removable for brush and ring inspection.
BEARINGS: Shielded or sealed ball bearings.

SEPARATE ROTOR AND BRUSH BLOCK SLIP RING ASSEMBLIES





PART NUMBER CODING — Specify fully when ordering

Type — Bore (inches) — No. Rings — Lead Length (inches) — Lead Type (Shielded - S / Unshielded - U) — Type Brush Block

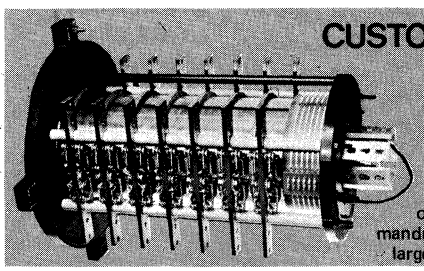
X —— X —— X —— X —— X —— X

TYPE	BORE DIA "A", inches Nominal	BORE DIA "A", inches Range	NO. RINGS MAX	CURRENT	Slip Ring Dia "B"	LENGTH "C", inches
2050	SOLID	.000 - .127	18	5 amp std	.500	.625 + .125 (no. rings - 1)
2087	SOLID	.000 - .377	48	5 amp std	.875	.625 + .110 (no. rings - 1)
2112	.375	.000 - .627	100	5 amp std	1.125	.625 + .125 (no. rings - 1)
2150	.750	.620 - 1.002	64	5 amp std	1.500	.625 + .120 (no. rings - 1)
2237	1.250	1.000 - 1.502	78	5 amp std	2.375	.750 + .130 (no. rings - 1)
2268	1.500	1.250 - 1.752	107	5 amp std	2.687	1.000 + .150 (no. rings - 1)
2350	2.000	1.750 - 2.502	100	5 amp std	3.500	1.000 + .150 (no. rings - 1)
2375	2.500	2.370 - 2.875	48	5 amp std	3.750	1.000 + .200 (no. rings - 1)
2462	3.000	2.750 - 3.752	112	5 amp std	4.625	1.250 + .160 (no. rings - 1)
2500	4.000	3.250 - 4.002	108	5 amp std	5.000	1.250 + .187 (no. rings - 1)
2600	5.000	4.000 - 5.002	48	5 amp std	6.000	1.250 + .186 (no. rings - 1)
2700	6.000	5.000 - 6.002	63	5 amp std	7.000	1.250 + .186 (no. rings - 1)
2800	7.000	6.000 - 7.002	68	5 amp std	8.000	1.250 + .1875 (no. rings - 1)
2900	8.000	7.000 - 9.002	58	5 amp std	10.000	1.250 + .1875 (no. rings - 1)
3268	1.000	.750 - 1.187	16	50 amp std	2.687	2.000 + 1.050 (no. rings - 1)
3300	1.500	1.187 - 1.500	6	50 amp std	3.000	2.000 + 1.000 (no. rings - 1)
3350	2.000	1.500 - 2.000	16	50 amp std	3.500	2.000 + 1.050 (no. rings - 1)
3462	3.000	2.000 - 3.125	9	50 amp std	4.625	2.000 + 1.120 (no. rings - 1)
3600	4.000	3.125 - 4.500	8	50 amp std	6.000	2.000 + 1.116 (no. rings - 1)
3700	5.000	4.500 - 5.500	10	50 amp std	7.000	2.000 + 1.116 (no. rings - 1)
3800	6.000	5.500 - 6.500	10	50 amp std	8.000	2.000 + 1.125 (no. rings - 1)
3900	7.000	6.500 - 8.500	10	50 amp std	10.000	2.000 + 1.125 (no. rings - 1)

CHARACTERISTICS

RINGS: Coin Silver 5 amp rings.
Copper 50 amp rings.
BRUSHES: Silver Graphite.
Fabricast Grade 180 (80% AG — 20% C)
Two Brushes per ring
Brushes individually removable and replaceable.
NOISE: 10 Milliohms dynamic resistance max.
5 Milliohms max with 4 brushes per ckt.
CURRENT: Noted in tabulated block.
Rating may be doubled with 4 brushes per ckt.
HI-POT: 1200 VAC 60 cycle for 15 seconds.
ROTOR: One piece steel sleeve.
Ring complement vacuum cast on sleeve as unit with epoxy dielectric.
ROTOR LEADS: 5 amp Leads — 20 ga per MIL-16878 type "E"
50 amp Leads — 8 ga per MIL-W-16878 type "B"
BRUSH BLOCK: Glass epoxy.
Optional mounting methods shown.

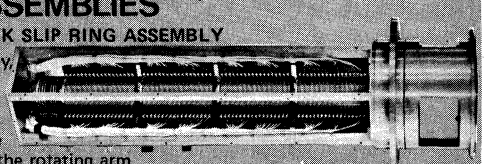
CUSTOM DESIGNED SLIP RING ASSEMBLIES



CUSTOM 7000 AMP SLIP RING ASSEMBLY

This slip ring assembly, as designed and manufactured by Fabricast, Inc., is used to supply 7000 amperes of current to the rotating mandrel of the world's second largest spin forging machine.

CUSTOM 222 TRACK SLIP RING ASSEMBLY



This slip ring assembly, as designed and manufactured by Fabricast, Inc. was used to complete the electrical circuits to the rotating arm of an astronaut carrying centrifuge.

The unit consists of 50 amp. power, 5 amp. instrumentation and 50 megacycle coaxial modules.

WRITE OR PHONE FOR THE FABRICAST CATALOG

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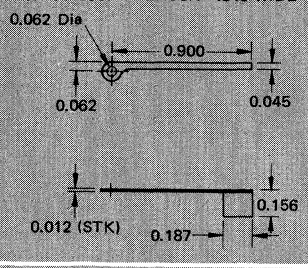
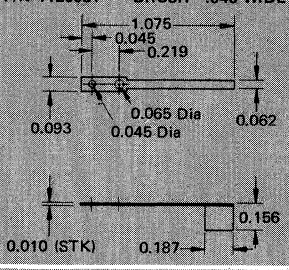
BRUSH ASSEMBLIES

LEAF TYPE (BRUSH MATERIAL - FAG 180 LEAF MATERIAL - BeCu)

2.0 AMP SINGLE BRUSH
P/N 1113007 BRUSH - .040 WIDE

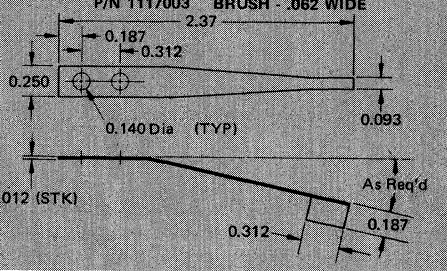


2.0 AMP SINGLE BRUSH
P/N 1120051 BRUSH - .040 WIDE

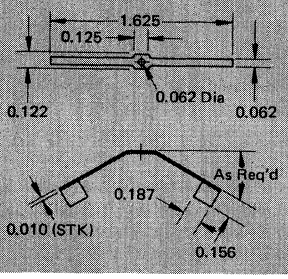


STOCK DELIVERY

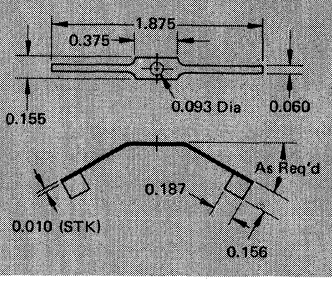
5.0 AMP SINGLE BRUSH
P/N 1117003 BRUSH - .062 WIDE



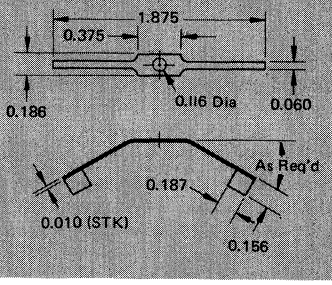
5.0 AMP DOUBLE BRUSH
P/N 1103004 BRUSH .040 WIDE



5.0 AMP DOUBLE BRUSH
P/N 1050006-5 BRUSH .040 WIDE

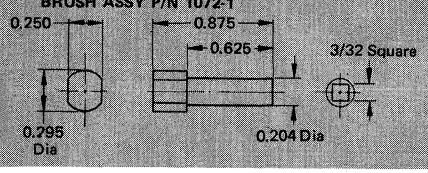


5.0 AMP DOUBLE BRUSH
P/N 1050006-2 BRUSH .040 WIDE

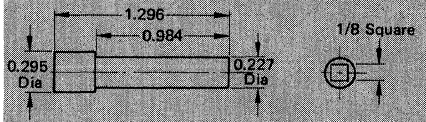


PLUNGER TYPE (BRUSH MATERIAL - FAG 180 HOLDER - BRASS)

2.5 AMP CAPACITY - 3/32" SQUARE BRUSH
HOLDER ASSY P/N 1070004
BRUSH ASSY P/N 1072-1

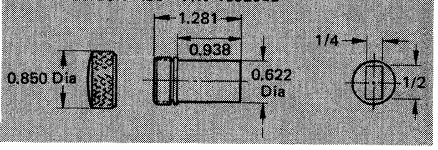


4.0 AMP CAPACITY - 1/8" SQUARE BRUSH
HOLDER ASSY P/N 1051032
BRUSH ASSY P/N 1072-2



STOCK DELIVERY

25 AMP CAPACITY
1/4" x 1/2" RECTANGULAR BRUSH
HOLDER ASSY P/N 1092006
BRUSH ASSY P/N 1092003



BRUSH MATERIAL

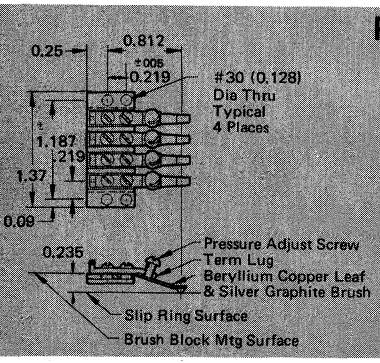
- Fabricast grade Fag 180, the universal low noise level grade used for all standard brush assembles.
- Fabricast grade FAG 193, the lowest noise level grade, however, the ring surface speed is limited to 250 SFM.
- Fabricast grade FAG 150, the highest surface speed grade, however, noise levels are compromised.

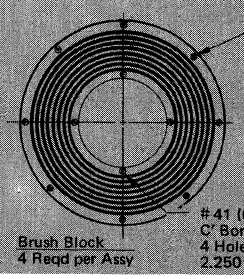
Grade No.	Composition	Recommended Surface Speed	Carrying Capacity
FAG150	50% silver, 50% graphite	Over 3500 ft. per min.	100 Amps per sq. in.
FAG180	80% silver, 20% graphite	Up to 3500 ft. per min.	250 Amps per sq. in.
FAG193	93% silver, 7% graphite	Up to 250 ft. per min.	300 Amps per sq. in.

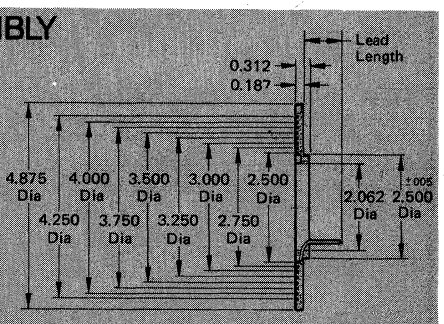
COIN SILVER RINGS – ½" TO 24" DIA – QUOTATION UPON REQUEST

PANCAKE TYPE SLIP RING ASSEMBLY

TYPE 1062 8 RINGS - 5 AMP CAPACITY







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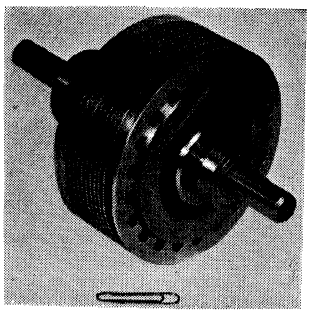
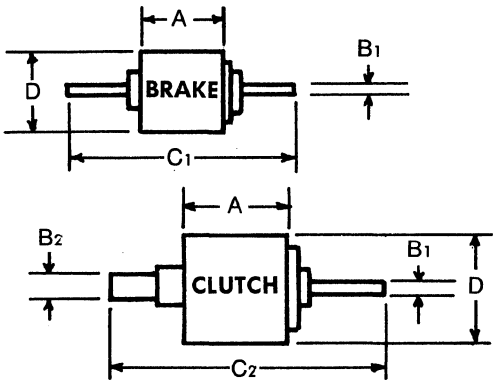
GEMCOR ELECTRO MECHANICAL COMPONENTS

HYSTERESIS CLUTCHES & BRAKES



offer maximum reliability — smooth clutching — minimum maintenance. They are ideal for tension control and power absorption devices where smooth variable slip torque is required. Torque is proportional to control current. Clutch-brake combinations and fixed field clutches also available.

SPECIFICATIONS	MODELS					
	PMC-6 PMB-6	PMC-16 PMB-16	PMC-35 PMB-35	PMC-120 PMB-120	PMC-175 PMB-175	PMC-325 PMB-325
TORQUE - RATED OZ. IN.	6	16	35	120	175	325
OUTPUT INERTIA SLUG FT²	1.55×10^{-6}	3.03×10^{-6}	6.3×10^{-6}	5.4×10^{-5}	1.5×10^{-4}	2.0×10^{-4}
CONTROL WATTAGE	2.5	4.5	12	5	3	7
			PMC-.75K PMB-.75K	PMC-1.5K PMB-1.5K	PMC-3K PMB-3K	PMC-5K PMB-5K
			750	1500	3000	5000
			6.3×10^{-3}	1.26×10^{-2}	2.68×10^{-2}	4.05×10^{-2}
			8.1	17	25	6

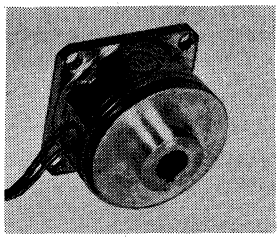


	PMC-6 PMB-6	PMC-16 PMB-16	PMC-35 PMB-35	PMC-120 PMB-120	PMC-175 PMB-175	PMC-325 PMB-325	PMC-.75K PMB-.75K	PMC-1.5K PMB-1.5K	PMC-3K PMB-3K	PMC-5K PMB-5K
A	.76	.81	1.72	1.53	1.98	2.06	3.62	5.83	4.37	5.12
B_1	.187	.187	.250	.375	.500	.500	.75	.875	.786	1.181
B_2	.375	.375	.500	.625	.750	.750	1.312	1.500	1.000	1.181
C_1	2.12	2.15	3.82	3.96	4.37	5.15	6.37	10.00	10.04	12.12
C_2	2.93	2.84	4.41	4.64	5.40	5.75	8.12	11.06	9.63	9.87
D	1.75	1.93	2.46	3.62	4.43	5.48	7.25	8.50	12.00	14.00

FRICTION CLUTCHES & BRAKES — FLANGE MOUNTED

LOW COST • HIGH TORQUE • LOW CONTROL POWER • FAST RESPONSE • MIN. EFFECT BY AMBIENTS

SPECIFICATIONS	MODELS						
	FC-25 FB-25	FFC-35 FFB-35	FFC-60 FFB-60	FFC-160 FFB-160	FFC-480 FFB-480	FFC-960 FFB-960	FFC-3.5K FFB-3.5K
TORQUE - RATED OZ. IN.	25	35	60	160	480	960	3500
OUTPUT INERTIA - SLUG FT.²	1.06×10^{-6}	2×10^{-6}	2.8×10^{-5}	5.11×10^{-6}	1.7×10^{-5}	6.56×10^{-5}	5.86×10^{-4}
CONTROL WATTAGE	3	6	3.6	9	10	10	30



FAIL-SAFE BRAKES

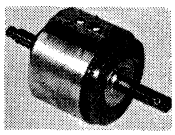
FOR POSITIVE SHAFT BRAKING WHEN POWER FAILS PREVENTS

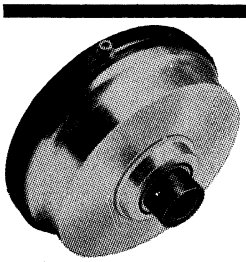
CREEPING • COASTING • HUNTING

Torque Ranges 8 to 7000 oz. in.

CROWN TOOTH CLUTCHES & BRAKES

MAX. TORQUE – MIN. SIZE POSITIVE ENGAGEMENT
LOW CONTROL POWER – FAST RESPONSE



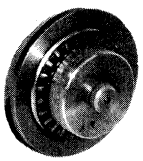


NEW!

ADJUSTA-TORQ CLUTCHES & BRAKES

- CONSTANT REPEATABLE SLIP TORQUE
- LIFE LIMITED ONLY BY BEARINGS
- CAN BE RUN IN OIL

USE AS A TORQUE LIMITING SLIP DEVICE, CLUTCH COUPLING, CONSTANT DRAG BRAKE OR IN TENSIONING APPLICATIONS.



NEW!

PERMANENT MAGNET

TEXTILE TENSION BRAKES

- CONSTANT PRESET TENSION
- MANUAL ADJUSTABLE TORQUE

0-3 OZ. IN. OR 0-10 OZ. IN.

PROVIDE SMOOTH, REPEATABLE TENSION FOR YARN, FIBER AND FINE WIRE

SPECIALS

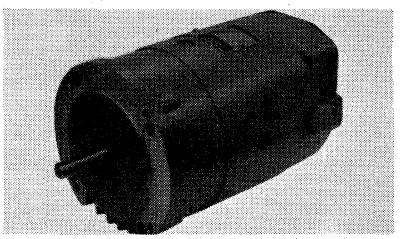
GEMCOR WILL DESIGN NEW UNITS OR MODIFY EXISTING UNITS TO SUIT CUSTOMER'S SPECIAL REQUIREMENTS. THIS SERVICE IS AVAILABLE ON HYSTERESIS, FRICTION AND PERMANENT MAGNET TYPES.

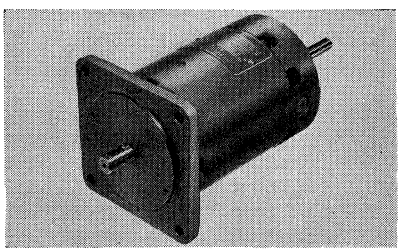
GENERAL ELECTRO-MECHANICAL CORP.
787 HERTEL AVE., BUFFALO, N. Y. 14207
TELEX: 91-222 AREA CODE 716 • 876-9685

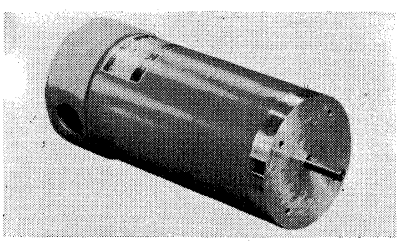
GEMCOR

AC and DC MOTORS AND GEAR-MOTORS

DC Motors







For general duty on variable- or constant-speed applications where the power supply is d-c or where a-c/d-c conversion is used for controlled speeds. Also ideal for reversing applications. Type BC direct-current motors will start, accelerate, and run fractional-horsepower devices smoothly and easily. They are available in open, totally enclosed, explosion-proof, and severe-duty enclosures with solid base, round frame, or end mounting in most ratings. Special-purpose type motors are also available for full- and half-wave rectified power drives. For complete information, write for Bulletin GEA-8264.

Reel-Drive Motors

GE's full line of fhp direct-current motors includes three frame sizes widely used for reel drives: 3.4", 4⅝", and 6⅝" diameters. Special end mountings and shaft extensions meet exacting application requirements. Series, split-series, compound, shunt, and compensated-shunt winding designs offer a broad design choice. Stall torque ratings from 3 to 120 ounce-feet and higher span various application needs, and motor voltage requirements are normally matched to your system design.

New Permanent Magnet Motors

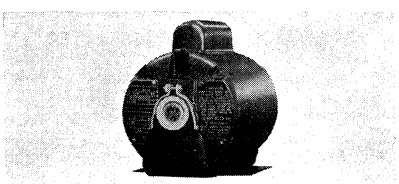
GE's new BPA-34 permanent-magnet motors are smaller and lighter than comparable wound-field motors of the same rating. Permanent magnets replace field windings, eliminating the need for field power supply and the chance of field-winding failure or burnout; and with battery power efficiency is increased, battery drain decreased. Two leads from power supply reduce connect and disconnect time. The motor features double shielded ball bearings and Class B-R insulation system that meets NEMA and USA Standards for Class B, and is recognized by UL for up to 130 C hot spot temperature.

In 3.4-inch-diameter totally enclosed frame, the BPA-34 is available in face, flange, or welded-base design for 115 volts d-c with modifications from 6 volts d-c. Speed-torque is linear, producing a d-c rating of about ⅓ hp at 3450 rpm, ⅕ hp at 1725 rpm, and 1/7 hp at 1140 rpm on a continuous basis.

The BPA-34 is ideally suited for such applications as copy machines, tape reel drives, printers, and filing equipment, and for any other equipment utilizing variable-speed drives or battery power where size and weight are critical.

NEMA 48- and 56-Frame A-c Induction Motors

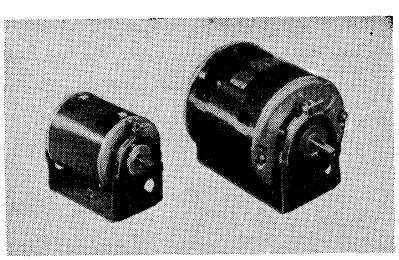
Dependable Form G Motors in Thousands of Variations



Form G a-c induction motors are available in most any electrical type, enclosure, and mounting in a variety of ratings from 1/20 to 5 hp for a complete range of commercial/industrial applications. For complete information write for Bulletin GEC-5000.

Small, Compact, A-c Induction Motors

Provide High Power in a Lightweight Package

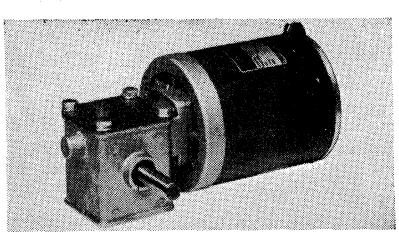


Small in size, but high in reliability, General Electric compact, powerful, a-c induction motors are available in ranges from 25 mhp to ½ horsepower. These reversible motors provide consistent, quiet, long-life operation in any mounting position. Synchronous motors for constant-speed applications are available in 3- and 3⅞-inch diameter models. Special designs can be provided for various torque motor applications such as tape reel drives. For dimensions, features, ratings, and application information, write for Bulletin GEA-8254.

Typical Electronic Applications: Computer memory drums, tape reels, capstans, disc filers, card stackers, card printers, card punchers, and data cells.

Mina-Gear™ Motors

Right-Angle and Parallel-Shaft



A compact, dependable, lightweight line of gear-motors with a flexible range of speeds, ratios, motor types, and frame sizes. Right-angle gear-motors are rated 1/40- to ½-hp with gear ratios of 102:1 to 11:1 with output speeds from 323 to 8 rpm. Parallel-shaft designs are of lightweight construction with aluminum gear housing and motor endshields. Ratings from 15 mhp to ⅙ hp with gear ratios of 195:1 to 4:1 and with output speeds from 417 to 8 rpm in two gear sizes. Mina-Gear motors offer you years of efficient operation, and are ideal for such devices as printing and office machines, medical equipment, door operators, and vending machines, and for many other applications requiring a compact design with relatively high-torque capability. For complete information on right-angle write for Bulletin GEA-7839; for parallel-shaft, Bulletin GEP-466.

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section **998-60**, Schenectady, N. Y. 12345.

GENERAL ELECTRIC

GRAPHALLOY

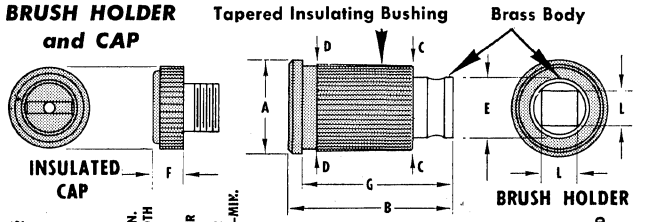
SILVER GRAPHALLOY BRUSHES and BRUSH & SLIP-RING ASSEMBLIES . . .

GRAPHALLOY BRUSHES

are used on such equipment as . . . **SERVO SYSTEMS • SYNCHROS • CHOPPERS • RADAR • GYROS • INVERTERS • THERMOCOUPLE and STRAIN GAGE CIRCUITS • GUIDED MISSILES • PULSE SYSTEMS • DIGITAL COMPUTERS • WAVE GUIDES • SONAR • TRANSDUCERS • TORQUE INDICATORS**

Silver GRAPHALLOY Brushes have been widely used because *of* LOW *and* CONSTANT CONTACT DROP, EXTREMELY LOW ELECTRICAL NOISE *and* LONG LIFE. Over 200 grades are now serving in a wide variety of applications. Silver GRAPHALLOY Brushes on ½"-diameter coin silver slip rings have operated successfully in highly critical electrical circuits at speeds up to 100,000 R.P.M. *Our Engineering Department will assist in determining the exact grade of* GRAPHALLOY *for your needs.* Ask for our Brush Inquiry Form 109.

BRUSH HOLDER and CAP



BRUSH HOLDER & CAP NO.	BRUSH SIZE	SUGGESTED MIN. SLIP-RING WIDTH	**MOUNTING HOLE DIAMETER	BRUSH HOLDER TO SLIP RING—MIN.	A	B OVERALL LENGTH	F	C	D	E	G	L BROACHED HOLE
14326	1/8" sq.	3/16"	13/32"	1/16"	.437"	7/8"	3/16"	.404"	.418"	.281"	25/32"	.129"
11509†	5/32" sq.	1/4"	13/32"	1/16"	.437"	7/8"	3/16"	.404"	.418"	.281"	25/32"	.160"
11570†	3/16" sq.	1/4"	7/16"	1/16"	.484"	7/8"	3/16"	.441"	.451"	.313"	25/32"	.193"
19011†	1/4" x 3/16"	5/16"	9/16"	1/8"	.616"	1 5/16"	3/16"	.561"	.573"	.438"	1 3/16"	.256 x .193"
11527†	1/4" sq.	5/16"	9/16"	1/8"	.616"	1 5/16"	3/16"	.561"	.573"	.438"	1 3/16"	.256"
14292†	3/8" x 1/4"	7/16"	43/64"	1/8"	.718"	1 7/16"	1/4"	.672"	.682"	.533"	1 5/16"	.382 x .256"
12166†	3/8" sq.	7/16"	13/16"	1/8"	.921"	1 13/16"	1/4"	.813"	.828"	.628"	1 5/8"	.382"
31392†	1/2" sq.	9/16"	1 1/8"	1/8"	1.237"	1 13/16"	1/4"	1.126"	1.141"	.878"	1 9/16"	.503"
35439†	3/4" x 1/2"	7/8"	1 33/64"	1/8"	1.661"	2 1/32"	5/16"	1.508"	1.528"	1.253"	1 25/32"	.753"
35440†	3/4" sq.	7/8"	1 33/64"	1/8"	1.661"	2 1/32"	5/16"	1.508"	1.528"	1.253"	1 25/32"	.753"

†Shunts are provided. **Mounting hole diameter for brush holder dimension D.

Request and fill in Brush Inquiry Sheet, Form 109, so that we can supply the proper grade of brush material.

SLIP RINGS Solid Coin Silver

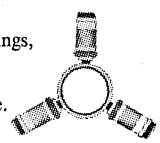
Standard Coin Silver Slip Rings, both *cylindrical* and *flat* types, are illustrated at right. We recommend the cylindrical type rings with three brushes per ring . . . spaced at 120°. The cylindrical type are designed for press fitting over standard steel shafting. The flat type rings are designed for nesting either on an insulated plate or for molding into insulation. Insulated slip rings of either type or slip-ring assemblies can be furnished with leads attached.

No. 168 Series flat type **to 20" O.D.**

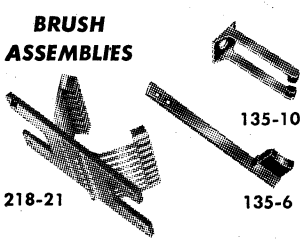
Standard "Flat" rings have ¼" radial contact surface and ⅛" radial spacing between adjacent rings.

No. 116 Series cylindrical type **to 36" O.D.**

Copper Slip Rings, flat or cylindrical, are available.



BRUSH ASSEMBLIES



CONTACTS

GRAPHALLOY, because of its inherent non-welding and arc-quenching characteristics, is used widely for contacts. Ask for Data Sheet 950.

BUSHINGS, Oil-free

Replace oil-lubricated bushings in synchros, instruments, timers and missiles.

Advantages: 1) Lower friction at room temperatures. 2) No oil to solidify at low temperatures. 3) No oil to carbonize at prolonged elevated temperatures.

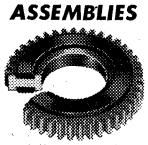
*Ask for Data Sheets 270 and 277 on Miniature Bronze-*GRAPHALLOY *Bushings.*

CONNECTORS

These silver-plated coil spring Connectors make for positive electrical connection to the brass body of the brush holder by snapping into the groove on the holder. The connecting lead can be pre-soldered to the Connector.

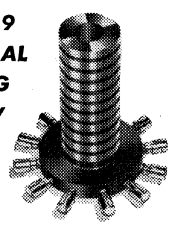
GARTER SPRING CONNECTORS	BRUSH SIZE	BRUSH HOLDER NO.
127-9	1/8" sq.	14326
127-9	5/32" sq.	11509
127-10	3/16" sq.	11570
127-14	1/4" x 3/16"	19011
127-14	1/4" sq.	11527
127-18	3/8" x 1/4"	14292
127-20	3/8" sq.	12166
127-24	1/2" sq.	31392
127-32	3/4" x 1/2"	35439
127-32	3/4" sq.	35440

CLUTCH FACINGS and CLUTCH GEAR ASSEMBLIES



Torque remains same within close operating limits despite changes in temperature and humidity. For instrumentation, guided missiles, constant friction devices.

Model 319 CYLINDRICAL SLIP-RING assembly

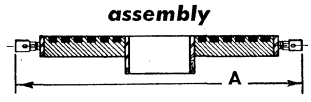


Solid Coin Silver Rings

MODEL	RINGS	LENGTH
319-4	4	2 9/16"
319-6	6	3 5/16"
319-10	10	4 13/16"
319-14	14	6 5/16"

O.D. Slip-ring 1⅝" Terminal 4" Assembly I.D.: .814"/.813" Range: Same as for Model 399

Model 409 FLAT SLIP-RING assembly



Solid Coin Silver Rings

MODEL	RINGS	OVERALL O.D.—"A"
409-2	2	5½"
409-4	4	7"
409-6	6	8½"
409-10	10	11½"

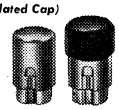
Hub: O.D. 2" I.D. 1.753"/1.751" Length 1⅛" To 5 amps., 125 v. More rings on application.

SPRING BINDING POSTS

(with or without Insulated Cap)

O.D.: ⅜", ½", 17/32" Lgth.: ⅝", ¾", 25/32"

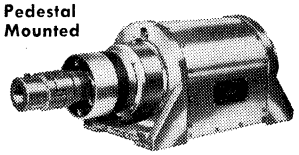
Also Miniature Spring Type!



19185 *22978*

Model 399 BRUSH and SLIP-RING assembly

Pedestal Mounted



MODEL	RINGS	bolt slot distances CL to CL WIDTH	bolt slot distances CL to CL LENGTH	**OVERALL LENGTH
399-4	4	4½"	7¾"	13¼"
399-6	6	4½"	8½"	14"
399-10	10	4½"	10"	16"
399-14	14	4½"	11½"	18"

Specifications: Width 6½"—Height 6½".Shaft CL above base 3¼".
Applications: from strain gage or thermocouple up to 5 amperes, 125 volts, 250°F.
Speeds to 5,000 RPM.
Three Silver-GRAPHALLOY Brushes per solid coin silver slip ring.
Extraneous noise level low.
Rugged in design and construction.
Readily connected mechanically and electrically.
Complete coupling provided for 13/16" shaft.
More rings and higher speeds available upon application.

Write for data sheets

CALL ON OUR OVER 50 YEARS OF DESIGN EXPERIENCE FOR HELP IN SOLVING YOUR BRUSH PROBLEMS!

GRAPHITE METALLIZING CORPORATION : 1036 NEPPERHAN AVENUE YONKERS, NEW YORK 10702

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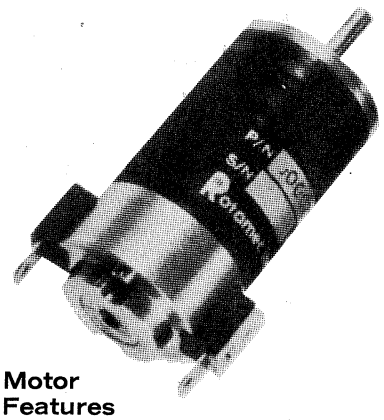
(918) 663-0110 • TWX 910-845-2129

PMDC MOTORS

Series 9 — 0.9 PMDC Gearmotors



The Rotamec line of 0.9 PMDC Instrument Gearmotors is comprised of the standard, field-proved line of .9 motors in combination with Rotamec's comprehensive family of gearheads.

All **Motors** feature 7-bar commutation, shielded field type magnets, life-lubricated ball or sintered bronze bearings, stainless steel shaft and end bells, black oxide treated housing, and armatures with fungus resistant varnish applied under vacuum impregnation. Minimum axial and radial shaft end play is standard.

Gearheads feature output torques to 500 in.-oz., stainless steel shafts and end bells, planetary gears, and four standard mounting configurations.

Optional extras include mil spec filters, special shaft and mounting configurations, and very low rollover voltage characteristics, as well as special electrical and mechanical designs.

All gearmotors are designed to meet the requirements of MIL-M-8609B. RFI filters for conformance with MIL standard can be provided on order.

Motor Features

SIZE: .9″ diameter. See dimension table.

POWER: 1/250 hp continuous duty at 8,000 to 18,500 rpm. Higher speeds are available at reduced life levels.

PROTECTION: Black oxide. Housing: treatment conforms to Mil-C-13924A. Armature: Fungus resistant varnish applied under vacuum impregnation.

MAGNETS: Shielded field construction.

BEARINGS: Ball bearings. Standard lubricant conforms to Mil-G-3278A, or sintered Bronze Bearings.

ARMATURE: Inertia: 3.8 gm. cm², seven bar commutation, low ripple.

BRUSHES: Selected to suit application. Available for the simplest to the most demanding jobs from undersea to rarified atmosphere conditions.

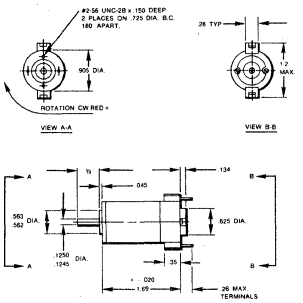
SHAFT: 416 Condition H Stainless Steel.

END BELL: Stainless Steel.

ELECTRICAL CONNECTIONS: Solder Terminals.

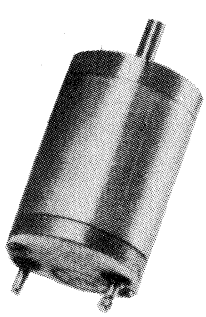
REVERSIBILITY: Rotation reverses when input polarity is reversed.

MOUNTING: Tapped holes in front end bell. See drawing.



SIZE 9 PMDC MOTOR

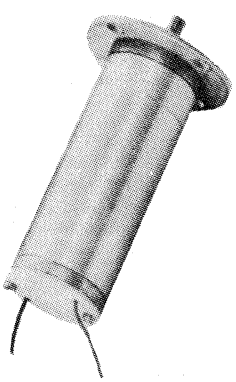
Super PMDC Motors



The Super ⅞ (Type 917) and 1¼ (Type 810) subfractional horsepower PMDC motors are equivalent in torque and output to many standard 1¼ and 1½ motors now available. The major advantages of these units are the savings in weight, space, and power consumption. In addition, for most applications they are considerably more economical than equivalent larger motors.

Designed for long life in both military and commercial applications, they feature rugged design, sturdy construction, and reliable performance. Seven bar commutation and stabilized high energy magnet insure smooth operation with a minimum of cogging.

⅞ PMDC Gearmotors

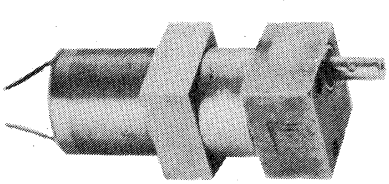


The Rotamec line of ⅞ PMDC Instrument Gearmotors is comprised of the standard, field-proved line of ⅞ motors in combination with Rotamec's comprehensive family of gearheads.

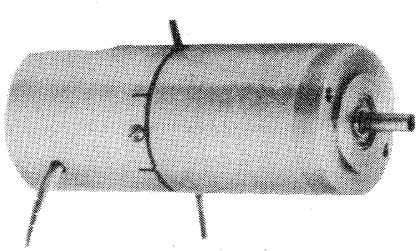
All **motors** feature 7-bar commutation, stabilized high-energy magnets, double shielded, life-lubricated ball bearings, stainless steel shaft and end bells, iridite treated housing, and armatures with fungus resistant varnish applied under vacuum impregnation. Minimum axial and radial shaft end play is standard.

Gearheads and options please consult the factory.

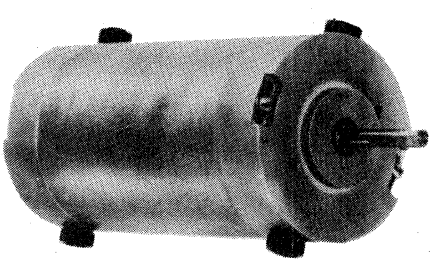
Size 9 Square PMDC Gearmotors



⅞ Dia PMDC Motor and A.C. Tachometer

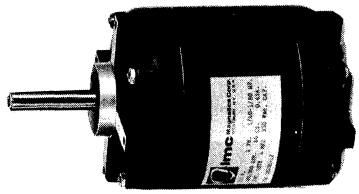


Size 30 PMDC Motor and Tachomeetr



Shown here are only a few of the complete line of PMDC motors available from Hathaway. Many other types, including military and commercial versions are available. Our engineering and production departments are staffed to supply special motors to suit your specific requirements.

FHP motors from IMC Magnetics Corp. Eastern Division... Precision, power, performance.



Whatever your motor requirements, chances are IMC Eastern Division has a pre-engineered design to meet them. If not, we will custom engineer to your exact specifications.

IMC offers a complete range of motor types, sizes and performance characteristics.

Hysteresis synchronous, polarized and reluctance synchronous, induction, torque, and servo motors. 50, 60 400, 800 and 1000 Hz, multi-Hz and variable frequency types. Standard voltages from 13 to 230 V, single, 2 and 3-phase. Models include totally enclosed and open frame designs with or without internal cooling. Base, face, flange and servo mountings. Shafts offset, double-ended, with slots, keyways, tapers, etc. at customer option.

The tables below provide a few typical examples of IMC Eastern Division motor capability. For additional data on these designs, information on your individual requirements, or application engineering assistance, contact us at **IMC Magnetics Corp., Eastern Division, 570 Main St., Westbury, New York 11590. Tel. (516) 334-7070, TWX 510-222-4469.**

imc

INDUCTION

Motor No. Size	Type	Voltage (VAC)	Frequency (Hz)	Current (A)	Rated Torque (oz-in)	Speed (rpm)	Poles (No.)	H.P. Rated	Power Input (Watts)	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BC905	804	115	400	.075	.18	18000	2	1/350	8	.937	1.178
BC1307	1330	115	400	.16	1.0	10500	4	1/90	17	1.500	1.468
BT1310	1972	200	400	.07	.25	20000	2	1/200	10	1.500	1.768
BC1507	520	115	60	.06	.10	3000	2	1/3000	6.5	1.700	1.703
BC1511	338	115	60	.095	.90	1400	4	1/800	12	1.700	2.103
FBC1615	101	115	400	.70	3.8	8500	4	1/30	75	2.000	3.000
BC2210	1246	115	60	.31	5.0	3300	2	1/60	35	2.750	2.437
BC2210	1382	115	60	.45	7.5	3300	2	1/40	44	2.750	2.437
BC2305	2151	115	60	.065	0.75	1200	4	1/1100	7	2.500	1.500
BC2910	2030	115	60	.28	9.0	1600	4	1/70	30	3.312	3.187
FBC2922	507	115	400	2.6	28.5	7000	6	1/5	300	3.312	5.312
FBC3815	1392	220	60	1.4	64.0	2600	2	1/6	300	4.375	5.718
FBT4525	1635	208	60	4.5	375.0	3400	2	1-1/4	1400	5.375	7.062
FBT4530	1095	208	400	12.0	510.0	5800	8	3	2700	5.375	7.281
FBT4625	1820	208	60	5.0	500.0	3400	2	1.7	1600	5.375	7.062

HYSTERESIS & RELUCTANCE SYNCHRONOUS

Motor No. Size	Type	Volts (V)	Frequency (Hz)	Current (Amps)	Rated Torque (oz-in)	Start Torque (oz-in)	Speed (rpm)	Poles (No.)	H. P. Rated	Input Power (Watts)	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BC703H	1787	26	400	.27	.025	.022	24000	2	1/1700	6.9	0.750	0.865
BC905H	1032	26	400	.210	.070	.10	8000	6	1/1800	4.7	0.937	1.178
BC100TH	1316	26	400	.23	.055	.027	8000	6	1/2270	4.7	1.062	1.375
BT1210H	1272	26	60	.28	.38	.59	3600	2	1/730	10.0	1.300	1.707
BC130TH	4.9	115	400	.11	.36	.360	12000	4	1/230	11.0	1.500	1.468
BC1404H	1549	115	400	.05	.16	.11	8000	6	1/780	5.7	1.437	1.363
BC1510H	1954	115	400	.21	.40	.45	8000	6	1/300	15.0	1.700	2.003
FBC1610H	1832	115	400	.24	.90	.6	6000	8	1/350	26.0	2.000	2.500
FBC1615H	633	115	400	1.20	1.9	2.3	12000	4	1/44	98.0	2.000	3.000
BC230TH	1900	115	60	.25	1.5	3.0	3600	2	1/180	28.0	2.500	1.750
FBC2922H	2049	115	60	1.8	35.0	44.0	1800	4	1/16	150.0	3.312	5.312
FBC3825H	2095	115	50	1.9	60.0	86.0	1500	4	1/11	160.0	4.375	6.718
FBC3830H	749	115	60	2.41	74.0	72.0	1800	4	1/8	214.0	4.375	7.218
FBC4530H	2147	115	60	2.8	100.0	150.0	1200	6	1/8	210.0	5.375	7.562
FBT4545H	1691	208	60	3.6	180.0	432.0	1800	4	1/3	430.0	5.375	9.062

TORQUE

Motor No. Size	Type	Volts (V)	Frequency (Hz)	Stall Current (Amps)	Stall Torque (oz-in)	No Load Speed (rpm)	Poles (No.)	Stall Watts	No Load Watts	Duty Cycle Class H%	Dimensions (Typ.) (inches) Housing O.D.	Housing length
BT703T	903	18/18	400	.12/.12	.15	6300	6	1.6/1.7	1.3/1.4	cont.	0.750	0.765
BT707T	948	115/33	400	.05/.14	.26	5900	6	3.4/3.0	3.0/2.5	cont.	0.750	1.165
BC907T	1835	115	400	.05	.27	7000	6	5.0	3.6	cont.	1.000	1.496
BT1005T	1687	115/36	400	.05/.16	.66	6200	6	3.4/3.5	1.6/1.5	cont.	1.062	1.175
BT1210T	1273	26	60	.35	1.9	3300	2	15.0	7.9	50	1.300	1.707
BC1307T	162	115	400	.17	1.25	5000	8	19.0	18.0	40	1.500	1.468
BC1311T	330	115	400	.45	3.8	5500	8	60.0	60.0	15	1.500	1.868
BT1406T	599	24/24	60	.24/.24	1.7	1600	4	4.6/4.4	4.7/4.5	cont.	1.437	1.563
BC1507T	96	115	60	.105	2.7	1650	4	12.5	13.0	cont.	1.700	1.703
BC1511T	338	115	60	.088	2.6	1600	4	10.7	10.5	cont.	1.700	2.103
BC1615T	347	115	400	1.4	9.0	10000	4	140.0	92.0	12	1.750	2.703
BT1615T	629	200	400	1.26	19.0	7300	6	290.0	64.0	7	1.750	2.703
BC2210T	1197	24	60	0.67	3.4	725	8	16.0	15.0	cont.	2.750	2.437
BC2929T	440	115	60	1.36	72.0	1100	6	145.0	120.0	30	3.312	5.125
FBC3825T	1208	115	60	1.3	110.0	830	8	142.0	100.0	55	4.375	6.718
FBC3830T	881	115	50	1.8	156.0	900	6	204.0	140.0	40	4.375	7.218
BC4520T	1718	115	60	2.7	250.0	810	8	305.0	220.0	35	5.375	6.562
BC4530T	1777	115	50	4.0	320.0	900	6	370.0	255.0	30	5.375	7.562

ALPHA MAX-LOW INERTIA DC SERVO MOTOR

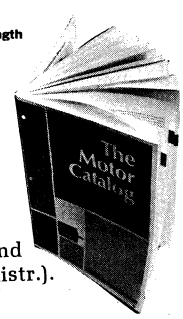
Available with integrally mounted incremental encoder or DC tachometer. Also with forced air internal cooling.

Motor No. Size	Torque Constant (oz-in/Amp.)	Armature Inertia (oz-in-sec²)	Armature Inductance (microhenries)	Rated Power Output (Watts)	Terminal Resistance (Ohms)	Dimensions Housing O.D. (inches)	Housing length (inches)
IM4000	6.0	.00039	< 100	92	0.9	3.980	3.46

SERVO MOTORS

Motor-generators, motor-tachometers in BuOrd sizes 5-18. All available with precision gearheads.

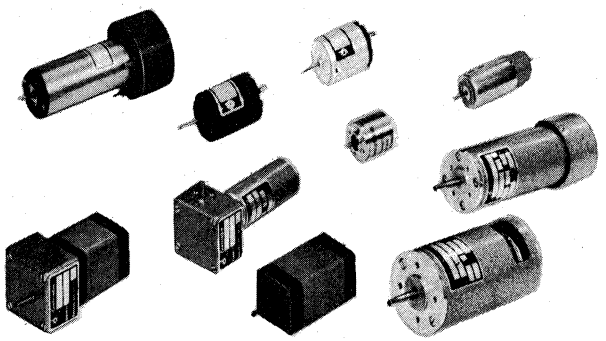
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)



Our Driver Manual.
It's your license to control all driving situations, free for the asking.
100 pages of detailed motor specifications, comprehensive theory and applications information (ref. cat. #EMistr.). From IMC Eastern Division.

ITT JENNINGS MOTORS

INDUSTRIAL PRODUCTS
970 McLAUGHLIN AVENUE, SAN JOSE, CALIFORNIA 95116
PHONE: (408) 292-4025 TWX: 910-338-0159, TELEX: 34-6311
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)



Precision miniature motors and miniature geared motors of the "Dunkermotoren" range offer an answer to almost every drive problem.

High performance battery motors (series GK) as d.c. motors with permanent magnet field and iron-free rotor (patented). Their high degree of efficiency makes these motors especially suitable for battery driven equipment.

Battery motors (series GVE) for normal requirements are d.c. motors with permanent ring magnet and iron armature with 8 coils.

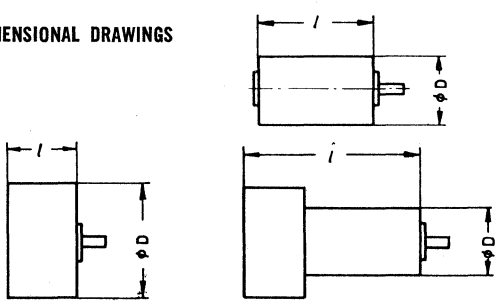
D.C. motors (series GR) are constructed as iron armature units with permanent magnet field, having a shunt characteristic and a high efficiency. They are successfully employed where varying speeds and high starting torques are desired. These motors can be speed controlled by varying the supply voltage (contact-free by use of a.c. or d.c. tachogenerators).

All d.c. miniature motors are available as production models with various gear designs:

1. Spur gears in enclosed cylindrical housings with central drive (ZGR)
2. Spur gears in enclosed rectangular housings (ZG)
3. Spur gears in open rectangular housings (PZG)
4. Worm gears in enclosed rectangular housings (SG), also with angle drive.

The reduction ratios cover a wide range with precise staging.

DIMENSIONAL DRAWINGS



DC GEARED MOTORS

Technical Data Gear Type	Motor	Dimensions (mm) D or □	l	Max. Continuous Torque (kgcm)	Reduction Ratios
ZGR18	GK16	18	45	0,800	5..... 488:1
ZGR22	GK22	22	60	0,500	4,5.....2,000:1
ZGR32	GK26	32	87	3	6.....3,000:1
ZGR32	GK32	32	105	3	6.....3,000:1
ZGR32	GK32	32	95/110	3	6.....3,000:1
ZGR42	GR42	42	110.....140	7	4,5.....4,000:1
ZGR52	GR52	52	125.....170	10	4,5.....4,000:1
ZG30	GK22	30□	62	3	10.....10,000:1
ZG30	GK26	30□	82,5	3	10.....10,000:1
ZG30	GR21	30□	67,5/82,5	3	10.....10,000:1
ZG30	GR26	30□	76/91	3	10.....10,000:1
ZG40	GK26	40□	87	5	5.....10,000:1
ZG40	GK32	40□	105	5	5.....10,000:1
ZG40	GR26	40□	81/96	5	5.....10,000:1
ZG50	GK32	50□	115	10	5.....10,000:1
ZG50	GK32	50□	105.....135	10	5.....10,000:1
ZG50	GR42	50□	105.....135	10	5.....10,000:1
ZG60	GR52	60□	120.....165	15	5....100,000:1
SG40	GK26	40□	87	5	10.....3,600:1
SG40	GK32	40□	105	5	10.....3,600:1
SG40	GR26	40□	81/96	5	10.....3,600:1
SG50	GK32	50□	115	10	10.....75,000:1
SG50	GR32	50□	100.....135	8....10	10.....75,000:1
SG50	GR42	50□	100.....135	8....10	10.....75,000:1
SG60	GR52	60□	110.....165	10....15	10.....75,000:1
PZG32	GK22	32□	62	3	6.....3,000:1
PZG32	GK26	32□	82	3	6.....3,000:1
PZG32	GR21	32□	67/82	3	6.....3,000:1
PZG32	GR26	32□	76/91	3	6.....3,000:1
PZG42	GK22	42□	58	4	6.....1,000:1
PZG42	GK26	42□	78	4	3.....1,000:1
PZG42	GK32	42□	96	4	3.....1,000:1
PZG42	GR21	42□	63/78	4	3.....1,000:1
PZG42	GR26	42□	72/87	4	3.....1,000:1
PZG42	GR32	42□	86/116	4	3.....1,000:1

DC MOTORS WITH SPEED CONTROL*

Technical Data Type	GK22TG2	GK32TG11	GK32TG5	GK32TG6
Dimensions in mm				
Overall length l	52	115	103	33
Motor diameter D	22	32	32	—
Tacho-generator diameter D	—	—	52	54
Weight (g)	62	310	320	180
Pole pairs	10	—	12	12
D.C. resistance of tacho-generator (Ω)	600	130	1700	1700
Induced voltage (mV/min)	0,8	3	10	10
Dimensional drawing	2	2	2	3

* Speed control available by centrifugal governors, or by a.c. or d.c. tacho-generators.

BATTERY MOTORS FOR GENERAL APPLICATIONS

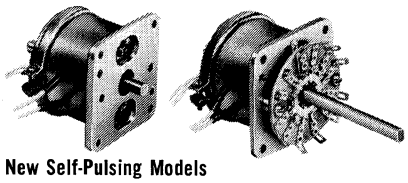
Technical Data Type	GK16	GK22	GK26	GK32	GVE30 X10	GVE30 X16	GVE30 X20	GVE30 X25
Dimensions in mm								
Overall length l	29	37	57	75	41	47	51	56
Motor Diameter D	16	22	26	32	30	30	30	30
Weight (g)	21	51	120	200	64	90	104	120
Voltage Range (V)	1,5....6	3....24	3....27	6....60	3—24	3—24	3—24	3—24
Rated Speed (rev/min)	—	—	—	—	6,000	6,000	6,000	6,000
Torque (pcm)	11,5	37	85	170	55	90	110	130
Max. No-Load Speed (rev/min)	12,000	12,000	12,000	15,000	10,000	10,000	10,000	10,000

HIGH PERFORMANCE BATTERY MOTORS

Technical Data Type	GR18		GR21		GR26		GR32			GR42			GR52	
Dimensions in mm														
Overall Length l	26	41	42	57	51	66	65	80	95	65	80	95	70	116
Motor Diameter D	18	18	21	21	26	26	32	32	32	42	42	42	52	52
Weight (g)	24	38	60	90	90	140	135	195	250	250	375	500	400	900
Voltage Range (V)	3....18	3....18	9,12,24	12,24	12,24	12,24	12,24	24,36	24,60	24,36	24,60	24,110	24,60	24,60,220
Speed (rev/min)	3,000	3,000	3,000	3,000	3,000	3,000	—	3,000	—	—	3,000	—	3,000	3,000
Torque (pcm)	8	20	12	23	27	43	37	95	150	65	100	170	140	650
Max. No-Load Speed	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000

STEPPING MOTORS, SERIES 50

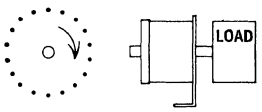
torque to 246 ounce inches



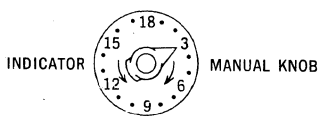
New Self-Pulsing Models

New Series 50/12S, 12-position, step motor has built-in pulsing contacts, so you simply apply DC voltage to make it step. Self-pulsing model is also available with notch control deck and flatted shaft extension. Add switch decks and you have a combination power positioner and self homing stepping switch. Details in Catalog D-7001.

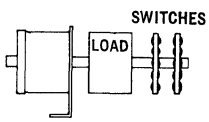
With a **unidirectional** Series 50 you can . . .



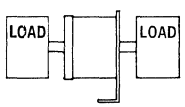
drive your load remotely through a series of short steps and stop at any one of 10, 12, 18, 24, or 36 positions.



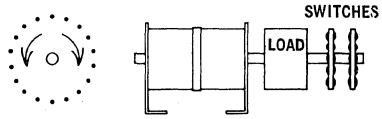
or add a knob for manual reset in either direction . . .



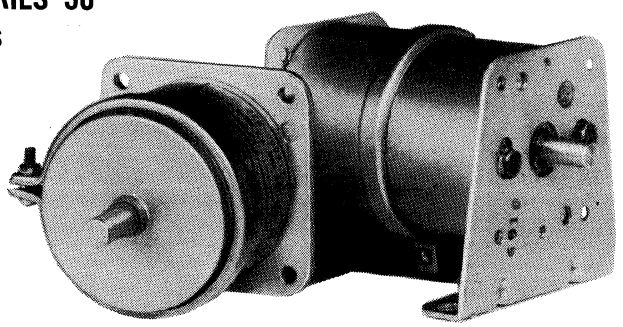
or add rotary switches for a combination power positioning drive and a step or program switch



or use shaft extensions on each end to direct-couple two loads and drive them in the same direction at the same time.

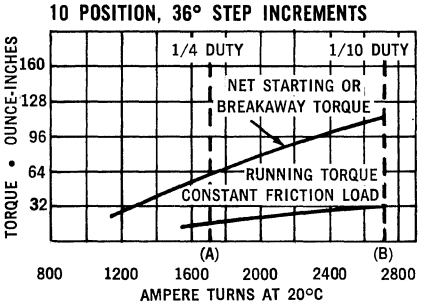


With a **bidirectional** Series 50 you can do all **this** . . . plus **remotely position** loads CW or CCW.

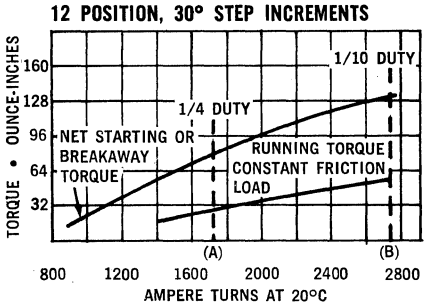


51 stock models for quick prototype starts

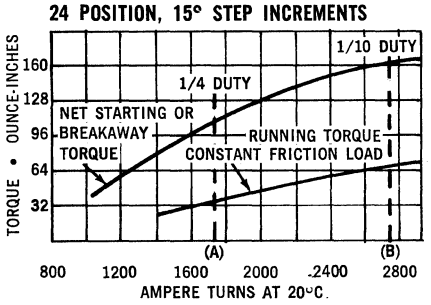
10 POSITION, 36° STEP INCREMENTS



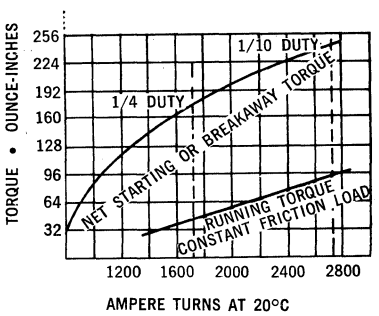
12 POSITION, 30° STEP INCREMENTS



18 POSITION, 20° STEP INCREMENTS
24 POSITION, 15° STEP INCREMENTS



36 POSITION, 10° STEP INCREMENTS



Top curve in each graph shows net starting or breakaway torque, typical when friction component of load is high in beginning — as in driving a valve. **Lower** curve applies when friction load is consistent throughout stroke. Dotted lines "A" show output at 1/4 duty, 84 watts; dotted lines "B" 1/10 duty at 210 watts.

Highlights	Unidirectional	Bidirectional
Voltage	6 to 220 VDC	6 to 220 VDC
Length	1.9″	2.5″
Width	2 1/16″ (Dia.)	2.5″
Height	2 1/8″ (Sq. plate)	2 13/32
Weight	14 oz.	24 oz.
Price, 1-9	$23-$24	$37-$39
Price, 1000 up	$10-$12	$16-$18

All working parts are completely enclosed. Minimum life is 3 million steps. For bidirectional, 3 million in each direction. And, the Series 50 works on simple square wave input pulses . . . so you don't need expensive logic circuitry. Ledex Series 50 stepping motors are engineered for high torque-to-size, uniform stepping accuracy, construction simplicity and economy.

Newly developed tooth clutch drive gives positive grip stepping action (no slip) and doubles as a built-in electromechanical clutch brake to eliminate the natural tendency of overdriving at the end of a step.

Catalog D-7000 lists complete details on 51 stock models, performance data and engineering considerations.

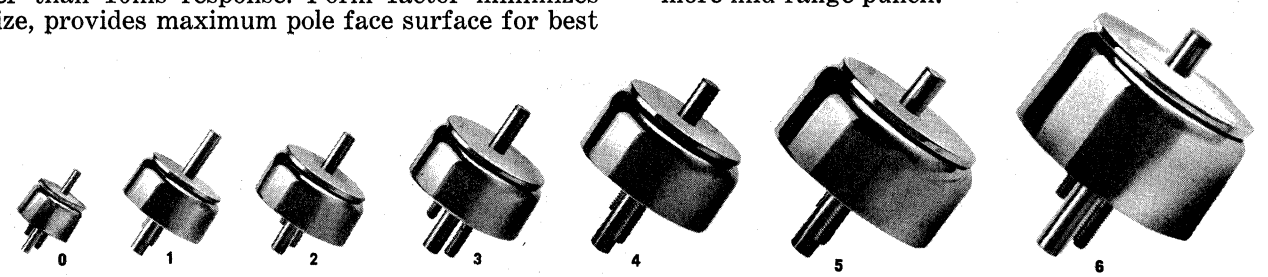
LEDEX INC., 126 WEBSTER STREET, DAYTON, OHIO 45401
phone (513) 224-9891
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

LEDEX

PUSH & PULL SOLENOIDS

You name the job.
Short, medium or long stroke. High speed.
Tight space. Unusual load. Ledex has the solenoid for you, usually on the shelf. Expert design assistance for your toughest custom requirements.

Pancake shaped Ledex push/pull solenoids are built for high force to size and fast response. Better than 10ms response. Form factor minimizes size, provides maximum pole face surface for best efficiency. Two types available. Flat face is for short stroke, rapid response. Conical face gives more mid-range punch.

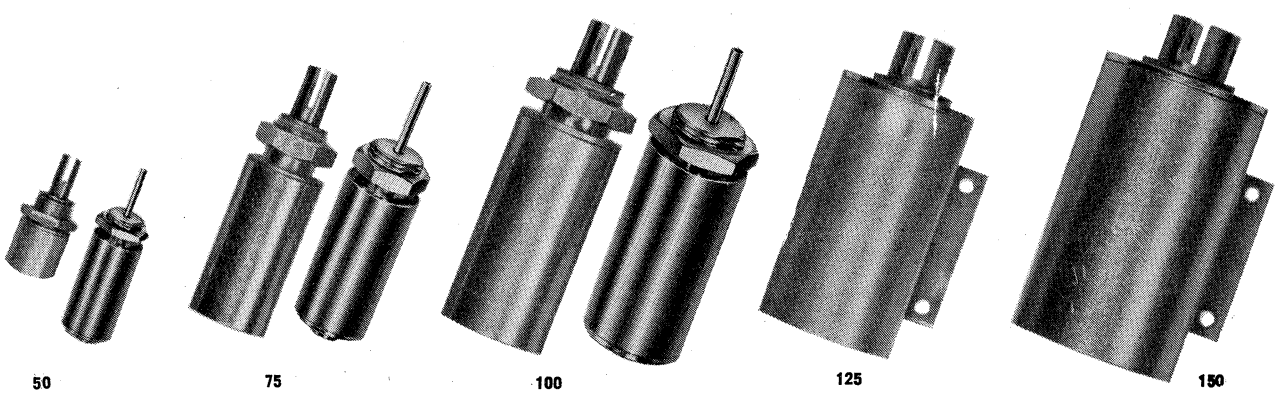


TYPICAL OUTPUT, 1/10 DUTY

Model	0		1		2		3		4		5		6	
Size	.75″D x ½″		1″D x 17/32″		1.2″D x 27/64″		1.3″D x 11/16″		1.6″D x 55/64″		1.9″D x 1¾4″		2.3″D x 1 23/64″	
	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face	Conical Face	Flat Face
Stroke (In.)	.020	—	.020	.010	.020	.010	.020	.010	.020	.010	.020	.010	.020	—
Force (Lbs.)	4.4	—	7.8	17	11	23	16	35	17	55	35	110	85	—
Stroke (In.)	.120	—	.120	.060	.120	.060	.120	.060	.200	.100	.250	.100	.250	—
Force (Lbs.)	1	—	2.4	3.3	3.3	4.5	8	10	6	12	16	20	52	—
Weight	1½ oz.		1½ oz.		2¼ oz.		3¾ oz.		6 oz.		10 oz.		1 lb. 5½ oz.	

(For detail performance curves, ask for Catalog C-1100)

Quality engineered for efficiency and long term dependability, the Ledex long stroke solenoid has a built-in impact cushion pad to absorb energy at the end of the power stroke. For smooth travel and long wear, the solenoid plunger is electroless nickel plated. It rides in a smooth bushing track designed for positive alignment and low friction. Slotted and cross drilled plungers on all stock models simplify load attachment. Off-the-shelf models available for 12, 28 and 100 VDC operations.



TYPICAL OUTPUT 1/10 DUTY

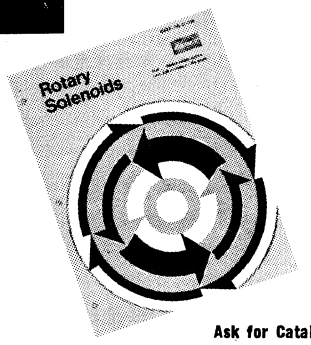
Model	Size 50		Size 75	Size 100	Size 125	Size 150
Size	½″D x ½″	½″D x 1″	¾″D x 1½″	1″D x 2″	1¼″D x 2¼″	1½″ x 2½″
Force, .050 Stroke	4.5 oz.	15 oz.	3 lbs.	7 lbs.	11.5 lbs.	16.5 lbs.
Force, .750 Stroke	—	—	.6 lbs.	2 lbs.	4 lbs.	7 lbs.
Shaft Diameter, pull	.187″	.187″	.312″	.437″	.500″	.625″
Shaft Diameter, push	.062″	.062″	.094″	.125″	—	—
Mounting	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Thr'd Bushing	Saddle	Saddle
Weight	14 grams	24 grams	3 oz.	6¾ oz.	9 oz.	1 lb. ½ oz.

When it comes to actuating, Ledex has both the people and products to give you the quickest and best solution. There's a wide choice of stock models for a fast start on your prototype. And our expert application staff is always glad to custom engineer to your exact stroke, force, speed and size requirements. Other models (not shown) are available on made-to-order basis with force outputs in excess of 350 pounds. Ask for Catalog C-1100.

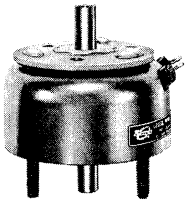
LEDEX

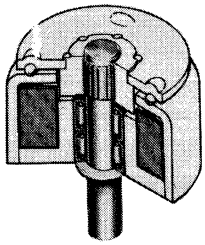
LEDEX INC., 126 WEBSTER STREET, DAYTON, OHIO 45401
phone (513) 224-9891
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

ROTARY SOLENOIDS



Ask for Catalog C-1000





230 stock models for quick prototype starts
Fast, direct rotary action

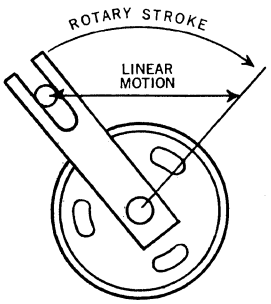
Ledex Rotary Solenoids step, turn, pull, push, index, hammer, punch or trigger — whenever there's a need for fast and dependable direct rotary action. Known for high force-to-size, ability to resist shock. Family of 8 basic sizes with right and left hand strokes from 25 to 95 degrees. Torque to 117 pound-inches. Wide choice of stock models offer economy and quick starts on prototypes. LIFE: 100,000,000 actuations with special endurance engineered models.

GROSS TORQUE IN POUND-INCHES

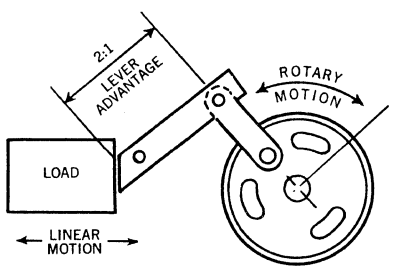
	Rotary Stroke		25°		35°		45°		67½°		95°	
	Duty Cycle		1/10	1/20	1/10	1/20	1/10	1/20	1/10	1/20	1/10	1/20
Size	Diam. (in.)	Ht. (in.)										
1E	1	5/8	.8	1.1			.43	.62				
2E	1 1/8	21/32	1.4	1.7	1.1	1.3	.72	.89				
3B*	1 5/16	7/8	2.7	3.2	2.0	2.3	1.4	1.7	.65	.8		
3E		51/64	2.7	3.2	2.0	2.3	1.44	1.8	.70	.89		
4E	1 9/16	61/64	4.5	5.2	3.1	3.5	2.6	3.1	1.6	1.9	1.0	1.2
5B*	1 7/8	1 13/64	8.3	10.0	6.9	8.3	5.0	6.0	3.3	4.0	1.6	1.9
5S		1 3/64	12.1	13.2	7.8	9.2	6.3	6.9	3.9	4.9	1.9	2.6
6S	2 1/4	1 27/64	27.8	30.6	18.6	20.5	11.0	12.1	8.8	9.7	5.2	5.7
7S	2 3/4	1 55/64	42.4	46.6	38.0	42.0	29.8	32.8	17.5	19.3	10.5	11.6
8S	3 3/8	2 5/16	98.0	117	64.0	77.0	54.0	65.0	29.0	35.0	17.0	20.0

* 3B and 5B have random wound coils; all other are precision wound.

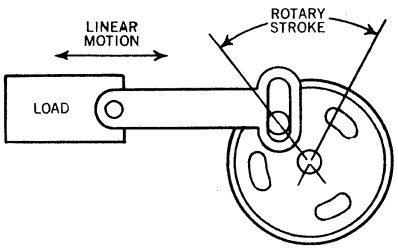
Rotary Solenoid as a Linear Actuator



SHAFT BAR LINK



ARMATURE LEVER



ARMATURE DRIVE PIN

When the stroke length is beyond the range of Ledex straight pull solenoids, a rotary solenoid may be the best solution.

Ledex rotary solenoids have raceways coined in the armature and stator. With precision ball bearings riding on inclined raceways, the solenoid provides direct, almost friction-free rotary motion. In the beginning of the stroke, where the output of a linear solenoid is low, the raceways are steep. Toward the closed end, where the magnetic attraction reaches maximum force, the raceways taper off. The effect is to evenly distribute the force.

Ledex solenoids can help you get a lot of work done in places where you don't have much room. We make both push/pull and rotary solenoids in a wide variety of shapes and sizes to solve just about any actuating problem you have.

Call Ledex when you need a lot of power in a small space to push, pull, turn, twist, step, index, hammer, punch or trigger. For a quick start on your prototype, choose from 230 different stock model designs. Or, send details and we'll custom design a space-saving solenoid for you.

LEDEX INC., 126 WEBSTER STREET, DAYTON, OHIO 45401
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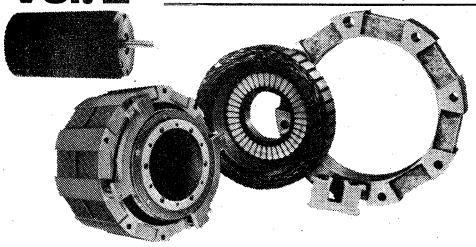


Magnedyne DC TORQUE MOTORS

for accurate, high torque positioning and speed control

2 types to choose from

Standard – Low cost units. Reliable varnished construction. Axially displaced commutator for easy installation. Cartridge-type brushes.

High-Performance – High torque in smaller, lighter motors. Special encapsulated, wrap-around commutator construction.

Advantages

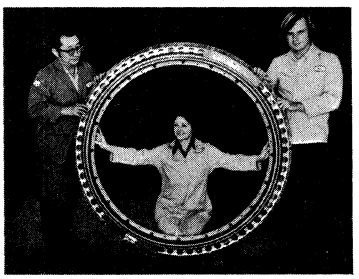
High Efficiency – High energy, permanent magnets in a unique field structure and an efficient, multi-pole armature produce high torque-to-power and torque-to-weight ratios.

Torque Applied Directly To Load – Wrap-around rotor mounts directly to, or around shafts; eliminates gear trains and backlash problems.

Housed or frameless models available for integration into customer's equipment.

Top source for big thin-ring motors

DC torquer up to 58" OD, 45" ID. Rated to 3000 ft-lbs.



Wide Application

- Position and velocity servo systems
- Antenna drives
- Missile and aircraft flight control actuators
- Memory drives
- Rate-of-turn tables
- Inertial navigation platforms
- Control moment gyros
- Rocket motor thrust vectoring systems
- Precision tape recorders
- Film drives
- Machine tool controls
- Throttle control actuators
- Linear and rotary servo actuators

Low Inertia Motors

For computer tape drives, high-speed printers, wherever high acceleration, low torsional resonance required. Intermediate and high performance models.

DC tachometers for every job

Extra low ripple, high-output tachs from 2" OD to 9.375" OD for big precision jobs. Low-cost units for machine tool control.

DC TORQUE MOTORS – VARNISHED

MODEL	Peak Torque (oz.-in.)	Power @ Peak Torque (watts)	No-Load Speed (rad./sec.)	OD (in.)	ID (in.)	Width (in.)	Weight (oz.)	Inertia (oz-in-sec^2)
443-11	30	80	360	1.937	.500	1.500	5.5	.0015
443-12	60	110	245	1.937	.500	1.875	9.2	.0025
443-13	90	145	215	1.937	.500	2.250	13.0	.0035
443-14	120	170	190	1.937	.500	2.625	16.5	.0045
402-06	100	92	125	3.070	.427	1.750	25	.011
402-05	200	125	84	3.070	.427	2.450	45	.02
402-14	300	155	69	3.070	.427	3.150	65	.029
402-15	400	190	64	3.070	.427	3.850	85	.038
	(lb.-ft.)	(watts)	(rad./sec.)	(in.)	(in.)	(in.)	(lb.)	(lb.-ft.-sec.^{2} x 10^3)
235-01	1	90	63	3.907	.875	1.680	1.65	.218
235-02	2	120	42	3.907	.875	2.245	3.1	.364
235-03	3	150	35	3.907	.875	2.810	4.4	.51
235-04	4	180	31	3.907	.875	3.375	5.9	.665
235-05	5	210	29	3.907	.875	3.940	6.9	.8
235-06	6	240	28	3.907	.875	4.505	8.6	.95
409-01	8	165	15	7.90	3.50	3.06	14.5	.009
409-02	16	220	10	7.90	3.50	4.06	24.0	.013
409-03	24	275	8.3	7.90	3.50	5.06	34.0	.018
409-04	32	320	7.3	7.90	3.50	6.06	44.0	.023
223-01	13	250	14	9.37	5.13	2.937	18.5	.022
223-02	26	315	8.9	9.37	5.13	3.937	30	.032
223-03	39	380	7.1	9.37	5.13	4.937	43	.042
223-04	52	450	6.4	9.37	5.13	6.375	55	.054
229-01	25	255	7.5	12.4	8.0	2.937	26	.066
229-02	50	340	5.1	12.4	8.0	3.937	42.5	.11
229-03	75	420	4.1	12.4	8.0	4.937	60	.15
229-04	100	500	3.7	12.4	8.0	6.375	78	.20
230-01	40	310	5.7	18.75	8.0	3.00	45	.095
230-02	80	405	3.7	18.75	8.0	4.00	71	.165
230-03	120	500	3.1	18.75	8.0	5.00	98	.24
230-04	160	590	2.7	18.75	8.0	6.00	123	.31
232-01	75	390	3.8	23.75	13.0	3.00	60	.31
232-02	150	500	2.5	23.75	13.0	4.00	95	.52
232-03	225	610	2.0	23.75	13.0	5.00	130	.72
232-04	300	720	1.8	23.75	13.0	6.00	165	.93
236-02	215	600	2.1	28.5	17.0	4.50	130	1.25
236-04	430	870	1.5	28.5	17.0	6.50	225	2.2
236-06	645	1125	1.3	28.5	17.0	8.50	315	2.85
240-02	310	645	1.5	33.6	21.5	4.50	170	2.6
240-04	620	940	1.1	33.6	21.5	6.50	290	4.4
240-06	930	1220	.97	33.6	21.5	8.50	400	5.8
244-02	450	800	1.3	40.6	27.6	4.50	220	5.8
244-04	900	1170	.96	40.6	27.6	6.50	380	9.5
244-06	1350	1500	.82	40.6	27.6	8.50	530	13
248-02	680	940	1.0	49.4	35.2	4.50	300	13
248-04	1360	1370	.74	49.4	35.2	6.50	500	21
248-06	2040	1770	.64	49.4	35.2	8.50	700	29
252-02	1000	1100	.81	60	44.5	4.50	380	29
252-04	2000	1590	.58	60	44.5	6.50	650	46
252-06	3000	2070	.51	60	44.5	8.50	920	65

DC TORQUE MOTORS – ENCAPSULATED

MODEL	Peak Torque (oz.-in.)	Power @ Peak Torque (watts)	No-Load Speed (rad./sec.)	OD (in.)	ID (in.)	Width (in.)	Weight (oz.)	Inertia (oz.-in.-sec.^{2})
433-01	30	90	400	1.937	.940	.600	4.7	.0017
433-06	150	310	292	1.937	.940	1.960	16.0	.0051
443-21	30	80	360	1.937	.625	.63	6	.0012
443-22	60	110	245	1.937	.625	1.00	10	.002
443-23	90	145	215	1.937	.625	1.38	14	.003
443-24	120	170	190	1.937	.625	1.75	16	.004
431-01	75	80	145	2.875	1.000	.600	11.0	.011
450-01	96	20	29.3	4.300	2.675	.687	1.1	.059
451-01	173	36	29.3	4.500	2.675	.687	1.54	.077
	(lb.-ft.)	(watts)	(rad./sec.)	(in.)	(in.)	(in.)	(lb.)	(lb.-ft.-sec.^{2} x 10^3)
403-04	1.0	90	63	3.907	1.640	.920	1.6	.218
403-05	2.0	120	42	3.907	1.640	1.460	2.65	.364
403-06	3.0	150	35	3.907	1.640	1.990	3.7	.51
403-07	4.0	180	31	3.907	1.640	2.520	4.7	.665
412-01	1.45	110	48	4.500	2.240	.920	2.0	.55
412-02	2.9	145	36	4.500	2.240	1.460	3.4	.91
412-03	4.35	185	30	4.500	2.240	1.990	4.8	1.27
412-04	5.8	220	27	4.500	2.240	2.520	6.1	1.66
414-01	2.0	130	45	5.125	2.900	.920	2.5	.98
414-02	4.0	175	30	5.125	2.900	1.460	4.2	1.64
414-03	6.0	220	26	5.125	2.900	1.990	5.8	2.3
414-04	8.0	265	23	5.125	2.900	2.520	7.5	3.0
416-01	2.6	150	40	5.750	3.500	.920	3.0	1.76
416-02	5.25	200	26	5.750	3.500	1.460	5.0	2.95
416-03	7.9	250	22	5.750	3.500	1.990	6.9	4.14
416-04	10.5	305	20	5.750	3.500	2.520	8.9	5.5
418-01	3.35	165	34	6.380	4.110	.920	3.4	3.0
418-02	6.75	225	23	6.380	4.110	1.460	5.7	5.0
418-03	10.0	285	20	6.380	4.110	1.990	8.0	7.0
418-04	13.5	340	18	6.380	4.110	2.520	10.0	9.0
420-01	4.12	185	31	7.000	4.730	.920	3.8	4.8
420-02	8.25	250	21	7.000	4.730	1.460	6.4	8.0
420-03	12.4	315	18	7.000	4.730	1.990	9.1	11.2
420-04	16.5	380	16	7.000	4.730	2.520	11.7	14.6
422-01	5.1	205	28	7.630	5.360	.920	4.3	7.4
422-02	10.2	275	19	7.630	5.360	1.460	7.2	12.4
422-03	15.3	345	16	7.630	5.360	1.990	10.0	17.3
422-04	20.4	420	15	7.630	5.360	2.520	12.9	22.6
424-01	6.0	220	26	8.245	5.970	.920	4.7	10.9
424-02	12.0	300	18	8.245	5.970	1.460	7.8	18.2
424-03	18.0	380	15	8.245	5.970	1.990	10.9	25.5
424-04	24.0	455	13	8.245	5.970	2.520	14.0	33.2
426-01	7.2	240	23	8.860	6.590	.920	5.1	15.7
426-02	14.3	325	16	8.860	6.590	1.460	8.4	26.2
426-03	21.2	410	14	8.860	6.590	1.990	11.8	36.8
426-04	28.6	495	12	8.860	6.590	2.520	15.2	48.0
428-01	8.4	260	22	9.500	7.200	.920	5.5	21.8
428-02	16.7	350	15	9.500	7.200	1.460	9.0	36.4
428-03	25.0	440	12	9.500	7.200	1.990	12.7	51.0
428-04	33.4	530	11	9.500	7.200	2.520	16.3	66.5
444-01	42	435	7	12.040	10.050	2.000	13.75	50.0

TACHOMETERS

MODEL	Kg(volts/ rad./sec.)	Ripple % Avg. to Pk.	Max. Output Volts	OD (in.)	ID (in.)	Width (in.)	Weight (lb.)	Inertia (oz.-in.-sec.^{2})
402-49	.3	2.0	63	3.070	.625	1.75	1.44	.011
435-01	.1	1.0	78	2.000	.500	1.000	.44	.0012
256-01	4.0	1.0	100	4.950	1.375	2.000	4.9	.18
224-100	23.4	.1	200	9.375	5.000	2.937	15	4.2
443-05	.5	5.0	52	1.937	.625	.625	.34	.0012

magnedyne inc.
a subsidiary of Axial Corporation
5580 El Camino Real, Carlsbad, Calif. 92008 • (714) 729-7191

Magnetic Technology®

High Performance DC Torque Motors.

Exotic one-of-a-kind motors as well as more than five hundred standard models combine high ratios of torque to power, speed and size with other desirable characteristics such as low electrical time constant and low ripple torque.

These are permanent magnet, armature excited motors that are furnished frameless for direct mounting to the driven load without gears. Large bore, minimum width and thin-ring configurations make possible compact system packaging.

Peak torque ratings of standard models range from 7 oz-in. to more than 120 lb-ft., OD's from 1.5 inches to more than 15 inches and armature bores to more than 10 inches.

These MagTech® designs have proven their merit in aircraft, missile and space applications.

Continuous Rotation Brushless DC Torque Motors

These motors have advantages over conventional brush-type DC torque motors in some applications. They provide

- reliability and operational life not affected by brush wear-out
- elimination of EMI problems associated with brushes
- no explosion hazard
- operation at higher rotational speeds
- fewer problems in preparation for outer space use

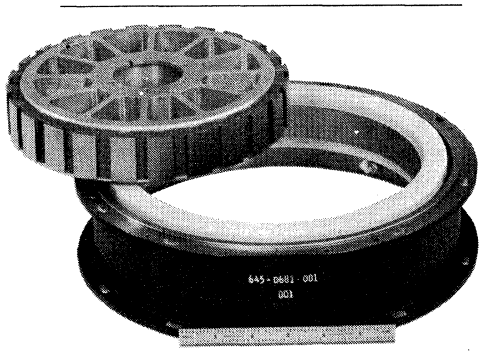
Motors can be furnished with two or more input phases for sine or square wave excitation. Motors are available with either the inner or outer member rotating.

Peak torque ratings range from 6 oz-in. to 14,000 oz-in. The motors are axially thin, ranging from .35 to 1.5 inch widths for OD's of 1.6 to 19.3 inches.

Magnetic Technology also can supply associated electronic drive and control systems. Such special features as constant speed or constant torque drives are available as are systems that exactly duplicate performance of a brush type torque motor.

Example Specifications

MagTech Part No.	1600B-035	2375D-050	3625B-050	3350B-125	645-0681	645-0697
Peak Torque (oz-in)	6	32	45	300	3250	14000
Pwr/Phase (watts)	26	60	25	200	250	680
O.D.	1.6	2.375	3.625	3.35	10.498	19.30
I.D.	.810	1.250	2.50	1.83	7.0	14.623



Volume Produced, Low Cost Industrial/Commercial DC Servo Motors

Only subtle design, performance and materials variations distinguish these quality, direct drive motors from Magnetic Technology's established military grade motors. Yet, through volume production they are priced for industrial and commercial markets.

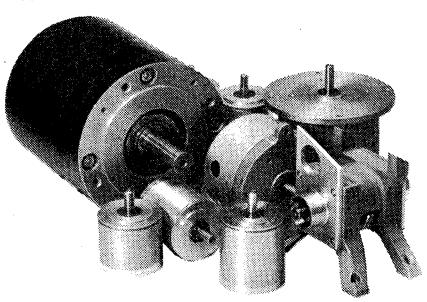
Features include fast response, high torque, precise positioning, high tracking accuracy, quiet operation, and relatively low ripple. Permanent magnet fields and moving iron design result in both higher efficiency and thermal inertia.

These servo motors couple directly to the driven load, eliminating the disadvantages of gears and gear trains in servo systems. System simplification is possible and excellent system stability results.

Applications for these units include disc memory systems, card sorters, tape transports and printers, N.C. machine table drives and feedback tachometers.

Example Specifications

MagTech Part No.	1937D-100	1937D-150	3069-175	3069-237	H5500-550	H5500-750
Peak Torque (oz-in)	20	50	75	140	1650	2750
Pwr @ T_P @ 25°C (watts)	33	50	52	79	1480	1125
Ripple Torque (%)	5	5	6	6	3	3
Elec Time Const (sec)	.0004	.0006	.001	.015	.003	.006
No Load Speed (rad/sec)	215	140	94	75	120	55
O.D.	1.937	1.937	3.50	3.069	5.0	5.0
Length	1.00	1.50	2.50	2.37	5.50	7.50



In addition to the above, industrial and aerospace tachometers and motor-tach combinations can be supplied. More than 130 pages of catalog information on standard models are available on request. Magnetic Technology, a division of Vernitron Corporation, 21001 Kittridge Street, Canoga Park, California 91303. TWX 910-494-1217.

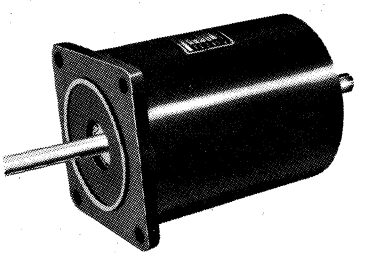
Magnetic Technology®

McLEAN COMPUTER DESIGNED PRECISION INSTRUMENT MOTORS

All motors feature: air-cooled bearings to reduce temperature and extend life; dimensionally stable aluminum alloy motor frames; rotors that exceed requirements of MIL-M-17059 to assure extra-smooth running; and other quality features.

HYSTERESIS SYNCHRONOUS MOTORS

OUTPUT PERFORMANCE ON 115 VOLTS, 60 Hz.			
FRAME	**RPM**	**PULL-OUT TORQUE**	**CAPACITOR**
47	1200	15 oz-in.	3 Mfd.
47	1800	14 oz-in.	3 Mfd.
47	3600	12 oz-in.	5 Mfd.
59	1200	55 oz-in.	8 Mfd.
59	1800	60 oz-in.	6 Mfd.
59	1200 3600	45 25 oz-in.	9 Mfd.



REQUEST DATA SHEET

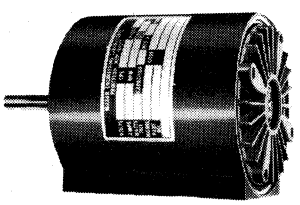
FEATURES

- The starting torque approximates the running torque. Self-starting.
- The motor runs at synchronous speed, but is not phase polarized as are the polarized synchronous motors shown elsewhere.
- The direction of rotation of the shaft is reversible externally.
- Dual voltage and/or dual speed motors available.

POLARIZED SYNCHRONOUS MOTORS

PERFORMANCE ON 115 VOLTS, 60 Hz., WITH INTERNAL FAN		
FRAME USED	**47 FRAME**	**59 FRAME**
Speed	3600 RPM	3600 RPM
Line current	1.2 amp.	1.5 amp.
Capacitor required	5 Mfd.	8 Mfd.
Stall torque	10-14 oz-in.	27 oz-in. max.
Pull-in torque	15-18 oz-in.	25 oz-in.
Pull-out torque	15 oz-in.*	14 oz-in.*
Reversible	yes	no

*Must not be exceeded for continuous duty.



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FEATURES

- Ideal where repeated phase synchronization is required between line voltage and shaft position for one or more motors.
- Single or dual voltage, but only single speed, motors available.
- Currently available for 3600 rpm only at 60 Hz. Other speeds and frequencies available when the need materializes.

INDUCTION MOTORS

PSC and 3-PHASE

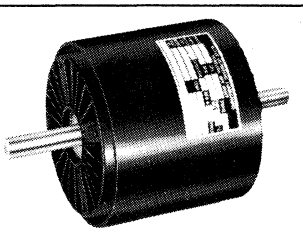
McLEAN 47 FRAME MOTOR

OUTPUT PERFORMANCE ON 115 VOLTS				
RPM	**WATTS**	**HERTZ**	**VENTILATION**	**PHASE**
1600	30	60	totally enclosed	single
1600	40	60	open, with circulation	single
3200	60	60	totally enclosed	single
3200	80	60	open, with circulation	single
5400	80	400	open, with circulation	single
5400	100	400	open, with circulation	three

McLEAN 59 FRAME MOTOR

OUTPUT PERFORMANCE ON 115 VOLTS					
RPM	**WATTS**	**"B"**	**HERTZ**	**VENTILATION**	**PHASE**
1600	20	2 5/8	60	open, with circulation	single
3300	20	2 5/8	60	open, with circulation	single
1600	100	4 1/8	60	totally enclosed	single
1600	165	4 1/8	60	open, with circulation	single
3200	250	5 1/8	60	open, with circulation	single
3200	525	6 7/8	60	open, with circulation	single
3200	100	4 1/8	400	open, with circulation	single
3200	130	4 1/8	400	open, with circulation	three

FEATURES



Optimum design achieved using McLean high speed electronic digital computer with our internally programmed analysis.

Starting and running torques matched to fan and blower loads, where the motors are so used.

Direction of rotation of the shaft is reversible externally.

Dual voltage and/or dual speed motors available.

Face mount is standard, but base mount is available in 47 Frame Size Motor and flange mount is available in 59 Frame Size Motor.

Available for single-phase use in 2, 4, 6, 8, and 12-pole speeds, and for three-phase use in the same speeds.

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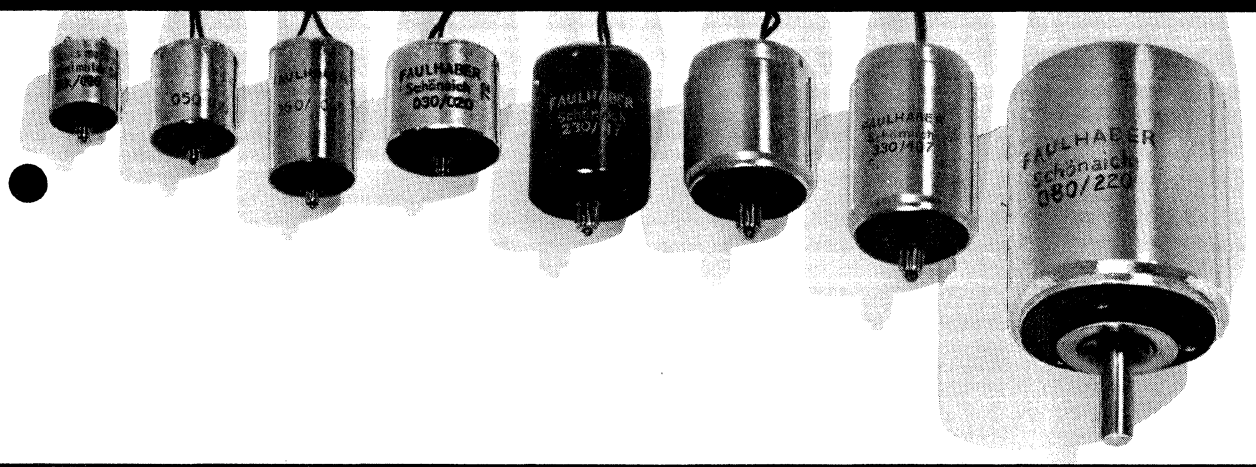

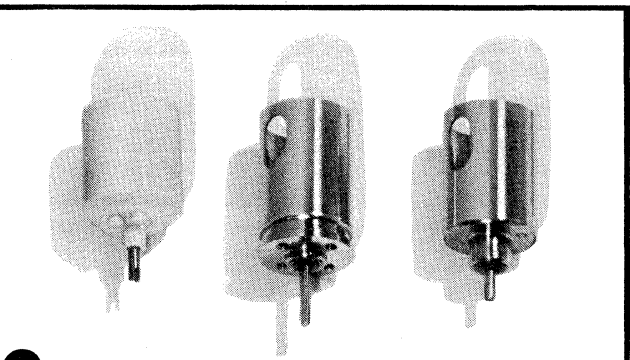

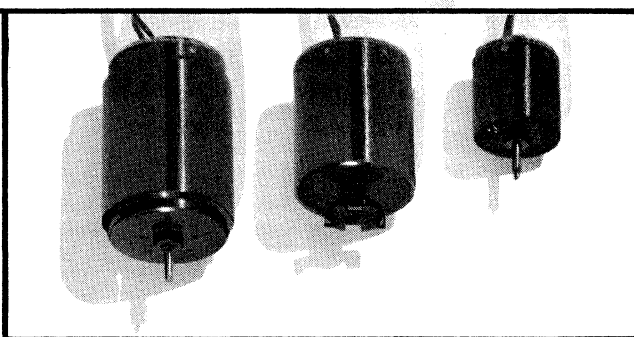

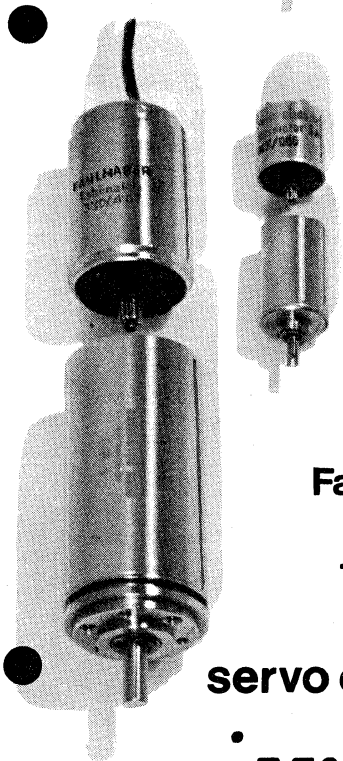

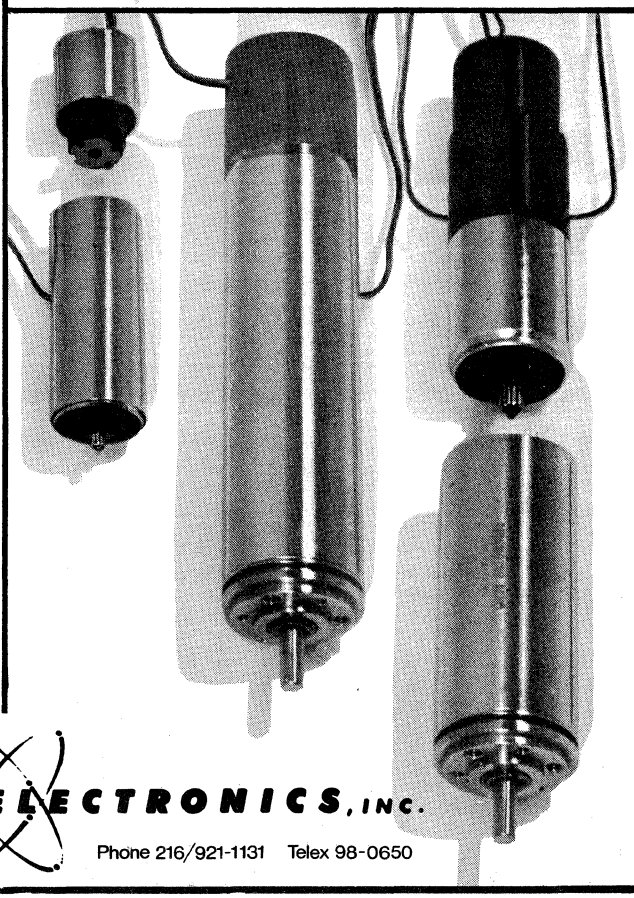

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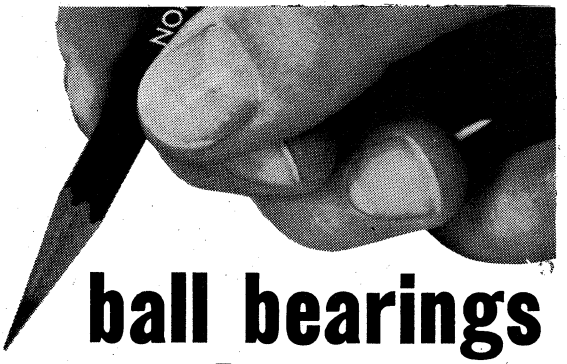
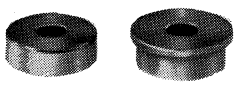
Northfield miniature precision instrument bearings- interchangeable with ball bearings -at only ⅓ the cost!





HERE'S HOW DESIGN ENGINEERS CUT BEARING COSTS WITHOUT LOSS OF ACCURACY

Here are the reasons why:

- ⅓ the cost of miniature precision ball bearings
- I.D., O.D., concentricity and facial squareness held to .0002″
- Precision made of sintered bronze (MIL-B-5687, Type I, Comp. A) with 4% Molybdenum Disulphide added at sintering
- Vacuum impregnated with instrument oil (MIL-L-6085A)
- Low coefficient of friction and excellent resistance to radial loads and impact
- Full range of sizes — flanged and sleeve types
- Immediate delivery from stock
- Used in gyro stabilizers, airborne compasses, analog and digital computers, inertial guidance systems, ground control approach instruments, infrared guidance systems, sound recording equipment, etc.

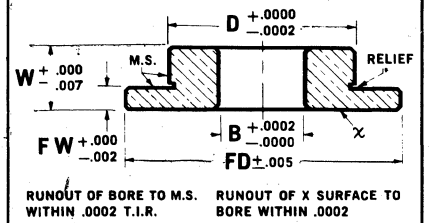
Write for latest brochure.

Typical Characteristics

Tensile Strength (psi)	16,000
Compressive Strength (psi)	18,000
Hardness (Rockwell No.)	H45-H54
Coeff. of Thermal Expan. per °F (x 10^{-6})	10.5
Coeff. of Friction (Break-away)	.07

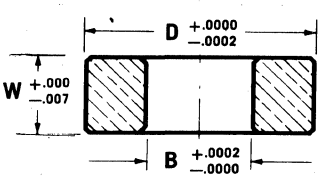
IN STOCK, AVAILABLE FOR IMMEDIATE DELIVERY OF PRODUCTION QUANTITIES

SERIES 127 FLANGED BEARINGS



RUNOUT OF BORE TO M.S. WITHIN .0002 T.I.R. RUNOUT OF X SURFACE TO BORE WITHIN .0002

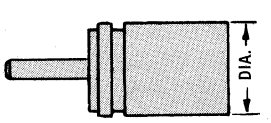
SERIES 238 SLEEVE BEARINGS



RUNOUT OF BORE & O.D. WITHIN .0002 T.I.R. FACIAL SQUARENESS HELD WITHIN .0002

Specify NORTHFIELD Miniature Precision MICROSPIN Instrument Bearings as direct replacement for miniature precision ball bearings

Miniature adjustable mechanical limit stops

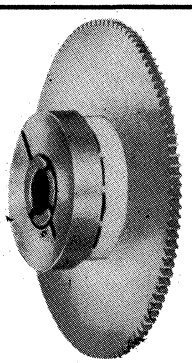


HIGH TORQUE RATINGS AND REPEATABILITY IN SMALLER DIMENSIONS

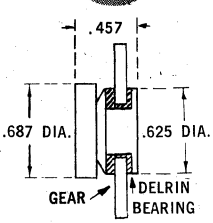
Model	Dia.	Torque Rating
BUORD Size 5	.500 max.	40 OZ. IN.
BUORD Size 8	.753 max.	80 OZ. IN.

Improved Quality Features: Outstanding repeatability • Low starting torque • Long Life—rugged construction • Hardened and ground lead screw • Precision engineered to MIL-E-5272 C. Immediate delivery from stock.

Improved gear type miniature adjustable slip clutch



TOP QUALITY FEATURES: Delrin bearing and clutch plate achieve smooth torque transmission with minimum charge from pre-set torque • Adjustable from zero to 50 inch ozs. torque • Precision engineered to MIL-E-5272 C • Stainless steel gear. Anodized aluminum hub and clamp • Low cost.



Miniature slip clutch coupling

• Simple interconnection between shafts • Teflon coated clutch faces for overload protection • Range: 0-50 oz. in. slip torque • No lubrication • Spring loaded, friction-type • Self-locking • Slip speeds to 1200 RPM.

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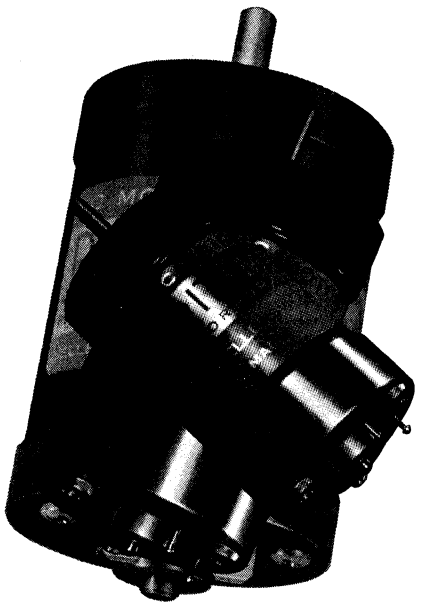
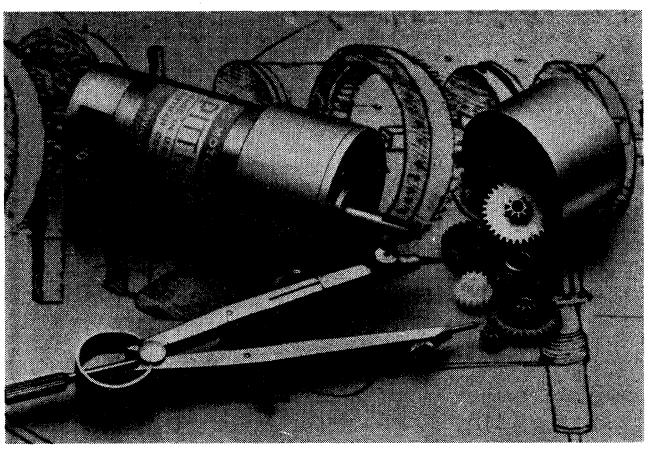


MOTORS: Three series of d-c motors having diameters of 1.27″, 1.63″ and 2.05″. Each in three lengths ranging upward from 2.2″ exclusive of shaft extension. Most models can be supplied for inputs from 6 to 48 VDC. Load speeds from under 1,000 rpm to approximately 10,000 rpm. Stall torques from under one oz.-in. to more than 70 oz.-in. Quality materials and construction ensure high performance and durability at moderate cost. All motors available with your choice of self-aligning oil-impregnated bronze bearings or double-shielded ball bearings. Custom modifications possible in production quantities.

LO-COG® servo motors are built in three series identical externally to the motors described above plus a fourth series 1.18″ in diameter exclusive of terminal block. These LO-COG motors offer exceptionally low magnetic cogging yet provide the desirable thermal characteristics and high torques of iron armature designs.

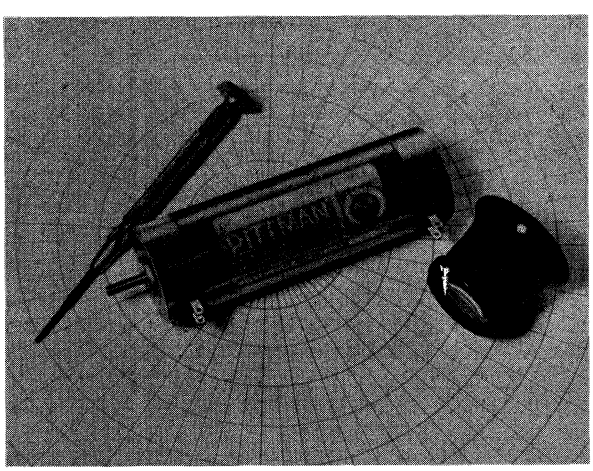


GEARMOTORS: PITMO® gearmotors have a gearbox diameter of 1.375″ with lengths from 2.99″ to 3.39″ excluding output shaft extension and pilot boss. Gears are sintered iron to AGMA 9E tolerances except for the first gear after the armature pinion. The latter is molded Delrin(1) acetal resin to AGMA 8E tolerances. Four standard gear ratios from 6.6:1 to 197:1 are available. Torque limit on the gearbox is 250 oz.-in. Motor sections feature LO-COG construction as described above under "MOTORS".

(1) TM of DuPont Company

MOTOR TACHOMETERS: Units in the current series of PITMO motor-tachs have a diameter of 1.18″ exclusive of terminal blocks. Their length is 3.66″ exclusive of shaft extension and pilot boss. Separate motor and tachometer-generator armatures are mounted on a single shaft and operate within two different field magnet systems. Standard 12-volt unit provides stall torque of 3.6 oz.-in. and No-load speed of 4,100 rpm. Tachometer gradient is two volts per 1,000 rpm with typical ripple of 5% peak-to-peak with no filtering. Other windings are available for both motor and tach.

Typical applications include digital tape cassette drives, chart and pen drives, and other velocity or position servo systems where accuracy of speed control or high damping is a requirement.



For specifications, performance curves and prices for models of PITMO miniature d-c motors to meet your needs, call or write us today. 112

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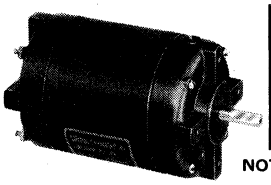

DIA.	MOTOR DESIG.	REFER. TABLE(S)
3.31	L FRAME	7, 8, 9
3.88	P FRAME	10,11,12
4.38	S FRAME	13,14,15

NOTE: For self-cooled version of all models, add .75" to case lengths listed in tables.

TABLE 7. L FRAME - HYSTERISIS SYNCHRONOUS MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.) ST	TORQUE (Oz. In.) P.I.	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
11988	1/15	3600	20	18	1.42	115	5.05	60
12694	1/20	3600	24	14	1.1	93	4.55	60
12714	1/25	3600	12	12	0.70	77	3.61	60
12745	1/30	3600	13	11	0.95	65	3.61	60
12290	1/35	3600	8	8	0.47	43	4.18	60
12338	1/50	3600	5	7	0.38	40	3.74	60
12693	1/25	1800	27	26	1.15	85	4.55	60
12692	1/35	1800	18	18	0.80	61	4.55	60
12695	1/40	1800	13	14	0.69	55	4.55	60
12337	1/50	1800	14	12	0.63	50	3.74	60
13590	1/60	1800	16	9	0.46	48	3.74	60
12330	1/75	1800	12	9	0.48	38	3.36	60
12329	1/100	1800	7	6	0.48	38	3.36	60
10878	1/160	1800	3	4	0.24	23	3.36	60
12721	1/60	1200	14	13	0.60	65	3.61	60
12738	1/75	1200	15	14	0.43	45	3.11	60
12720	1/100	1200	8	8	0.48	52	2.93	60
12742	1/125	900	10	10	0.52	40	3.61	60
13528	1/200	900	7	6	0.30	24	4.18	60
12328	1/250	900	6	5	0.35	27	3.36	60
11544	1/320	900	5	3	0.17	16.5	3.36	60
12741	1/250	600	11	7	0.60	42	3.61	60
12736	1/300	600	9	4	0.65	45	3.11	60
12325	1/900	600	1	2	0.25	17	3.11	60
12696	1/10	12000	18	8	2.65	240	3.74	400
12724	1/20	12000	7	4	0.82	75	2.93	400
12850	1/72	4000	3	3	1.0	60	3.61	400
12697	1/125	4000	6	2	1.67	100	4.18	400

TABLE 8. L FRAME - TORQUE MOTORS

PART NO.	N.L. SPEED (RPM)	STALL TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13481	3540	16	.65	70	3.50	60
13483	3360	36	1.20	132	5.18	60
13480	3200	7	.26	29	3.94	60
13486	1725	10	.40	35	3.13	60
13489	1700	28	.61	66	3.94	60
13487	1700	13	.28	31	3.94	60
13498	1685	65	1.20	135	5.18	60
13493	1670	39	1.06	95	3.63	60
13488	1650	20	.38	42	4.32	60
13492	1585	32	.80	92	4.32	60
13502	1150	70	1.30	138	5.18	60
13501	1140	36	.70	75	4.32	60
13500	1125	16	.32	32	3.94	60
13506	880	38	.64	72	4.32	60
13507	850	70	1.20	135	5.18	60
13505	825	16	.24	29	3.94	60

TABLE 9. L FRAME - INDUCTION DRIVE MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13694	1/10	3400	31	1.65	140	4.94	60
10885	1/25	3400	12.5	.48	50	3.38	60
10873	1/35	3400	8.5	.44	42	3.12	60
10912	1/10	3350	27.5	1.00	111	3.94	60
10898	1/18	3200	18	.63	72	3.62	60
10887	1/20	3200	15	.60	65	3.50	60
13695	1/10	1650	60	1.40	140	4.94	60
13691	1/15	1650	47	.86	93	4.32	60
10855	1/25	1650	2.25	.14	14	2.62	60
10859	1/70	1650	9.0	.23	22	3.12	60
13698	1/40	1600	16.5	.39	38.5	4.94	60

TABLE 10. P FRAME - HYSTERISIS SYNCHRONOUS MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.) ST	TORQUE (Oz. In.) P.I.	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13550	1/14	3600	28	21	2.0	150	5.19	60
11941	1/40	1200	30	21	1.0	85	4.44	60
13576	1/80	1200	14	12	0.5	55	4.44	60

TABLE 11. P FRAME - TORQUE MOTORS

PART NO.	N.L. SPEED (RPM)	STALL TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13551	1740	42.5	1.5	100	5.19	60
13776	1160	60.0	2.0	125	4.44	60
13776-2	880	64.0	2.0	150	4.44	60

TABLE 12. P FRAME - INDUCTION DRIVE MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13838	1/10	3450	30.0	1.0	170	5.19	60
13837	1/20	1700	30.0	0.75	110	5.19	60
13835	1/36	1100	25.0	1.0	120	4.44	60
13836	1/50	850	23.5	1.5	150	4.44	60

TABLE 13. S FRAME - HYSTERISIS SYNCHRONOUS MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.) ST	TORQUE (Oz. In.) P.I.	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13791	1/5	3600	64	66	3.2	290	5.50	60
13786	1/7	3600	78	46	3.0	225	5.50	60
13783	1/14	3600	35	26	2.4	190	4.50	60
13792	1/10	1800	57	61	2.5	190	5.50	60
13787	1/22	1800	31	31	1.4	100	5.50	60
13781	1/30	1800		24	1.0	75	4.50	60
13779	1/40	1800	19	16	0.6	60	3.50	60
13790	1/22	1200	93	45	1.8	150	5.50	60
13782	1/45	1200	24	21	0.9	80	4.50	60
13789	1/65	900	60	20	1.3	100	5.50	60
13784	1/110	600	33	17	0.7	60	4.50	60
13797	1/42	24000	18	14	6.0	360	4.50	400
13798	1/11	6000	14	18	7.8	355	5.50	400
13796	1/35	4000	11	8	1.7	120	5.50	400

TABLE 14. S FRAME - TORQUE MOTORS

PART NO.	N.L. SPEED (RPM)	STALL TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13807	3400	14	3.3	325	3.50	60
13808	1770	45	1.0	115	4.50	60
13812	1670	140	2.3	245	5.50	60
13809	950	40	0.6	60	4.50	60
13810	830	75	1.3	120	4.50	60
13806	800	30	0.5	55	3.50	60
13813	800	140	2.0	200	5.50	60
13815	800	170	2.5	256	5.50	60
13814	750	140	1.7	175	5.50	60

TABLE 15. S FRAME - INDUCTION DRIVE MOTORS

PART NO.	H.P.	SPEED (RPM)	TORQUE (Oz. In.)	CURRENT (AMPS)	INPUT POWER (WATTS)	CASE LENGTH	FREQ. (Hz)
13841	1/8	3450	38.0	2.00	170	5.50	60
13840	1/10	3450	30.0	1.70	150	4.50	60
13839	1/20	3400	15.0	1.10	94	3.50	60
13843	1/15	1725	38.0	1.75	140	5.50	60
13842	1/12	810	105.0	1.90	132	5.50	60

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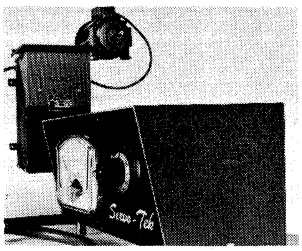


MAINTENANCE — Design eliminates vacuum tubes, selenium rectifiers and time delays. Utilizes silicon diodes, transistors and a magnetic amplifier for exceptionally long service life. Modular plug-in construction requires only a screwdriver for servicing.

REMOTE CONTROL — A 10-turn potentiometer provides precise adjustment and can be placed in any convenient location. Meter monitors operation and continuously indicates speed.

GEARED MOTORS — Motors are available with integral gear reducers.

BRAKE-REVERSING — Relay-controlled braking and reversing models available.

SPEED RANGE — Infinitely adjustable from less than 24 rpm to more than 3600 rpm (150:1) while delivering full-rated torque. Continuous duty rating at all speeds.

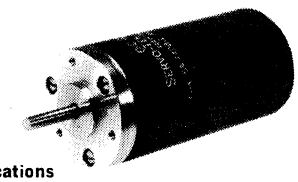
REGULATION — Temperature-compensated tachometer feed-back provides both line and load regulation of better than ⅓ of 1% of rated speed.

Models available from ⅛ to 1½ hp

D-C PERMANENT-MAGNET

TACHOMETER GENERATORS

TEMPERATURE-COMPENSATED



Applications

SERVOS — The highly linear output and wide speed range are ideal for velocity or integrating servos. Low-driving torque permits its use as a damping or rate signal in all types of servos.

TEMPERATURE-COMPENSATED — The voltage output @ +25°C will not deviate from this amount by more than 1/100 of 1% per degree of change when operated at any temperature within the designed temperature range of −20°C to +75°C.

SIZE — Miniature. Approx. Dia. 1⅛".

OUTPUT — Various models with outputs as high as 45v/1000 rpm.

LINEARITY — Linearity from 0 to 12,000 rpm is better than 1/10 of 1% of voltage output at 3600 rpm.

BRUSH LIFE — Better than 100,000 hours (10 years) of continuous operation at 3600 rpm.

BIDIRECTIONAL OPERATION — Output in either direction is held to a ¼ of 1% tolerance.

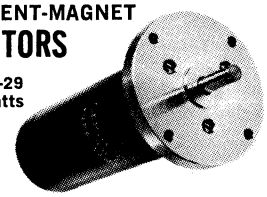
RIPPLE — The rms value will not exceed 3% of the d-c value at any speed in excess of 100 rpm.

CONSTRUCTION — Aluminum housings with protective treatment; stainless steel shafts; fully shielded stainless steel ball bearings; Mylar insulation.

Our Engineering Test Report describing performance characteristics, test procedure and test results, is available at no charge, upon request.

D-C PERMANENT-MAGNET

SERVO MOTORS



Model SU-680D-29 delivers 12.7 watts of Continuous Power Output at 8600 rpm

Applications

Chart Recorder Pen Drives, Null-seeking Devices, Capstan Drives for Tape Transports, Proportioning Applications, Prime Mover in Servo-Mechanisms.

Specifications

DYNAMIC: Maximum No-Load Speed @ 23v D-C — 10,000 rpm; ±500 rpm; Full Load Torque @ 8600 rpm — 2.0 Oz.-In. (max.); Stall Torque @ 23v D-C (Theo.)—15.0 Oz.-In. (min.); Frictional Torque — 0.25 Oz.-In. (max.); Acceleration at Stall (Torque / Inertia) — 38,000 RAD / SEC² (min.); Case Temperature Rise @ Full Load (Free Air Dissipation) −55°C. (max.); Case Temperature Rise Per Watt of I^2R loss (Free Air Dissipation) −6°C.

STATIC: D-C Resistance — 4.24 Ohms (typ.); Inductance — 1.85 Millihenry (typ.); Rotor Inertia — 30.0 GM-CM² (typ.); Total Weight — 8.25 Oz. (max.); Length — 3.25 in., excluding shaft; Maximum Ambient Temp. −40°C.

FUNCTIONAL CONSTANTS: Inertial Time Constant — 30.0 Milliseconds (max.); Electrical Time Constant — 0.45 Milliseconds (typ.); Torque Constant — 2.8 Oz.-In./Amp. (min.); Voltage Constant (Back E.M.F.)—0.019v @ (1) RAD/SEC. (min.); Viscous Damping Factor — 1.25 x 10^{-3} Oz.-In./rpm (min.).

Other Models Available

BI-MODE SERVO

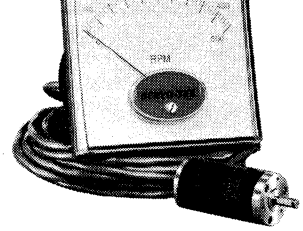
A device which is so versatile it can be programmed to operate as either a bi-directional speed regulator or positioning servo. A d-c permanent magnet servo motor and temperature compensated d-c generator (torque unit) designed for maximum reliability provide control to the driven load. An integrated operational amplifier with external gain adjustment coupled with a high efficiency booster provide high follow-up accuracy and excellent dynamic response under various load conditions. A highly regulated temperature compensated reference supply insures stable operation with variations in ambient temperature, line voltage and time.

Features

Adjustable, stepless bi-directional speed control—Dynamic speed range in excess of 2000:1 —High accuracy maintained with load, line voltage and temperature variation—Adjustable output torque control—Controlled deceleration capability—Remote programming capability—Easy conversion from one mode to the other.

ACCURATE

SPEED INDICATING SYSTEMS



A truly versatile "package" provides accurate speed indication for almost anything that moves. Nearly every industrial process or machine can benefit by the economy and safety of continuous speed indication.

SELF POWERED — No batteries or external power required.

LOW VOLTAGE—Connecting cable can be as long as 500 ft.

PERMANENTLY LUBRICATED BALL BEARINGS.

EASILY READ 4½" INDICATOR.

TAUT BAND MOVEMENT—Withstands vibration and shock.

STANDARD RANGES — 0 to 100, 250, 500, 1000, 2000, 3000, 4000, 6000, 8000, 10,000 and 12,000 rpm. These speeds can also be provided to read "Percent of Full Speed" or "Percent of Capacity."

0 to 10 rpm available at small additional cost.

Complete System includes Generator, Indicator (specify range), Mounting Base, Coupling and 15 ft. of Connecting Cable.

PRICES quoted with a quantity discount schedule.

***An additional discount is available to resale organizations and original equipment manufacturers using these drives as an integral part of their product.**

Prices subject to change without notice.

Write for our RC200 Catalog

SERVO-TEK
PRODUCTS COMPANY
1086 Goffle Road, Hawthorne, N.J. 07506
(201) 427-3100

8155 Van Nuys Blvd., Van Nuys, Calif. 91401 • (213) 786-0690

CABLE ADDRESS: SERVOTEK, HAWTHORNE, N. J., U.S.A.
WESTERN UNION: FAX, HAWTHORNE, N. J.

Overseas Representative: NECO ELECTRONIX (Europe) LTD., North Street, Clapham Common, London S.W. 4

SLO-SYN® Synchronous/Stepping

M SERIES STEPPING MOTORS Shown in chart with M prefix. Represent the most advanced permanent magnet stepping motor design available and the most complete range in both torque ratings and size. Provide the highest torque per pound and torque to inertia ratios. Can be driven at rates above 20,000 steps per second with minimum of power input. Have Class B insulation and may be operated at ambients from −40°C to +65°C. Stepping increment is 1.8° using a 4-step input sequence; 8-step input sequence gives an 0.9° stepping increment. Step accuracy choice of either ±3% or ±5%. Chart shown gives off-the-shelf SLO-SYN drives for motors listed but custom drives can be designed by Superior Electric or built by the user if desired. For torque vs speed characteristics and complete ratings and specifications, request Superior Electric Catalog MSM1171.

PRECISION STEPPING MOTORS Shown in chart with HS prefix. Designed for phase-switched d-c stepping. Make 200 steps of 1.8° per shaft revolution. Each step is accurate within ±3% nonaccumulative. Can be used with SLO-SYN controls and drives or with user-designed and built drives. With proper circuitry, may be operated at speeds greater than 1000 steps per second without missing steps.

BIFILAR MOTORS Shown in chart with 4-number suffixes. Contain twice the windings of a 3-lead motor for better L/R time constant, better performance. Use simple drive circuitry or recommended SLO-SYN drives. Make 200 steps of 1.8° per shaft revolution except LS prefixed types which have a 0.72° step angle and TS prefixed types which have a 5° step angle. X prefixed are explosion proof. Step accuracy is ±5% nonaccumulative.

AC SYNCHRONOUS MOTORS

PERMANENT MAGNET A-C CONTROL MOTORS have no brushes, ratchets or detents feature extremely rapid starting, stopping and reversing characteristics. Need only a single-pole, 3-position switch for complete forward, reverse and "off" control. No excessive inrush current when energized because starting and operating currents are nearly identical. Can be completely stalled or overdriven without overheating and without harmful effects on components. Start or stop in less than 5° of shaft rotation; no need for electrical or mechanical braking. Phase-shifting resistor and capacitor must be used when operating from a single-phase source. Speeds available are 28.8, 72 or 200 rpm at 60 hertz.

TYPE	MAXIMUM AMPERES	TORQUE (Oz-In)	MAXIMUM MOMENT OF INERTIA OF A RIGIDLY ATTACHED LOAD (Lb-In²)
120 Volts, 50/60 hertz, 1 Phase, 28.8 RPM at 60 hertz			
LS50	0.2	40	0.5
120 Volts, 50/60 hertz, 1 Phase, 200 RPM at 60 hertz			
• TS25	0.2	25	0.12
• TS50	0.3	50	0.25
120 Volts, 50/60 hertz, 1 Phase, 72 RPM at 60 hertz			
• SS25	0.1	25	0.15
• SS50	0.3	50	0.5
• SS150	0.4	150	1.5
SS150M†	0.4	150	1.5
• SS250	0.6	250	3
• X250‡	0.6	250	3
• SS400	0.6	400	4.5
• X1000‡	3.0	1000	9
• X1500	3.0	1500	12
240 Volts, 50/60 hertz, 1 Phase, 200 RPM at 60 hertz			
TS52	0.2	50	0.25
240 Volts, 50/60 hertz, 1 Phase, 72 RPM at 60 hertz			
SS52	0.2	50	0.5
• SS152	0.2	150	1.5
• SS252	0.4	250	3
• X252‡	0.4	250	3
• SS402	0.4	400	4.5
• X1002‡	1.5	1000	9

† Militarized.

‡ Explosion-proof.

• Available off-the-shelf from distributor stock

CONTROLS AND DRIVES

TRANSLATOR ST1800B For pulse-to-step conversion of data to bifilar motors. Converts low-level signal pulses or square waves into the correct switching sequence needed to drive a SLO-SYN motor at the desired stepping rate. Input is 105-125 volts a-c, 1.5 amps. Signal input impedance is 500 ohms. Input may be triggered by pulse or square wave or by an external switch. Operates in ambients from 0°C to +40°C. Ideal for a wide range of programmed positioning and indexing functions. Approx. shipping weight 12 lbs.

ADJUSTABLE SPEED DRIVE ST1800BV Essentially a translator with a built-in oscillator to supply triggering signals. The oscillator frequency can be adjusted to vary the speed from 4 steps per second up to the maximum permissible with the motor used. Have same other characteristics as SLO-SYN Translator ST1800B.

TRANSLATOR MODULES Plug-in printed circuit boards with logic capabilities for stepping SLO-SYN motors. STM1800 and STM1800C are basic translators capable of bidirectional operation of motors. Those suffixed V, i.e. STM1800V and STM1800CV, are similar but have built-in oscillators to provide triggering signals. Potentiometers are supplied with V-suffixed models for adjusting the oscillator speed. STM1800 and STM1800V have speeds to 500 steps/sec and are used with HS and bifilar motors. STM1800C and STM1800CV have speeds to 2000 steps/sec and are used with M Series motors. Types STM1800 and STM1800V require 8 amps power supply transformer T5934-G2. Types STM1800C and STM1800CV require 10 amp power supply transformer T6382.

HIGH SPEED TRANSLATORS Used with precision (HS prefix) and M series (M prefix) motors to provide high stepping speeds. High speed translator HTR400 has 50 to 2000 step/sec speed; HTR103RT has 100 to 3000 step/sec speed; and HTR105RT has 100 to 5000 step/sec speed. Acceleration and deceleration is adjustable. Each pulse received from a built-in oscillator or from an external source will cause the translator to advance the motor one step. Triggering pulses can be supplied by tape readers, computers, oscillators, etc. Ambient temperature: 0°C to 40°C operating; −55°C to 85°C storage. Rack mounted design with plug-in solid-state circuitry.

BUFFERED TRANSLATOR Drives M Series (M prefix) motors in response to commands from computer, digital control or other device which operates at a fixed pulse rate. Acceleration and deceleration not required from pulse source. Translator stores incoming pulses and feeds them to the motor, automatically accelerating and decelerating at a rate compatible with the response characteristics of the motor. Acceleration and deceleration rates are approximately 6000 steps/sec² for BTR103RT and 15,000 steps/sec² for BTR105RT. Motor is driven one step for each pulse received from control unit. BTR103RT has speed of 100 to 3000 steps/sec, BTR105RT has speed of 100 to 5000 steps/sec. Rack mounted only.

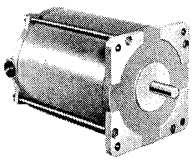
PRESET INDEXER SP1800B-5 Controls indexing operations where bifilar motors are used for positioning. Automatically provides the correct switching sequence needed to drive motors the required number of steps. Has provision for actuating external equipment needed to perform related operations. Dials on control panel can be set to provide desired number of steps up to 99,999 counting range. Operates in ambients from 0°C to +40°C. Input current 1.25 amps. Approx. shipping weight 19 lbs.

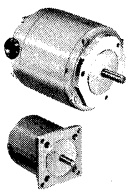
HIGH SPEED PRESET INDEXERS Used with precision (HS prefix) and M Series (M prefix) motors in indexing and other positioning operations. HPR400R-5 has 50 to 2000 steps/sec speed; HPI 153RT has 100 to 3000 step/sec speed; and HPI 155RT has 100 to 5000 step/sec speed. Decade counter controls on front panel permit selecting positioning increments up to 99,999 counting range. On index command, unit drives the motor the prescribed number of steps and then actuates a relay which controls external equipment. Count can also be set by computer or external decade switches. Ambients: 0°C to 40°C operating; −55°C to 85°C storage. Rack mounted only.

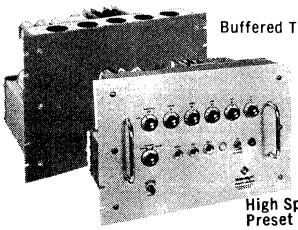
THE SUPERIOR ELECTRIC COMPANY
1000 MIDDLE STREET • BRISTOL, CONN. 06010 • PHONE: (203) 582-9561

SEE OTHER SUPERIOR ELECTRIC PRODUCT

Motors, Controls and Drives

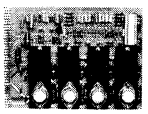




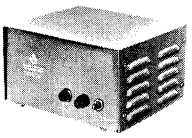


Buffered Translator

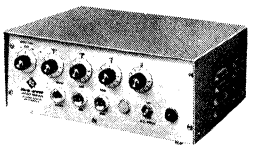
High Speed Preset Indexer



Translator Module



Translator



Preset Indexer

DRIVE TYPE		MOTOR TYPE	MOTOR RATINGS AND SPECIFICATIONS							
			STEP ACCURACY	DC VOLTS	AMPS PER WINDING	HOLDING TORQUE OZ-IN	MOTOR DIA. INCHES	MOTOR LENGTH INCHES	SHAFT DIA. INCHES	NET WT. LBS
UP TO 500 STEPS/SEC										
• ST1800B‡ Translator ST1800BV Adj. Speed Drive • STM1800§‡ Translator Module • STM1800V§‡ Translator Module	• SP1800B-5‡ Preset Indexer	• HS25	±3%	5.4	1.5	70	2.22	3.25	.250	2
		• HS50	±3%	3.0	4.0	175	3.38	3.69	.375	4¾
		• HS50L	±3%	4.5	3.5	320	3.38	5.31	.375	7½
		• LS50-1005*	±5%	3.0	4.0	75	3.38	3.69	.375	4¾
		• LS50-1006*	±5%	12.0	1.0	75	3.38	3.69	.375	4¾
		• SS25-1001	±5%	11.8	0.44	28	2.72	2.25	.250	1¼
		• SS50-1008	±5%	8.0	0.85	70	3.25	2.44	.375	3
		• SS150-1010	±5%	10.0	1.25	250	4.19	4.44	.375	6½
		• SS250-1027	±5%	4.6	3.1	300	4.19	4.72	.375	6½
		• SS400-1021	±5%	5.3	3.4	500	4.19	6.59	.500	12¼
		• SS1800-1007	±5%	11.5	3.9	3000	6.5	8.63	.625	45
		TS25-1008**	±5%	5.4	1.5	40	2.22	3.25	.250	2
		TS50-1001**	±5%	3.0	4.0	65	3.25	3.69	.375	4¾
		X250-1003	±5%	4.6	3.1	300	4.19	4.88	.375	6½
		X1500-1001	±5%	12.0	3.8	2500	6.5	7.63	.625	38
UP TO 2000 STEPS/SEC										
• STM1800C†‡ Translator Module • STM1800CV†‡ Translator Module		• M061-FC08	±3%	1.3	3.9	53	2.22	2	.250	1¼
		• M061-FD08	±5%							
		• M062-FC09	±3%	1.7	4.7	100	2.22	3	.250	2
		• M062-FD09	±5%							
		• M063-FC09	±3%	2.2	4.6	150	2.22	4	.250	2¾
		• M063-FD09	±5%							
		• M091-FC09	±3%	1.8	4.7	150	3.25	2.45	.375	3¼
		• M091-FD09	±5%							
		• M092-FC09	±3%	2.5	4.6	300	3.25	3.70	.375	5½
		• M092-FD09	±5%							
		• M093-FC11	±3%	2.8	5.5	450	3.25	5.07	.375	7¾
		• M093-FD11	±5%							
		• M111-FD12	±5%	2.3	6.1	625	4.19	4.72	.375	8
		• M112-FJ12	±5%	3.6	6.1	1125	4.19	7.16	.625	14½
• HTR400 Translator	• HPR400R-5† Preset Indexer	• HS25	±3%	5.4	1.5	70	2.22	3.25	.250	2
		• HS50	±3%	3.0	4.0	175	3.38	3.69	.375	4¾
		• HS50L	±3%	4.5	3.5	320	3.38	5.31	.375	7¾
		HS400B-1003	±3%	4.2	4.3	850	4.19	6.97	.500	13¾
UP TO 3000 STEPS/SEC										
• BTR103RT Buffered Translator • HTR103RT Translator	• HPI153RT† Preset Indexer	• M112-FJ25	±5%	1.8	12.7	1125	4.19	7.16	.625	14½
UP TO 5000 STEPS/SEC										
• BTR105RT Buffered Translator • HTR105RT Translator	• HPI155RT† Preset Indexer	• M061-FC02§§	±3%	5.1	1.0	53	2.22	2	.250	1¼
		• M061-FD02§§	±5%							
		• M062-FC04	±3%	4.3	1.8	100	2.22	3	.250	2
		• M062-FD04	±5%							
		• M063-FC06	±3%	3.4	2.9	150	2.22	4	.250	2¾
		• M063-FD06	±5%							
		• M091-FC06§§	±3%	2.9	3.05	150	3.25	2.45	.375	3¼
		• M091-FD06§§	±5%							
		• M092-FC09	±3%	2.5	4.6	300	3.25	3.70	.375	5½
		• M092-FD09	±5%							
		• M093-FC14	±3%	2.2	7.0	450	3.25	5.07	.375	7¾
		• M093-FD14	±5%							
		• M111-FD16	±5%	1.7	8.0	625	4.19	4.72	.375	8

*LS50-1005 and LS50-1006 have 0.72° stepping increment.
**TS25-1008 and TS50-1001 have 5° stepping increment.
†Cabinet available at additional cost.
††Also requires T6382 power supply transformer.
‡Also requires series dropping resistor.
§Also requires T5934-G2 power supply transformer.
§§Require modified drives. Consult factory.

• Available off-the-shelf from distributor stock.

PAGES IN SECTIONS 2100, 4000 AND 5600

TRW GLOBE MOTORS
AN ELECTRONIC COMPONENTS DIVISION OF TRW, INC.
2275 Stanley Avenue, Dayton, Ohio 45404, U.S.A.
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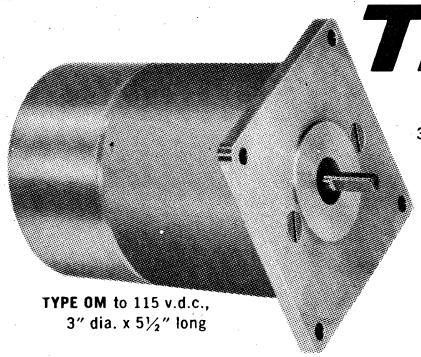
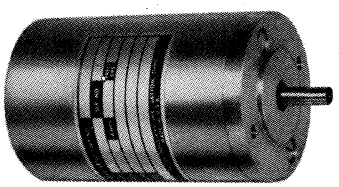
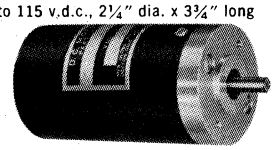


TYPE OM to 115 v.d.c., 3" dia. x 5½" long

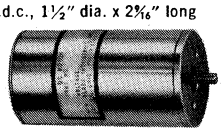


TYPE GRP to 115 v.d.c., 2¼" dia. x 3¾" long



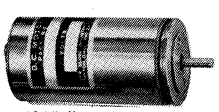
TYPE BL to 115 v.d.c., 1½" dia. x 2 15/16" long

TYPE BD to 115 v.d.c., 1½" dia. x 2 9/16" long

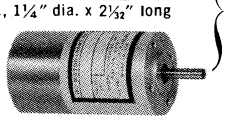


TYPE LL to 75 v.d.c., 1¼" dia. x 2⅜" long

TYPE JM to 115 v.d.c., 1¼" dia. x 2 1/32" long



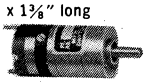
TYPE MM to 50 v.d.c., 1¼" dia. x 2 1/32" long



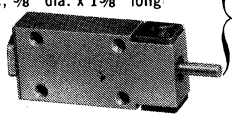
TYPE HM to 75 v.d.c., 1" dia. x 1 59/64" long

TYPE SS to 50 v.d.c., ⅞" dia. x 1⅜" long

TYPE SD to 50 v.d.c., ¾" dia. x 1⅜" long

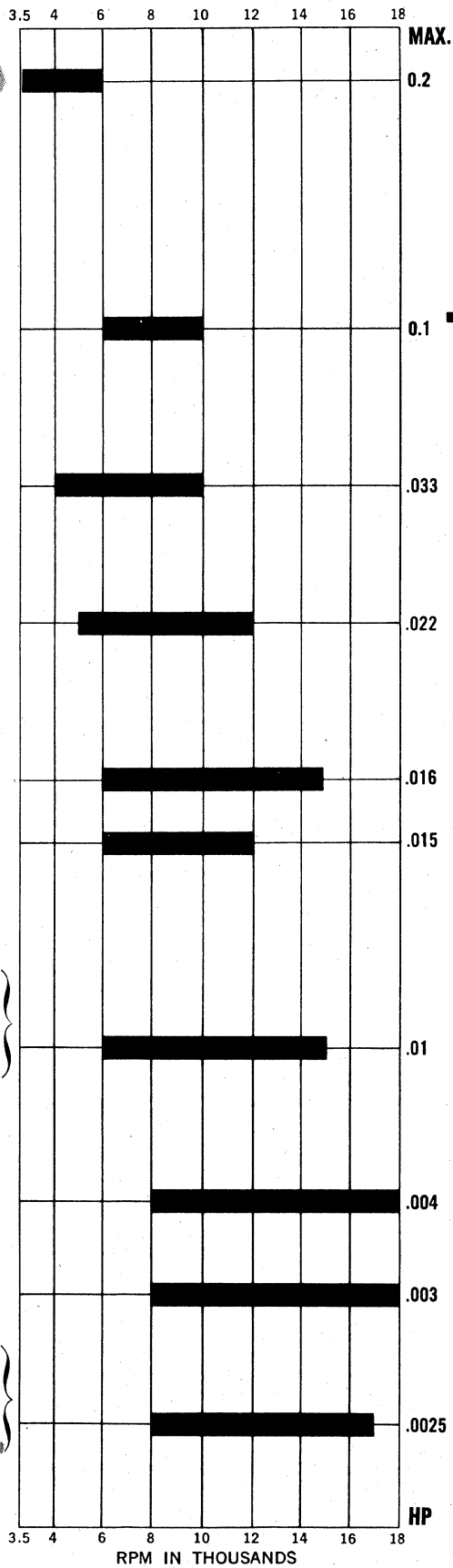


TYPE VT to 50 v.d.c., ⅝" dia. x 1⅝" long



TYPE VS to 50 v.d.c., ⅞" x 7/16" x 1⅞" long

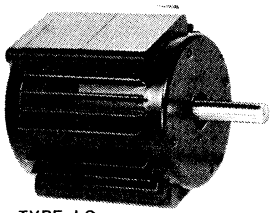
RELATIVE SIZE & DIMENSIONS



The MIL-spec D.C. motors you need are here!

If your MIL-spec d.c. motor needs fall within the parameters shown, a Globe high torque motor or gearmotor will fill the bill. Globe's complete line of compact permanent magnet and wound field motors plus integral planetary geartrains adds up to your best source for precision miniature motors.

TRW **GLOBE MOTORS**
AN ELECTRONIC COMPONENTS DIVISION OF TRW, INC.
2275 Stanley Avenue, Dayton, Ohio 45404, U.S.A. • Telephone: (513) 228-3171
TWX: 810-459-1642 • Telex: 28-8224 • Cable: GLODAY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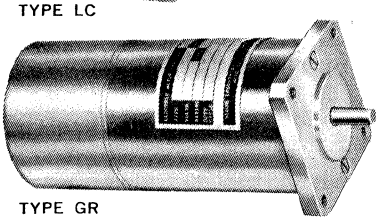
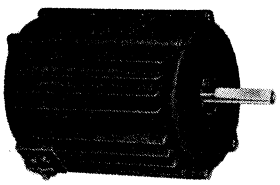
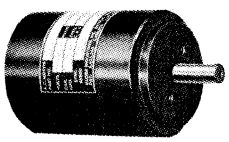

TYPE GR


TYPE YCL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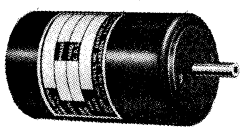
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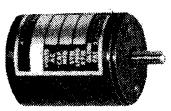
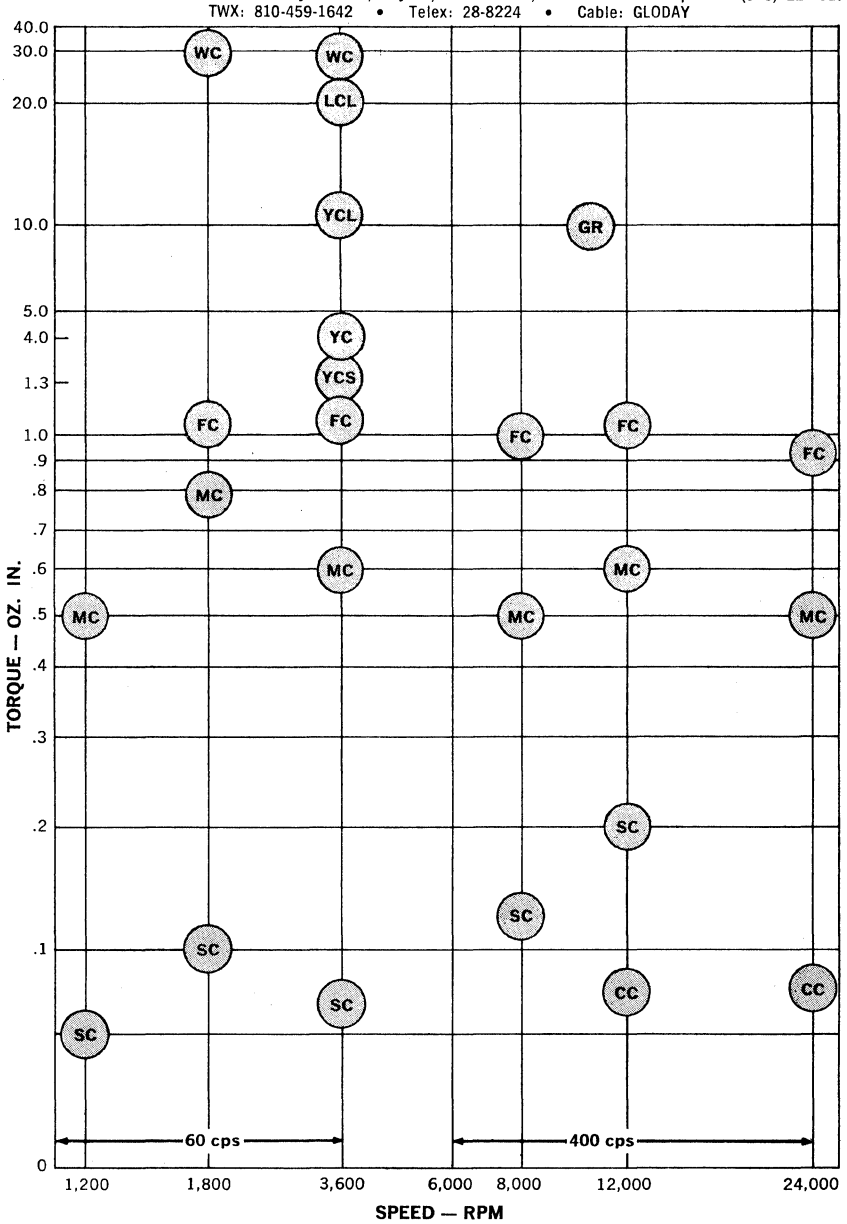

TYPE SC

TYPE CC

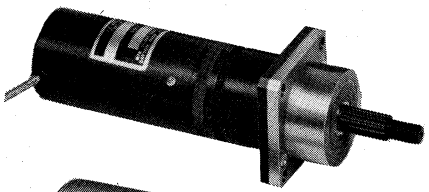


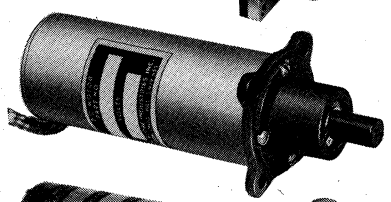
TRW/GLOBE MIL-SPEC A.C. MOTORS COVER THE TORQUE MAP

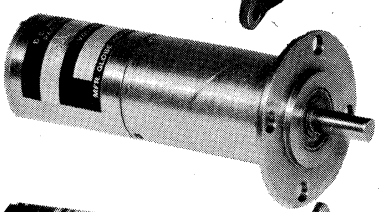
TYPE	DIA. (")	LENGTH (")	VOLTAGE	POLES	WEIGHT (oz.)
WC	3½	4½	115 v.a.c.	Consult Factory	
LC	3¾	3 3/32*	to 208 v.a.c.	2, 4	72.0
GR	2¼	4 11/32	115 v.a.c./v.d.c.	2	36.0
YCS	2¾	1 15/16**	to 230 v.a.c.	2, 4, 6	26.0
FC	1 11/16	2¼	to 200 v.a.c.	2, 4, 6, 8	11.5
MC	1¼	2¼	to 200 v.a.c.	2, 4, 6	6.5
SC	1 1/16	1 5/16	to 200 v.a.c.	2, 4, 6	2.4
CC	21/32	1 3/16	to 26 v.a.c.	2, 4	2.0

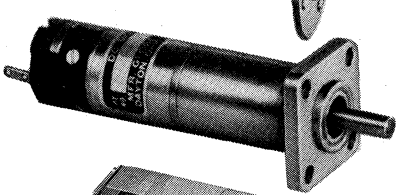
*LCL 3 27/32 **YC 2 1/16, YCL 3 3/16

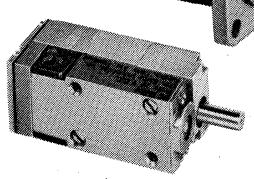
When you need helpful service in precision miniature and small motors, check first with TRW/Globe. Catalog standard a.c. motors are rated above; custom units also available. TRW/Globe hysteresis synchronous motors deliver exact speeds. Induction units produce giant torques for their size. Both types are available with standard integral planetary geartrains to match your speed-torque requirements.











D.C.

TYPE BD & BL PLANETARY

1⅞" flange: Provides 18 ratios for 1½" dia. Type BD and BL d.c. motors. Max. length 4²¹⁄₃₂". Max cont. output torque to 100 lb. in.

TYPE MM & LL PLANETARY

Provides 18 ratios for 1¼" dia. Type MM and LL d.c. motors. Max. length 4⁹⁄₆₄". Square flange is optional. Max. cont. output torque to 1000 oz. in.

TYPE SS PLANETARY

Provides 21 ratios for ⅞" dia. Type SS d.c. motors. Max. length 3¹¹⁄₆₄". Continuous output torque to 300 oz. in.

TYPE SD PLANETARY

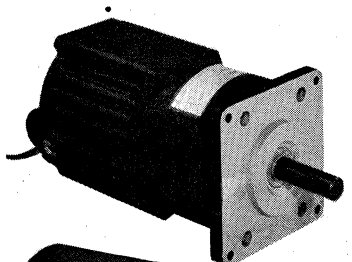
Provides 19 ratios for ¾" dia. Type SD d.c. motors. Max. continuous output torque to 300 oz. in.

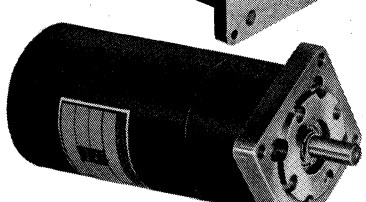
TYPE VT PLANETARY

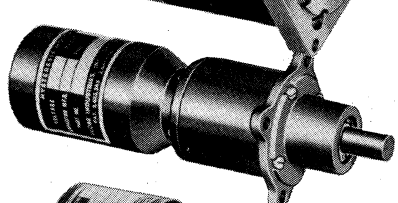
Provides 35 ratios for ⅝" dia. Type VT d.c. motors. Max. length 3". Max. output torque to 50 oz. in.

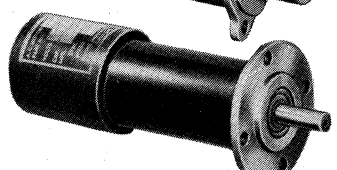
TYPE VS SPUR

Provides 62 ratios for ⁷⁄₁₆" x ⅞" Type VS d.c. motors. Max. output torque to 35 oz. in. Side-by-side version is ⅞" x ⅞" x 2¼" long.









A.C.

TYPE LC PLANETARY

Available with 11 standard ratios from 12:1 to 1800:1. Torque to 200 lb. in. continuous duty and to 600 lb. in. intermittent duty.

TYPE FC PLANETARY

Provides 18 odd and 83 even ratios for 1¹¹⁄₁₆" dia. Type FC a.c. motors. Max. length 4³⁄₃₂". Max. continuous output torque to 1250 oz. in.

TYPE MC PLANETARY

Provides 83 even ratios, or 18 odd ratios for 1¼" dia. Type MC a.c. motors. Max. length 4³⁄₁₆". Square flange is optional. Max. continuous output torque to 1000 oz. in.

TYPE SC PLANETARY

Provides 21 ratios for 1⁹⁄₁₆" dia. Type SC a.c. motors. Max. length 3⁷⁄₃₂". Max. continuous output torque to 300 oz. in.

TRW GLOBE MOTORS

AN ELECTRONIC COMPONENTS DIVISION OF TRW, INC.
2275 Stanley Avenue, Dayton, Ohio 45404, U.S.A.
Telephone: (513) 228-3171 • TWX: 810-459-1642
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Mil-Spec Gearmotors

TRW/Globe MIL-Spec motors may be fitted with integral geartrains of planetary or spur gear design. Standard units, mated to the proper motor, can produce almost any desired speed. Torque multiplication possibilities are enormous because of the efficiency and ruggedness of TRW/Globe's planetary design. Geartrain capacities extend through 1/5 hp.

TRW GLOBE MOTORS

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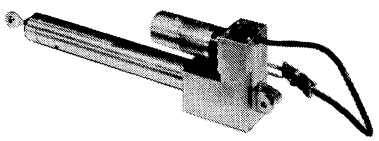
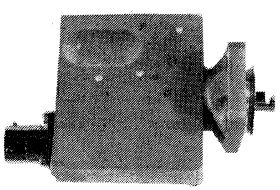
Linear Actuators

(Tension or Compression)

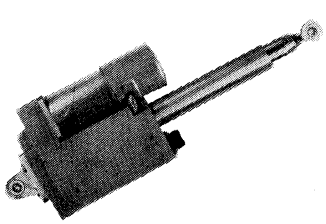
TRW/Globe linear actuators are furnished specifically to meet your package size and performance requirements. Because they incorporate one or more TRW/Globe a.c. or d.c. motors, gear boxes and other components, we exercise control over design, manufacturing and testing.



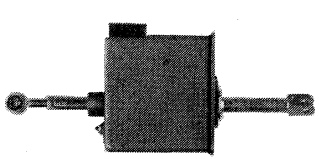
PART NO. 65A106
rated voltage: 28 v.d.c.
rated load: 500 lbs.
stroke length: 6 in.
travel rate: .167 in. per sec.



PART NO. 65A117
rated voltage: 115 v.a.c., 400 Hz, 1 phase
rated load: 80 lbs.
stroke length: ⅛ in.
travel rate: .167 in. per sec.



PART NO. 65A119
rated voltage: 28 v.d.c.
rated load: 600 lbs.
stroke length: 8.46 in.
travel rate: .7 in. per sec.



PART NO. 65A127
rated voltage: 28 v.d.c.
rated load: 7 lbs.
stroke length: 1.53 in.
travel rate: .21 in. per sec.

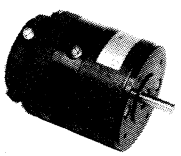
Snapper Series Wide Bandwidth

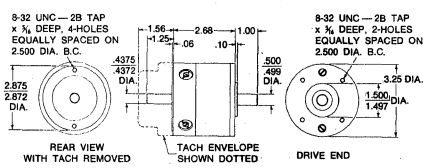
DC SERVO MOTORS

(FOR COMPLETE SNAPPER SPEED/POSITION CONTROL SYSTEMS, SEE **EEM** Vol.2•991)
(FOR AMPLIFIER COMPONENTS SEE **EEM** Vol.2•322)

The SNAPPER is a high performance permanent magnet field DC servo motor for use in both direct drive or geared servo systems. It is capable of high speed, low speed, control through zero speed, as well as plugging and operation at stall. The SNAPPER line is so named because of its very high torque capability in a TOTALLY ENCLOSED, NON VENTILATED frame. The excellent thermal capacity of the SNAPPER makes it possible to operate severe servo duty cycles without overheating. Its rotor construction is not subject to warpage, or to the extreme temperature cycles that plague designs of lesser thermal capacities and ruggedness.

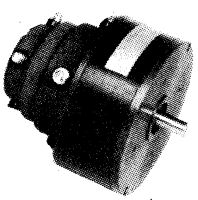
SPECIFICATIONS FOR MODELS MT-3210-023 (A) THROUGH (H)

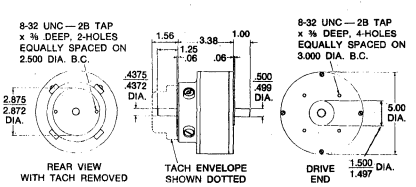




SPECIFICATIONS	Peak Torque	Rated Torque	Rated Power	Inertia	Mech. Time Const.	Elec. Time Const.	Resistance @ 25°C	Torque Sensitivity	Back EMF
SYM	T_P	T_R		J_M	τ_M	τ_E	R_M	K_T	K_B
Units	oz-in	oz-in	HP	oz-in-sec² x 10^{-3}	milli-sec	milli-sec	ohms	oz-in-amp	volts-KRPM
A	100	30	1/20	3.8	9.6	0.34	4.5	16.0	11.9
B	100	30	1/20	3.8	9.6	0.34	11.0	26.0	19.3
C	100	30	1/20	3.8	9.6	0.34	7.0	20.0	15.0
D	100	30	1/20	3.8	9.6	0.34	2.8	12.7	9.4
E	100	30	1/20	3.8	9.6	0.34	17.5	32.0	23.7
F	100	30	1/20	3.8	9.6	0.34	1.75	10.0	7.4
G	100	30	1/20	3.8	9.6	0.34	1.1	8.0	5.9
H	100	30	1/20	3.8	9.6	0.34	.70	6.3	4.7

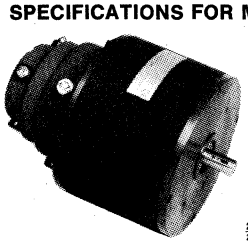
SPECIFICATIONS FOR MODELS MT-5010-023 (A) THROUGH (H)

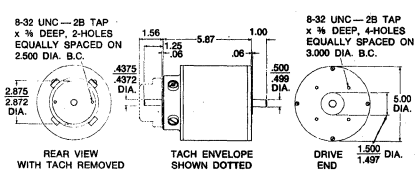




A	600	150	1/6	45	10.0	1.2	0.63	20.0	14.8
B	600	150	1/6	45	10.0	1.2	6.4	62.0	46.0
C	600	150	1/6	45	10.0	1.2	2.5	40.0	29.5
D	600	150	1/6	45	10.0	1.2	0.25	12.8	9.5
E	600	150	1/6	45	10.0	1.2	4.0	50.0	37.0
F	600	150	1/6	45	10.0	1.2	1.57	32.0	23.7
G	600	150	1/6	45	10.0	1.2	1.0	25.0	18.5
H	600	150	1/6	45	10.0	1.2	.40	16.0	11.8

SPECIFICATIONS FOR MODELS MT-5030-029 (A) THROUGH (H)





A	1600	400	1/2	120	10.0	1.6	0.70	36.0	26.0
B	1600	400	1/2	120	10.0	1.6	5.8	115	85.0
C	1600	400	1/2	120	10.0	1.6	1.1	44.0	33.0
D	1600	400	1/2	120	10.0	1.6	1.75	56.0	41.0
E	1600	400	1/2	120	10.0	1.6	0.45	28.0	21.0
F	1600	400	1/2	120	10.0	1.6	0.30	22.0	16.4
G	1600	400	1/2	120	10.0	1.6	0.08	17.5	13.0
H	1600	400	1/2	120	10.0	1.6	0.12	13.7	10.0

NOTE: FOR ALL SPECIFICATIONS:
Tach. Sensitivity, K_V, Volts-KRPM: 3.0
Tach. Ripple Volts, % of Avg.: ±1

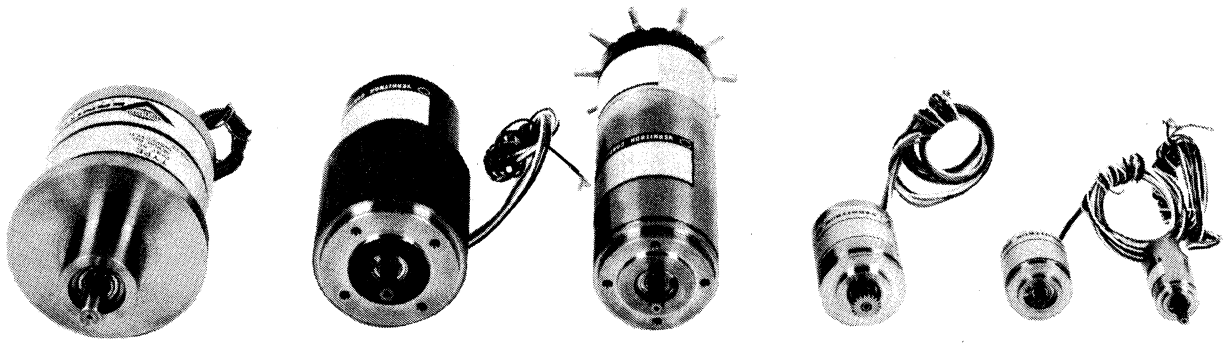
Torque Systems Inc.
P.O. Box 167, 225 Crescent Street, Waltham, Mass. 02154 (617) 891-0230

VERNITECH
DIVISION OF VERNITRON CORPORATION

the best known name in

MOTORS, TACHOMETERS, INTEGRATORS & STEPPER MOTORS

Over 1500 standard designs
or, custom designed to YOUR requirements



ALL UNITS WITH AND WITHOUT GEARHEADS

the full range of motors

TYPES		Servomotors Viscous Damped Motors Inertially Damped Motors	Hysteresis Synchronous Motors Stepper Motors Motor Generators Rate Motor Tachometers	Computing Motor Tachometers Integrating Motor Tachometers Spin (Gyro) Motors
SIZES	BuOrd Size 5 (0.5″ Dia.) to BuOrd Size 23 (2.250″ Dia.)			
SPEEDS	900 RPM to 36,000 RPM (Stepper Motors in Steps of 7.5°, 15°, 45°, and 90°)			
FREQUENCY	50, 60, 80, 400, 420, 480, 1000, and 1200 (Sine or Square Wave) Variable Frequency Motors are also standard at Vernitron			
VOLTAGES	6.3V (Filament) to 280V			
PHASES	1, 2, and 3 (In Stepper Motors—2, 3, and 4)			

PLUS THE NEW 14M4B SERIES INDUSTRIAL GRADE INDUCTION MOTORS

typical data

SIZE	1.375″ Dia. x 2.5″	**VOLTAGE**	115 VAC, Single ϕ
BREAKDOWN TORQUE	1.0 Oz.-In.	**POWER**	27 Watts
NO LOAD SPEED	11,000 RPM	**FREQUENCY**	400 Hz

Also available in 60 Hz, 26 VAC versions. Ask about our industrial synchronous motors.

VERNITECH
DIVISION OF VERNITRON CORPORATION
300 Marcus Boulevard, Deer Park, New York 11729 / (516) 586-5100, TWX: 510-227-6079

SEE Vol.1•380, 1•381 & Vol.2•543 FOR OTHER ENCODERS, CONVERTERS, AND READOUTS

CENTRALAB SEMICONDUCTOR

OPTOELECTRONIC PRODUCTS

WE SOLVE LIGHT SENSING PROBLEMS! As the leading developer and producer of silicon photosensitive devices, we have the technical know-how and ability to provide solutions to your most complex optoelectronic problems. ■ These standard Centralab Semiconductor products are designed to cover a broad general range of applications. Often one of them can be adapted to fit your special needs. However, we are also a major producer of custom designed circuits or packaging to fit particular requirements. Call us! Our applications department is ready to help you solve your problem.

OPTO-HYBRID SENSORS

DTL/TTL compatible light sensor/amplifier/digitizer subsytems; available in standard 1, 9 and 12 channel packages.

Type Number	Supply Voltage	Current Requirement (Max per channel)	Threshold (Radiometric) H_{th} Min	Threshold (Radiometric) H_{th} Max	Maximum Matching Ratio H Max/Min	Maximum Shape Factor F	Min. Output High (Light) I_{OH} = 0.2mA	Max. Output Low (Dark) I_{OL} = 4 mA	Max. Propagation Delay t_{pd}	Max. Rise Time t_r	Max. Fall Time t_f
	Vdc	mA	mw/cm²	mw/cm²			Vdc	Vdc	µsec	µsec	µsec
OH100	5 ± .25	6	2.5	10.0	—	1.10	4.0	0.4	1.0	1.0	1.0
OH102			1.0	3.0	—						
OH106			—	0.2	—						
OH106A			.03	0.1	—						
OH900			—	10.0	2.0						
OH900A			—	10.0	1.2						
OH1200			—	10.0	2.0						
OH1200A			—	10.0	1.2						

All types also available with monolithic integrated circuits

LIGHT EMITTING DIODES

Type Number	Case Type	Minimum P_O @ I_F	Maximum V_F @ I_F	I_F	Typical λ_P	Typical $\Delta\lambda$	Minimum BV_R I_R @ 10µA	I Maximum T_A = 25°C
		mW	Volts	mA	nm	nm	Volts	mA
CL100	TO-18(L)	1.0	1.50	100	930	36	—	100
CL110	TO-18(E)	0.25	1.60	50	900	50	—	70
CL110A	TO-18(E)	0.50	1.50	50	900	50	3	70
CL110B	TO-18(E)	0.60	1.50	50	900	50	5	70
CL150	DO-31	0.27	1.50	50	930	36	6	120

TO-18(L): Glass lens TO-18(E): Epoxy lens

THE PERFECT PAIR Matched emitter/sensor Opto-Hybrid assembly

Type Number	Supply Voltage V_{CC}	Minimum Output High (Light) V_{OH}(1)	Maximum Output Low (Dark) V_{OL}	Typical Propagation Delay t_{pd}	Maximum Rise Time t_r	Maximum Fall Time t_f	Isolation Emitter-to Detector	Detector Supply Current, Total
	Vdc	Vdc	Vdc	µ sec	µ sec	µ sec	Vdc	mA
PP900	5 ± .25	3.0	0.4(2)	1.5	2.0	2.5	100	120
PP900A	5 ± .25	3.0	0.4(3)	1.5	2.0	2.5	100	120

Operating Temperature: 0 to +75°C Storage Temperature: −55 to +125°C
(1) With 80% transmissive neutral density filter in tape slot.
(2) With 10% transmissive neutral density filter in tape slot.
(3) With 50% transmissive neutral density filter in tape slot.

PHOTO DIODES

Type Number	Case Type	Light Current H = 20mW/cm² 2800°K Tungsten V_R = −5V, T_A = 25°C Min.	Light Current Max.	Maximum Dark Current H = 0 I_R @ V_R 25°C	100°C	V_R	Effective Active Area	Typical Junction Capacitance @ V_R = −5V	P_D (max.) T_A = 125°C
		µA	µA	nA	nA	volts	cm²	pf	mW
CPD 110	TO-18(W)	10	20	20	150	5	.008	8	50
CPD 110A	TO-18(W)	10	20	20	150	20	.008	8	50

TO-18(W): Glass window

PHOTO RELAY

Parameters	Min.	Typ.	Max.	Units
Relay Operating Voltage	50	115	135	Vac
Relay Contact Rating (SPDT)		1		Amperes (Continuous)
Sensitivity Threshold (Radiometric Terms) (1)		20		µW/cm²
Sensitivity Threshold (Photometric Terms) (1)		0.6		Ft. C
Operating Temp.	0		+80	°C
Storage Temp.	−55		+125	°C

(1) Based on irradiance or illuminance from a Tungsten source at 2800°K color temperature.

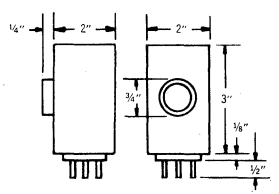
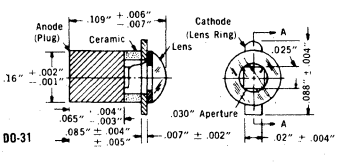
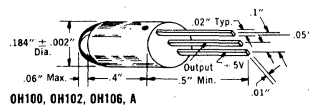


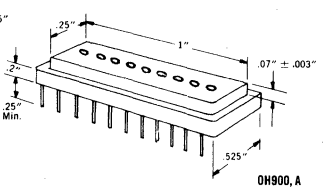
Photo Relay



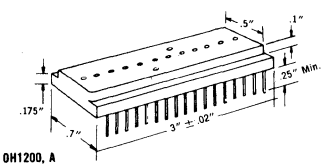
OPTOELECTRONIC DEVICE OUTLINE DIMENSIONS



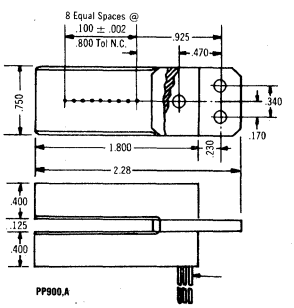
OH100, OH102, OH106, A



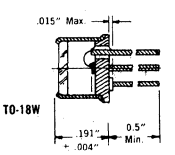
OH900, A



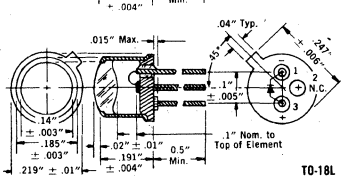
OH1200, A



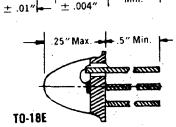
PP900,A



TO-18W



TO-18L



TO-18E

CENTRALAB SEMICONDUCTOR
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CENTRALAB SEMICONDUCTOR

OPTOELECTRONIC PRODUCTS

PUNCHED TAPE AND CARD SENSORS

Type Number (1)	Sensor Positions		Segment Active Area	Nominal Output	Maximum Dark Reverse Current
	Total Number (1)	Center-to-Center Spacing			
		inches	inches	μA (2)	μ (3)
HPC	3 thru 10	.100	.160 x .080	205-345	20
HSR	3 thru 10	.087	.125 x .030	100-140	10

NOTES: 1. To order, indicate number of segments after type number; i.e., HPC-9 is 9 segment HPC.
2. Per segment. Measured at 500 foot-candles, 2800°K, 25°C, 1 K Load.
3. Per segment. Measured at −1.0V, 25°C.

1 WATT SOLAR PANELS

Type Number	Overall Dimensions Excluding Terminals	Output Voltage	Output Power	
			100 mW/cm² Sunlight or Tungsten	Daily Average from Fixed Position
CSP4.7 CSP7 CSP14 CSP16.5 CSP28	.75 x 6.25 x 6.75 inches	4.7 7 14 16.5 28	1 Watt minimum	6 Watt-hours

TWO ELEMENT NULL INDICATOR

Type Number	Nominal Overall Dimensions inches Excluding 1.3" leads			Electrical Specifications	
	Case	Each Active Area	Null	Voltage (1)	Imbalance Between Elements (1)
HLSN-221	.063 H x .10 W x .44 L	.09 L x .04 W	.02 Wide	250 mV min.	50 mV max.

NOTE: (1) Measured at 280 foot-candles, 2800°K, 10 K Load.

PHOTO SENSORS

Type Number	Maximum Overall Dimensions Excluding 2" Min. Leads	Active Area	Output (1)		Maximum Dark Reverse Current
	inches	inches	mV	μA	μA
EA7E1	0.5 x .082	.130 x .050	300	300	5
EA7E2			300	300	10
EA7E3			250	250	10

SPEED OF RESPONSE: 10 microseconds or less, depending on load resistance.
SPECTRAL RESPONSE: Range, 0.4 to 1.15 microns; Peak, 0.85 microns.

NOTE: (1) Measured at 280 foot-candles, 2800°K, 10 K Load.

PLANAR PHOTO SENSORS

Type Number	Nominal Overall Dimensions		Active Area		Minimum Output (1)		Maximum Dark Current	
	cm.	inches	square cm.	square inches	I_{SC}	V_{OC}	I_R @ V_R = 1	I_R @ V_R = 6
					mA	mV	μA	μA
58P-1	0.5 x 0.224	0.197 x 0.088	0.077	0.012	0.130	400	0.1	0.4
58P-2								
55P-1	0.5 x 0.478	0.197 x 0.188	0.18	0.028	0.310		0.4	5.0
55P-2								
51P-1	0.5 x 0.986	0.197 x 0.388	0.38	0.059	0.650		0.8	10.0
51P-2								
52P-1	0.5 x 2.0	0.197 x 0.788	0.77	0.119	1.2		2.0	15.0
52P-2								
110P-1	1 x 1	0.394 x 0.394	0.86	0.133	1.4		1.0	15.0
110P-2								

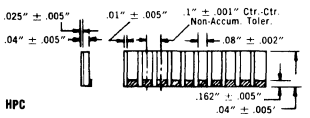
(1) Measured at 20 mW/cm² irradiance from 2800°K tungsten source

GENERAL PURPOSE PHOTO SENSORS

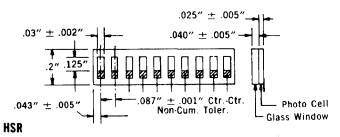
Type Number	Nominal Overall Dimensions		Active Area		Typical Output (1)		Typical Output @ 400 mV (1)		Typical Dark Current
					I_{SC}	V_{OC}	Current	Power	I_R @ V_R = 1
	cm.	inches	square cm.	square inches	mA	mV	mA	mW	μA
2A	2.86 dia.	1.125 dia.	5.1	0.79	155.0	550	127.0	50.8	40
110C	1.0 x 1.0	0.4 x 0.4	0.9	0.14	27.0	550	21.4	8.5	22
52C	0.5 x 2.0	0.2 x 0.8	0.8	0.12	23.0	550	20.0	8.0	15
51C	0.5 x 1.0	0.2 x 0.4	0.4	0.06	11.0	550	9.3	3.7	10
55C	0.5 x 0.5	0.2 x 0.2	0.2	0.03	5.4	530	4.6	1.8	5
58C	0.5 x 0.25	0.2 x 0.1	0.1	0.014	2.5	510	2.2	.88	2

(1) Measured at 200 mW/cm² irradiance from 2800°K tungsten source

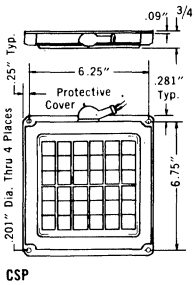
OPTOELECTRONIC DEVICE OUTLINE DIMENSIONS



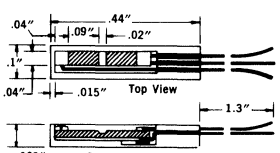
HPC



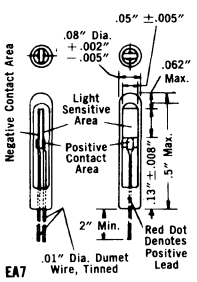
HSR



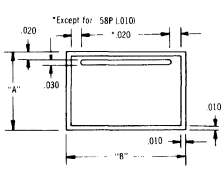
CSP



HLSN-221

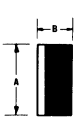


EA7



Planar Photo Sensors

Type Number	Nominal Overall Dimensions		Active Area	
	A	B	Sq. cm	Sq. in.
58P-1, 2	.197	.088	.077	.012
55P-1, 2	.197	.188	.18	.028
51P-1, 2	.197	.388	.38	.059
52P-1, 2	.197	.788	.77	.119
110P-1, 2	.394	.394	.86	.133



General Purpose Photo Sensors

Type Number	Nominal Overall Dimensions		Active Area	
	A	B	Sq. cm	Sq. in.
2A	1.125 dia.	1.125 dia.	5.1	0.79
110C	0.4	0.4	0.9	0.14
52C	0.2	0.8	0.8	0.12
51C	0.2	0.4	0.4	0.06
55C	0.2	0.2	0.2	0.03
58C	0.2	0.1	0.1	0.014

A comprehensive condensed catalog of all Centralab PRIME semiconductor products is available upon request.

Contact us for complete data on these devices or for assistance from our opto-electronic engineers with your particular application.

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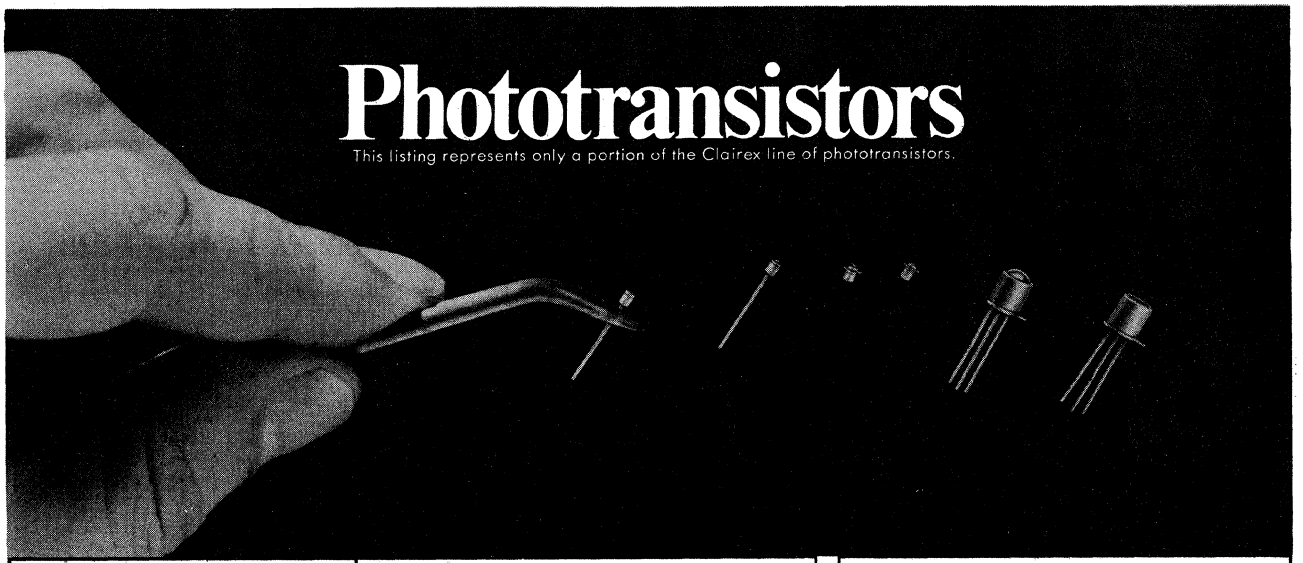
Phototransistors

This listing represents only a portion of the Clairex line of phototransistors.



Silicon NPN Planar Epitaxial Phototransistors

Maximum Ratings
Maximum Temperatures
Storage Temperature −65°C to + 200°C
Operating Junction Temperature +150°C
Maximum Power Dissipation
Total Dissipation at 25°C, P_T =250mW derate 2.0mW/°C
Total Dissipation at 100°C, P_T = 100mW

ELECTRICAL CHARACTERISTICS	CLT 2010	CLT 2030	CLT 2130	CLT 2160	CLR 2050	CLR 2060	CLR 2170	CLR 2180
Package or Size ("O.D.)	TO-18	TO-18	TO-18	TO-18	TO-18	TO-18	TO-18	TO-18
Window or Lens	W	W	L	L	W	W	L	L
MAX VOLTAGES (Volts)								
V_{CBO}	80	60	80	60	80	80	80	80
V_{CEO}	50	30	50	30	40	40	40	40
V_{ECO}	5	5	5	5				
V_{EBO}					10	10	10	10
MAX CURRENT I_C ma, Note 3.	200	200	200	200	200	200	200	200
LIGHT CURRENT in ma , Note 1.								
I_L (V_{CE}=5V, H=0.02mW/cm²) min.							0.2	0.6
I_L (V_{CE}=5V, H=0.02mW/cm²) max.							0.8	
I_L (V_{CE}=5V, H=0.2mW/cm²) min.					0.6	1.4	2.0	4.0
I_L (V_{CE}=5V, H=0.2mW/cm²) max.					1.8	4.0		
I_L (V_{CE}=5V, H=2.0mW/cm²) min.					6.0	14.0		
I_L (V_{CE}=5V, H=2.0mW/cm²) max.								
I_L (V_{CE}=5V, H=5.0mW/cm²) min.	0.2	1.0	0.6	4.0				
I_L (V_{CE}=5V, H=5.0mW/cm²) max.	0.6	3.0	1.8	12.0				
I_L (V_{CE}=5V, H=20.0mW/cm²) min.								
I_L (V_{CE}=5V, H=20.0mW/cm²) max.								
DARK CURRENT								
I_D (I_{CEO} @ 25°C) in na, H=O max.	25	25	25	25	100	100	100	100
I_D (I_{CEO} @ 100°C) in μa, H=O max.	25	25	25	25				
BREAK DOWN VOLTAGES (Volts)								
BV_{CEO} I_C=100 μa min.	50	30	50	30	40	40	40	40
BV_{CBO} I_C=100 μa min.	80	60	80	60	80	80	80	80
BV_{EBO} I_E=100μa min.					10	10	10	10
BV_{ECO} I_{EC}=100 μa min.	5	5	5	5				
t_rμsec (I_C=0.5ma, R_L=100 Ω, V_{CC}=5V) Note 2. (Typical)	3	3	3	3	100	100	100	100
t_fμsec (I_C=0.5ma, R_L=100 Ω, V_{CC}=5V) Note 2. (Typical)	3	3	3	3	150	150	150	150
$V_{CE\ (SAT)}$ I_C=10ma, I_B=0.05ma, H=O					1.0	1.0	1.0	1.0
$V_{CE\ (SAT)}$ I_C=10ma, I_B=0.5ma, H=O	0.30	0.30	0.35	0.30				
$V_{CE\ (SAT)}$ I_C=0.4, H=20mW/cm²								

Maximum Ratings
Maximum Temperatures
Storage Temperature −65°C to +180°C
Operating Junction Temperature +150°C
Maximum Power Dissipation
Total Dissipation at 25°C, P_T =50mW derate 0.5mW/°C
Total Dissipation at 100°C, P_T =12.5mW

CLT 3020	CLT 3030	CLT 3160	CLT 3170	CLT 4020	CLT 4030	CLT 4160	CLT 4170
.060"	.060"	.060"	.060"	.060"	.060"	.060"	.060"
W	W	L	L	W	W	L	L
50	40	50	40	50	40	50	40
5	5	5	5	5	5	5	5
200	200	200	200	200	200	200	200
0.1	0.25	0.5	2.0	0.1	0.25	0.5	2.0
0.4	1.0	2.0	7.0	0.4	1.0	2.0	7.0
1.2	3.0	7.0		1.2	3.0	7.0	
10	10	10	10	10	10	10	10
50	40	50	40	50	40	50	40
5	5	5	5	5	5	5	5
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Note 1: The light source is a frosted tungsten incandescent lamp at 2854°K. **Note 2:** The light source is a gallium arsenide LED pulsed with a rise and fall time of < 0.3 μsec.
Note 3: Pulsed conditions: 300 μsec., 2% duty cycle.

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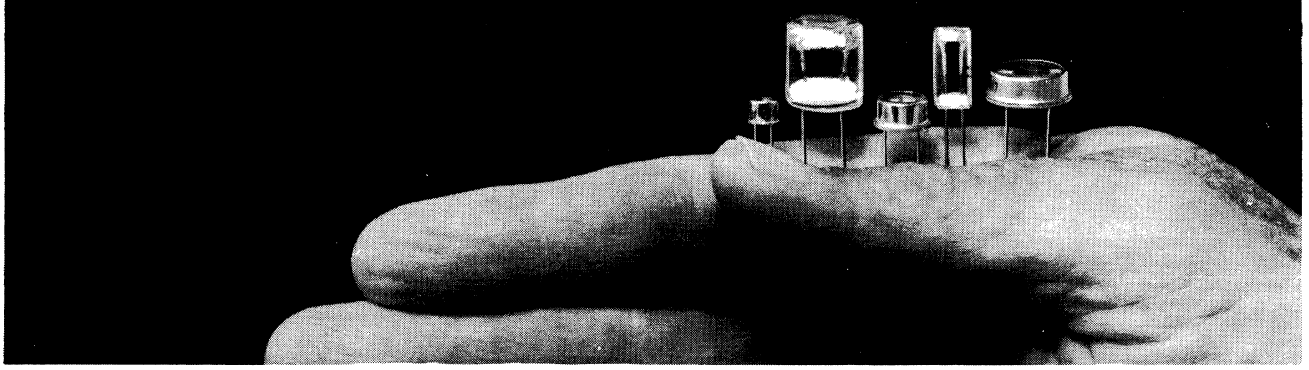
Photoconductive Cells

This listing represents less than half of the Clairex standard and special photocells available. A 16-page design manual is available on request.



Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 fc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)
CL5M2	.55 X .18	55K	1:100	250	2000-500[1]
CL602	.25 X .5	1 meg.		300	75
CL702	.36 X .18	1 meg.		300	125
CL902	.21 X .15	1 meg.		250	50

Type 2 CdS (photosensitive material designated by last number in ordering abbreviation, i.e. CL5M2). Peak spectral response 5150 angstroms, bluest response photosensitive material, high stability, lowest temperature error.

CL503	.5 X .5	7.2K	1:10,000	250	500-250[1]
CL5M3	.55 X .18	7.2K		250	2000-500[1]
CL603	.25 X .5	133K		300	75
CL603A	.25 X .5	75K		300	75
CL603AL	.25 X .5	3.5K		170	75
CL703	.36 X .18	133K		300	125
CL703A	.36 X .18	67K		300	125
CL703L	.36 X .18	2.7K		100	125
CL903	.21 X .15	133K		250	50
CL903A	.21 X .15	67K		250	50
CL903L	.21 X .15	6.0K		100	50

Type 3 CdSe, peak spectral response 7350 angstroms, fast response, and very high light-to-dark resistance ratio. Can be used for high speed switching or counting. Sensitive to near infra red. For use with incandescent or neon lamps.

CL504	.5 X .5	1.5K	1:400	250	500-250[1]
CL5M4	.55 X .18	1.5K		250	2000-500[1]
CL504L	.5 X .5	0.25K		170	500-250[1]
CL5M4L	.55 X .18	0.25K		170	2000-500[1]
CL604	.25 X .5	30K		300	75
CL604L	.25 X .5	1.5K		170	75
CL704	.36 X .18	30K		300	125
CL704L	.36 X .18	0.6K		100	125
CL904	.21 X .15	30K		250	50
CL904L	.21 X .15	2K		100	50

Type 4 CdSe, peak spectral response 6900 angstroms, lowest resistance photocells available. Can be used for "on-off" applications when low resistance is desired. For use with incandescent or neon lamps.

CL505	.5 X .5	9K	1:100	250	500-250[1]
CL5M5	.55 X .18	9K		250	2000-500[1]
CL505L	.5 X .5	1.5K		170	500-250[1]
CL5M5L	.55 X .18	1.5K		170	2000-500[1]
CL605	.25 X .5	166K		300	75
CL605L	.25 X .5	7.5K		170	75
CL705	.36 X .18	166K		300	125
CL705L	.36 X .18	3.3K		100	125
CL905	.21 X .15	166K		250	50
CL905L	.21 X .15	10K		100	50

Type 5 CdS, peak spectral response 5500 angstroms (closely matches the human eye), most stable, lowest memory photocell available. Can be used in light measuring applications and precision low speed switching. For use with incandescent, fluorescent or neon lamps.

CL705HL	.36 X .18	28K	1:1000	100	125
CL905HL	.21 X .15	100K		100	50
CL905HN	.21 X .15	700K		100	50

Type 5H CdS, peak spectral response 5500 angstroms (closely matches the human eye). Combines high speed, stability, linearity, and uniform color temperature response.

Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 fc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)
CL507	.5 X .5	7.2K	1:300	250	500-250[1]
CL5M7	.55 X .18	7.2K		250	2000-500[1]
CL607	.25 X .5	133K		300	75
CL707	.36 X .18	133K		300	125
CL707L	.36 X .18	2.7K		100	125
CL907	.21 X .15	133K		250	50
CL907N	.21 X .15	66K		100	50

Type 7 CdS, peak spectral response 6150 angstroms, moderate speed and ratio. Can be used in general beam breaking applications. For use with incandescent, neon or fluorescent lamps.

CL707H	.36 X .18	500K	1:1000	300	125
CL707HM	.36 X .18	100K		250	125
CL907H	.21 X .15	600K		250	50
CL907HN	.21 X .15	300K		100	50
CL907HL	.21 X .15	24K		100	50

Type 7H CdS Peak Spectral response 6200 angstroms. Very fast decay time coupled with low resistance and high linearity. Ideal for beam breaking applications.

Photocell ordering abbreviation	Diam. X Length (inches)	Resistance @ 2 fc ± 33⅓%	Minimum resistance ratio from 2 ftc to Dark within 5 sec.	Maximum voltage	Power Dissipation @ 25°C (mw)	Type
CL703/2	.36 X .18	50K	1:10,000	300	125	3 CdSe
CL703L/2	.36 X .18	6.5K	1:10,000	100	125	3 CdSe
CL704/2	.36 X .18	17K	1:400	300	125	4 CdSe
CL704L/2	.36 X .18	1.5K	1:400	100	125	4 CdSe
CL705/2	.36 X .18	166K	1:100	300	125	5 CdSe
CL705L/2	.36 X .18	7.5K	1:100	100	125	5 CdSe

DUAL ELEMENT

• Photocells contain two separate elements with two separate leads and one common lead.

CELL • CLAIREX • LAMP
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PHOTOMOD®

PHOTOCELL-LAMP ASSEMBLIES

Part No.	Rated Lamp Voltage	Resistance (Max. Ohms) @ Rated Lamp Voltage	Max. Allowable Cell Voltage @ Peak AC
CLM3006A	6	160	120V
CLM4006A	6	55	120V
CLM4012A	12	30	120V
CLM3012A	12	160	120V
CLM5H10A	10	3000	120V
CLM7H16A	16	550	170V
CLM3120A	120	1150	120V
CLM4120A	120	160	120V

FOOTNOTE: [1] With and without heat sink.

CLAIREX ELECTRONICS

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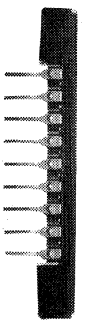
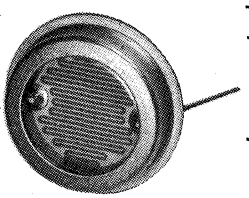
VARIATIONS OF LIGHT

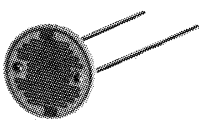
STANDARD PHOTOELECTRIC PRODUCTS FROM NSL

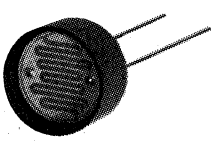
CdS & CdSe PHOTOCELLS

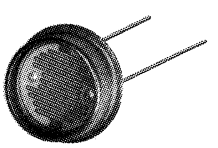
Cell Type No.	Typ. 1 Ftc Res. KΩ	Min. Dark Res. MΩ	Max. Peak Volt.	Max. Power MW.	Description
NSL-312	75	100	70	50	
NSL-313	30	1uJ	70	50	
NSL-314	14	100	70	50	CdSe Photoconductive Cell in Hermetic Glass and Metal TO-18.
NSL-315	550	1000	250	50	
NSL-316	260	1000	250	50	
NSL-317	110	1000	250	50	
NSL-318	50	500	120	50	
NSL-3122	75	20	70	50	
NSL-3132	30	20	70	50	CdSe Epoxy Coated "Open Pill" TO-18 dia. Photoconductive Cell. CdS versions also available.
NSL-3142	14	20	70	50	
NSL-3152	550	200	250	50	
NSL-3162	260	200	250	50	
NSL-3172	110	200	250	50	
NSL-3182	50	100	120	50	
NSL-412	75	10	80	50	
NSL-413	30	2.0	80	50	Cds Photoconductive Cell in Hermetic Glass and Metal TO-18. Epoxy Coated "Open Pill" versions also available.
NSL-414	14	.2	80	50	
NSL-415	550	160	250	50	
NSL-416	260	100	250	50	
NSL-417	110	50	250	50	
NSL-418	50	5.0	120	50	
NSL-443	200	300	2000	1000	
NSL-444	120	100	2000	1000	Cds Photoconductive Cell in Hermetic Glass and Metal 1.25" Dia. Case
NSL-445	26.0	15	420	1000	
NSL-446	11.4	5	420	1000	
NSL-447	5.5	1	420	1000	
NSL-361	65	200	70	100	
NSL-362	28	200	70	100	
NSL-363	12	200	70	100	CdSe Photoconductive Cell in Hermetic Glass and Metal ¼" Dia. Case.
NSL-364	5.2	200	70	100	
NSL-365	550	3000	250	100	
NSL-366	230	3000	250	100	
NSL-367	100	3000	250	100	
NSL-461	65	80	80	100	
NSL-462	28	20	80	100	
NSL-463	12	2.7	80	100	Cds Photoconductive Cell in Hermetic Glass and Metal ¼" Dia. Case
NSL-464	5.2	0.7	80	100	
NSL-465	550	160	250	100	
NSL-466	230	20	250	100	
NSL-467	100	4	250	100	
NSL-381	43.0	100	80	200	
NSL-382	18.6	100	80	200	
NSL-383	8.0	100	80	200	CdSe Photoconductive Cell in Hermetic Glass and Metal TO-5.
NSL-384	3.5	100	80	200	
NSL-385	330	1000	250	200	
NSL-386	155	1000	250	200	
NSL-387	66	1000	250	200	
NSL-3812	43.0	20	100	200	
NSL-3822	18.6	20	100	200	CdSe Epoxy Coated "Open Pill" TO-5 dia. Photoconductive Cell. CdS versions also available.
NSL-3832	8.0	20	100	200	
NSL-3842	3.5	20	100	200	
NSL-3852	330	200	320	200	
NSL-3862	155	200	320	200	
NSL-3872	66	200	320	200	
NSL-481	43.0	65	120	200	
NSL-482	18.6	15	120	200	Cds Photoconductive Cell in Hermetic Glass and Metal TO-5. Epoxy Coated "Open Pill" versions also available.
NSL-483	8	1.8	120	200	
NSL-484	3.5	0.25	120	200	
NSL-485	330	200	250	200	
NSL-486	155	130	250	200	
NSL-487	66	20	250	200	
NSL-392	4.0	10	70	500	
NSL-393	1.7	10	70	500	
NSL-394	0.75	10	70	500	CdSe Photoconductive Cell in Hermetic Glass and Metal TO-8.
NSL-395	40.0	20	250	500	
NSL-396	17.0	20	250	500	
NSL-397	7.5	20	250	500	
NSL-3921	4.0	2	80	200	CdSe Photoconductive Cell in Plastic Case. Glass Lens and Epoxy Coated "Open Pill" and CdS versions also available
NSL-3931	1.7	2	80	200	
NSL-3941	0.75	1	80	200	
NSL-3951	40.0	20	320	200	
NSL-3961	17.0	20	320	200	
NSL-3971	7.5	10	320	200	
NSL-491	9.3	14	80	500	
NSL-492	4.0	3.2	80	500	
NSL-493	1.7	0.4	80	500	CdS Photoconductive Cell in Hermetic Glass and Metal TO-8.
NSL-494	0.75	0.05	80	500	
NSL-495	40	32	320	500	
NSL-496	17	4.0	320	500	
NSL-497	7.5	0.54	320	500	

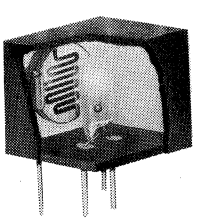












PHOTODETECTOR LAMP ASSEMBLIES

CdSe Photodetector

Module Type No.	Emitter Volts	Emitter Current MA	Detector Max. ON Res. Ω	Detector Min. OFF Res. MΩ	Detector Max. Volts	Detector Max. Power	Description
PL-1033-1	10	15	100	10	80	250	Phenolic .75" x .75" x .625" Pin Leads for P.C. Board Mounting. (Matched, Multi-Detector Configurations also available)
PL-1036-1	10	15	400	100	320	250	
PL-2H33-1	120	2	100	10	80	250	
PL-2H36-1	120	2	400	100	320	250	
PL-3A33-1	100	2	150	10	80	250	
PL-3A36-1	100	2	500	100	320	250	
PL-5S33-1	1.6	25	200	10	80	250	
PL-5S36-1	1.6	25	2000	100	320	250	
PLT-10384	10	15	400	10	80	100	Standard Tube; Axial Leads
PLT-10387	10	15	5000	100	320	100	
PLF-5S380	1.6	25	250	10	80	100	4 Leaded, Hermetic TO-5
PLS-5S387	1.6	25	4000	100	320	100	Small Tube, Axial Leads
PLM-5S310	1.6	25	500	10	80	50	Miniature Tube, Axial Leads

Silicon Photodetector

Module Type No.	Emitter Volts	Emitter Current MA	Detector Min. BV_{CEO}	Coupled Characteristics Typ. Dark Curr. nA	Coupled Characteristics Current Trans. Ratio	Coupled Characteristics Rise Fall Time μsec	Description
PLF-6S610	1.5	50	30	1	30	3	4 Leaded, Hermetic TO-5 Isolation: 700V
PLF-6S510	1.5	50	50	2	0.1	0.05	
PLM-6S610	1.5	50	30	1	30	3	Miniature Tube, Axial Leads. Isolation: 2.5 kV
PLM-6S510	1.5	50	50	2	0.1	0.05	
PLS-6S610	1.5	50	30	1	30	3	Small Tube, axial leads. Isolation: 5kV.
PLS-6S510	1.5	50	50	2	0.1	0.05	

SILICON PHOTODIODES

NSL Type No.	Minimum Short Ckt.* Curr. MA	Open Ckt.* Volt.	Dark Curr. μA @ 1V. @ 55°C	Reverse Voltage Recom. Maximum	Description
NSL-701-1	0.30	0.4	10	5	.1" x .2" Chip. Wire Leads
NSL-701-9	0.30	0.4	10	5	9 Element Cell, 0.1" Spacing
NSL-702-1	0.65	0.4	20	5	.2" x .2" Chip, Wire Leads
NSL-702-2	0.65	0.4	10	5	
NSL-703	1.5	0.4	50	5	.2" x .4" Chip, Wire Leads
NSL-707	3.75	0.4	100	5	.2" x 1" Chip, Wire Leads
NSL-708	1.85	0.4	50	5	.1" x 1" Chip, Wire Leads
NSL-710	0.125	0.4	2	5	TO-18 Package
NSL-751	1.5	0.4	50	5	0.5" dia. Epoxy Package
NSL-781	0.28	0.4	10	5	Hermetic TO-5 Case
NSL-881	0.28	0.3	5	5	
NSL-782	0.45	0.4	15	5	
NSL-791	0.65	0.4	20	5	Hermetic TO-8 Case.
NSL-792	1.2	0.4	40	5	

*At 500 Ftc (25 MW/Cm²) 2870°K Source.

SILICON PHOTOTRANSISTORS

NSL Type No.	*I_{CEO}, MA @ 5V Min.	*I_{CEO}, MA @ 5V Typ.	Dark I_{CEO} @ 15V 25°C — nA Typ.	Dark I_{CEO} @ 15V 25°C — nA Max.	Description
NSL-610-1	.2	1	1	50	TO-18 Encased NPN Silicon Phototransistor; Power Dissipation @ 25°C 200 mW, Minimum Breakdown Voltage BV_{CEO} 30 volts
NSL-610-3	1	3	1	50	
NSL-610-6	4	6	1	50	
NSL-610-9	7	9	1	50	
NSL-611	8	15	10	100	
NSL-2565	.4	2	2	100	9 Element Array, 0.1" Spacing

*At 200 Ftc (10 MW/Cm²) 2870°K Source.

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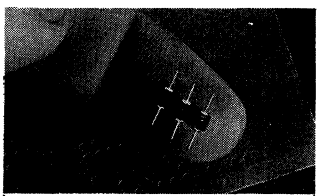
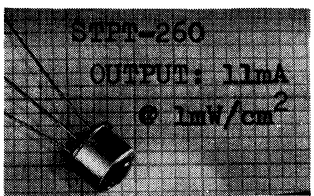
For computer card/tape readout and photosensing devices.



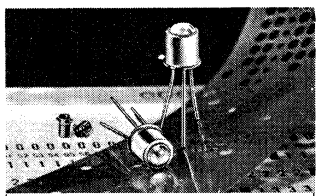
MICROMINIATURE "OPTO-PAK" PHOTO-TRANSISTORS

High speed NPN sensors mount on 0.087" centers for high density packaging and produce a high output (2 mA at 1 mW/cm²) to drive TTL, DTL, or RTL circuits.



"QUANTISTOR" PHOTO-TRANSISTORS

High-gain output switches TTL, DTL and RTL circuits at low light levels or provides 7 times greater output at normal light. High radiant response (70mA output at 5mW/cm²).



MINIATURE AND TO-18 PHOTO-TRANSISTOR STYLES

High sensitivity and fast switching in rugged TO-18 case or miniature no-lead case for mounting directly into PC boards. All ratings.

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For computer card/tape readout and photosensing devices.

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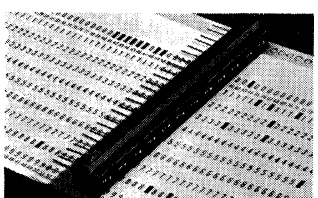
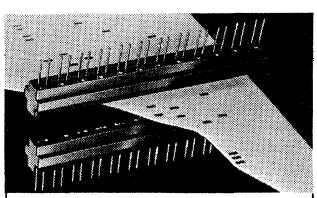


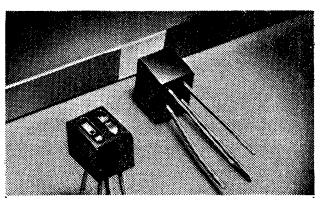
HIGH EFFICIENCY PHOTO-TRANSISTOR ARRAYS

Multi-position NPN arrays housed in standard drop-in packages. High sensitivity and fast reading. Interface with DTL, RTL or TTL logic.



OPTO-PAIR INFRARED SOURCE/SENSOR ARRAYS

Matched pairs of infrared LED's and phototransistor sensors in 9, 10 and 12 position arrays. Output: 5VCE @ 50 mA. Operates digital IC's without amplifying.

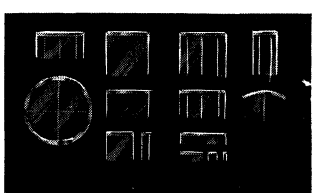


COMPACT OPTO-PAIR REFLECTIVE TRANSDUCER

An infrared LED and an NPN phototransistor combined in one package for B/EOT and mark sensing, optical ignition, character recognition, etc. Output: 125μA typical.

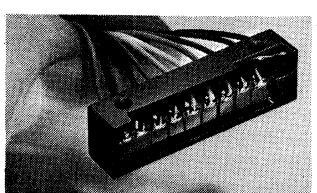
SILICON PHOTOVOLTAIC CELLS

For light actuated devices and solar energy conversion.



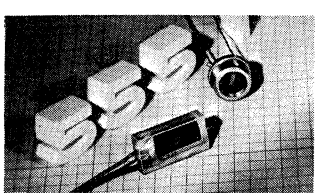
SILICON SOLAR CELLS

Highly efficient photovoltaic cells for light actuated devices or for converting sunlight directly into DC power. Cells, arrays or panels to any size or shape requirement.



SENSOR TECH ULTRA-CELL®

Silicon photovoltaic cells for faster response speed and lower reverse leakage than standard cells. Single cells or arrays in geometries to meet any device requirement.



BLUE AND GREEN PEAK COLOR RECOGNITION CELLS

"Hi-Blue" cells provide 300% greater output at 400nm than standard cells. "555 Green Cells" have the same peak response as the human eye. Both simplify designs, reduce amplification.

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Advanced thin-film hybrid and fiber optic technologies.

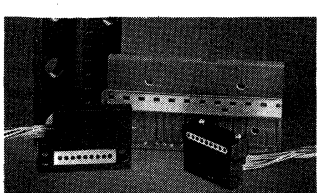
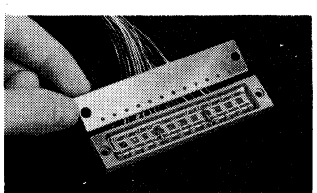


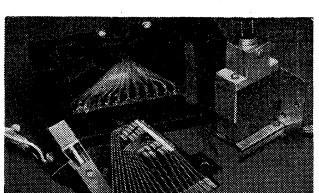
PHOTO-TRANSISTOR CARD/TAPE READERS

Dual-in-line packaged phototransistor arrays in rugged mountings designed and produced to your specifications. DTL, RTL or TTL interfacing.



THIN-FILM HYBRID READOUT ASSEMBLIES

Thin-film sensor/amplifier circuits in minimum space, in custom housings for ease of mounting. Amplifiers are DTL or TTL compatible.



COMPLETE SYSTEMS... DESIGN THRU TESTING

Photovoltaic or Photo conductive. Fiber optic interfacing, sensing, amplification, biasing and packaging in one unit, to any requirement.

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SHARP

Photo-Electric Components

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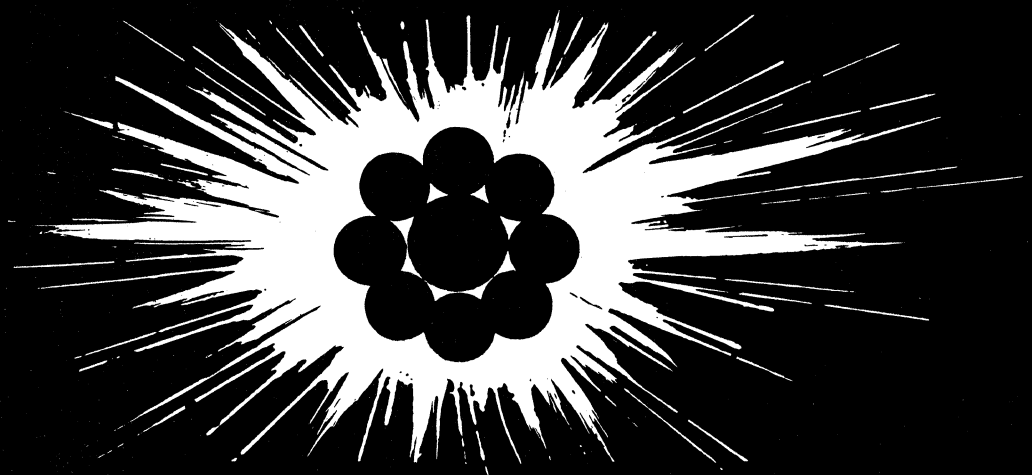

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OPTOELECTRONIC COMPONENTS & ASSEMBLIES

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(214) 234-4271

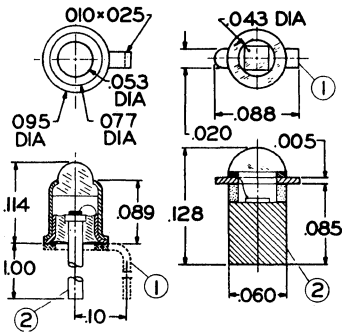
LIGHT EMITTING DIODES

Optical/Electrical Characteristics at T_A=25°C unless otherwise specified. Operating or storage temperature range: —65 to +100°C.

PARAMETER	OPTICAL POWER			BEAM ANGLE	FWD. VOLTAGE DROP			REVERSE BREAKDOWN	RADIATION RISE TIME	PEAK WAVELENGTH	CONT. FWD. CURRENT[2]	
TEST COND.	@ I_F (mA)			Note 1	@ I_F (mA)			I_R=10 μA		I_F=50mA	T_A=25°C	T_C=25°C
SYMBOL	P_O			θ_{HP}	V_F			V_{BR}	t_r	λ_p	$I_{F(CONT)}$	
UNIT	mW			degrees	VOLTS			VOLTS	μsec	nm	mA	
	MIN	TYP	I_F	TYP	TYP	MAX	I_F	MIN	TYP	TYP	MAX	
SE-1450-1†	.20		50	12		2.0	50	2	0.7	930	50	
SE-1450-2†	.35	0.5	50	12	1.3	1.5	50	6	0.7	930	50	
SE-1450-3†	.70		50	12	1.3	1.5	50	6	0.7	930	50	
SE-1450-4†	1.40		50	12	1.3	1.5	50	6	0.7	930	50	
SE-2460-1	.27		50	18		2.0	50	2	0.7	930	50	
SE-2460-2	.40		50	18	1.3	1.5	50	6	0.7	930	50	
SE-2460-3	1.0		50	18	1.3	1.5	50	6	0.7	930	50	
SE-2460-4	1.5		50	18	1.3	1.5	50	6	0.7	930	50	
SE-3451-1	1.0		100	90		2.0	100	2	0.7	930	100	750
SE-3451-2	2.0		100	90	1.3	1.7	100	6	0.7	930	100	750
SE-3451-3	3.5		100	90	1.3	1.7	100	6	0.7	930	100	750
SE-5451-1	1.0		100	16		2.0	200	2	0.7	930	100	750
SE-5451-2	2.0	1.5	100	16	1.3	1.7	100	6	0.7	930	100	750
SE-5451-3	3.5		100	16	1.3	1.7	100	6	0.7	930	100	750
CHIP:452	1.0		50		1.5		50	6	0.7	930	SIZE .020″x.022″ EMITTING AREA .020″x.020″	

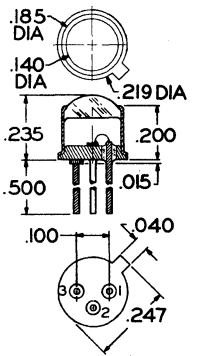
† Offered with extra lead attached to case. Suffix "L" (SE-1450-2L).

1. Angle between half-intensity points. 2. Polarity of all devices can be reversed on special order.



Gold plated Kovar/Glass
SD-1440 SERIES
1. Emitter
2. Collector
SE-1450 SERIES
1. Cathode
2. Anode

Gold plated Kovar/Ceramic/Glass
SD 2441 SERIES
1. Emitter
2. Collector
SE-2460 SERIES
1. Cathode
2. Anode



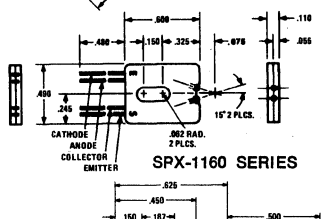
Hermetic TO-46
SD-5443 SERIES
1. Emitter
2. Base
3. Collector
SE-5451 SERIES
1. Cathode
2. No connection
3. Anode

PHOTOTRANSISTORS (SILICON)

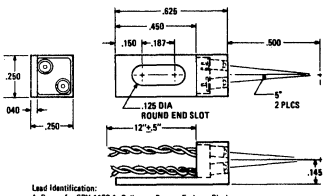
Optical/Electrical Characteristics at T_A=25°C.

PARAMETER	LIGHT CURRENT			DARK CURRENT	COLLECTOR BREAKDOWN	EMITTER BREAKDOWN	LIGHT CURRENT RISE TIME	SATURATION VOLTAGE	ANGULAR RESPONSE
TEST CONDITION	V_{CE}=5.0V H as shown			V_{CE}=30V H=0	I_C=100μA	I_E=100μA	R_L=1000Ω V_{CC}=5V I_L=1.0mA	I_C=0.4 mA H as shown	NOTE 1
SYMBOL	I_L			I_D	$V_{BR(CEO)}$	$V_{BR(ECO)}$	t_r	$V_{CE(sat)}$	Ⓗ
UNIT	mA			nA	VOLTS	VOLTS	μsec	VOLTS	degrees
	MIN	TYP	H*	MAX	MIN	MIN	TYP	TYP	TYP
SD-1440-1†	0.7		5	1000 @ 10V	>10			0.3	12
SD-1440-2†	1.5		5	25	50	7	4	0.3	12
SD-1440-3†	3.0		5	25	50	7	8	0.3	12
SD-1440-4†	6.0		5	25	50	7	16	0.3	12
SD-2441-1[2]	1.0		20	1000 @ 10V	>10	7		0.3	18
SD-2441-2[2]	4.0		20	100	50	7	4	0.3	18
SD-2441-3[2]	8.0		20	100	50	7	8	0.3	18
SD-2441-4[2]	12.0		20	100	50	7	12	0.3	18
SD-3443-1	0.5	0.7	5	1000	>10			0.2	45
SD-3443-2	1.0	1.5	5	100	30	7	6	0.2	45
SD-3443-3	2.0	2.5	5	100	30	7	8	0.2	45
SD-5443-1	1	2	5	1000	>10			0.2	
SD-5443-2	4	6	5	100	30	7	4	0.2	9
SD-5443-3	8	12	5	100	30	7	6	0.2	9
SD-5443-4	16	24	5	100	30	7	8	0.2	9
							CHIP SIZE	SENSITIVE AREA	
CHIP:440	0.5		20	100	50	7	.025″x.025″	.017″ dia.	
CHIP:442	0.6		1	100	10	5	.068″x.068″	.060″x.060″	

* Irradiance in mW/cm² from a tungsten source at a color temperature of 2870 K.
† Offered with extra lead attached to case. Suffix "L" (SD-1440-2L).
1. The angle between incidence for peak response and incidence for 50% of peak response.
2. Larger aperture for higher sensitivity; reduced angular response minimizes crosstalk.



SPX-1160 SERIES



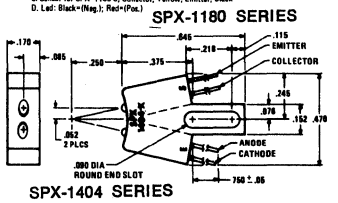
Lead Identification:
A. Sensor for SPX 1180-1; Collector, Brown; Emitter, Black
B. Sensor for SPX 1180-2; Collector, Orange; Emitter, Black
C. Sensor for SPX 1180-3; Collector, Yellow; Emitter, Black
D. Led: Black=(Neg.); Red=(Pos.)

SPX-1180 SERIES

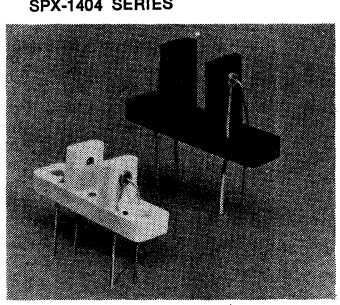
REFLECTIVE SENSOR ASSEMBLIES (LED and Phototransistor)

Optical/Electrical Characteristics at T_A=25°C unless otherwise specified. Operating or storage temp. range: —40 to +100°C.

PARAMETER	LED FWD. VOLTAGE		COLLECTOR BREAKDOWN	EMITTER BREAKDOWN	LIGHT CURRENT		DARK CURRENT	LIGHT CURRENT RISE TIME
TEST CONDITION	I_F=50mA		I_C=100μA	I_E=100μA	V_{CE}=5V LED I_F=30mA		V_{CE}=30V I_F=0; H=0	V_{CC}=5V; I_C=1mA R_L=1KΩ
SYMBOL	V_F		$V_{BR(CEO)}$	$V_{BR(ECO)}$	I_L		I_D	t_r
UNIT	VOLTS		VOLTS	VOLTS	mA		nA	μsec
	TYP	MAX	MIN	MIN	MIN	TYP	MAX	TYP
SPX-1160-1		2.0	10		0.5	0.75	1000 @ V_{CE}=10V	4
SPX-1160-2	1.3	1.6	50	7	1.0	1.5	25	5
SPX-1160-3	1.3	1.6	15	7	5.0	10.0	250 @ V_{CE}=10V	25 @ R_L=100Ω
SPX-1180-1		2.0	10		.04	.07	1000 @ V_{CE}=10V	4
SPX-1180-2	1.3	1.6	50	7	.125	.200	25	5
SPX-1180-3	1.3	1.6	15	7	2.0	4.0	250 @ V_{CE}=10V	25 @ R_L=100Ω
SPX-1404-1		2.0	10		0.2	0.3	1000 @ V_{CE}=10V	4
SPX-1404-2	1.3	1.6	50	7	0.4	0.6	25	8
SPX-1404-3	1.3	1.6	15	7	2.0	4.0	250 @ V_{CE}=10V	25 @ R_L=100Ω



SPX-1404 SERIES



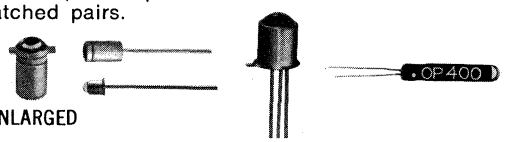
Spectronics, Inc., also manufactures other optoelectronic assemblies, including sector sensors, photo-transistor arrays for tape reading, optocouplers, and optical switches. Shown, the SPX 1636 and 1637 optical switches, available with phototransistor or photoDarlington sensors. ***Write for complete data sheets.***

OPTRON IS COMPLETE OPTOELECTRONICS

Optron's wide range of design and production capabilities includes components, chips, assemblies, and arrays ... either standard or custom.

DISCRETE PHOTOTRANSISTORS and LED's

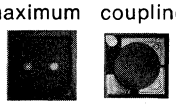
These devices include high sensitivity silicon N-P-N phototransistors and high output gallium arsenide infrared LED's in companion packaging. A wide variety of packages are available ... from standard TO-18 to miniature "pill." Optron also offers sensors and LED's in matched pairs.



ENLARGED

CHIPS

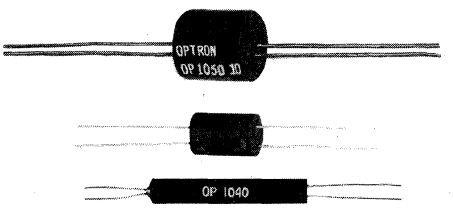
A wide selection of sensor and light emitting diode chips are available from Optron in standard or custom packages. Choose standard silicon sensor chips in photodiode, phototransistor or photodarlington configurations. Liquid epitaxial gallium arsenide chips provide the highest efficiency available in infrared LED's. The 9400 Å emission wavelength provides maximum coupling efficiency with silicon sensor chips.



ENLARGED

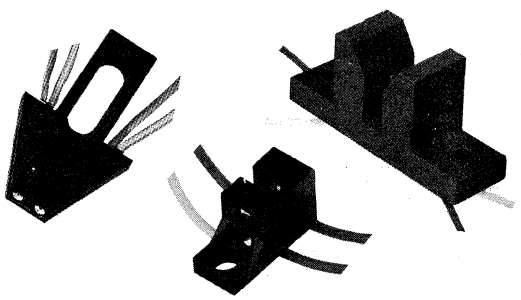
OPTICALLY COUPLED ISOLATORS

Optron optically coupled isolators consist of a gallium arsenide LED coupled with a silicon sensor. All isolators contain discrete hermetically sealed LED's and sensors for maximum life and reliability. Isolation voltages to 50 Kv with high transfer ratios are available. Typical applications include replacement for a coupling transformer, isolation of ground loops and general purpose switching.



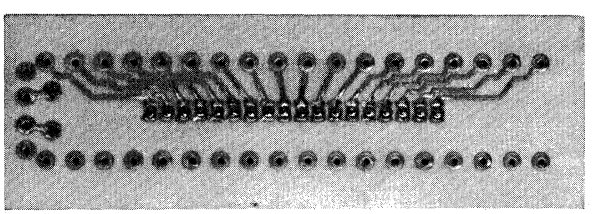
OPTOELECTRONIC ASSEMBLIES

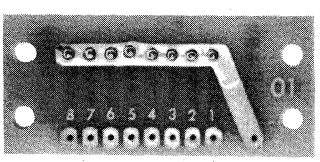
Optron assemblies consist of infrared LED's coupled with silicon phototransistors or photodarlingtons. They feature noncontact switching, solid state reliability, TTL compatibility, and fast switching speeds. These low priced assemblies are immediately available and include transmissive optical switches for applications such as shaft encoders, level indicators, timing, and reflective optical sensors for use in line finders, edge detectors and EOT/BOT sensing. Custom designed assemblies for special applications also are available.

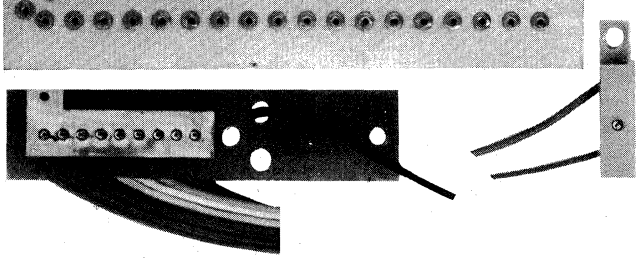


PC BOARD ARRAYS

Emitters and sensors are available mounted in printed circuit boards to customer specifications for applications such as tape readers, card readers, optical character recognition, shaft encoders, etc. Optron sensor and emitter arrays come individually, or as matched pairs ... tested and ready for installation. Standard tape and card reader arrays are immediately available off-the-shelf.







Complete Optoelectronic Production Capabilities

Optron can provide complete discrete, hybrid or monolithic optical arrays, preassembled and pre-tested, to your specifications. In addition, Optron is experienced and capable of working on your most stringent custom requirements or interface problems. An Optron-assembled functional module offers you significant system cost and performance advantages. Contact your Optron sales representative or the factory direct for additional information.

OPTRON, INC.
1201 Tappan Circle
Carrollton, Texas 75006
214/242-6571

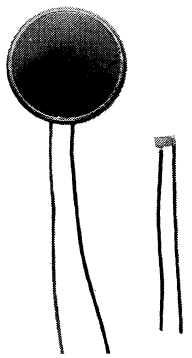
SEE PAGES Vol. 2 • 920 – Vol. 2 • 922 for complete electrical and physical descriptions of the Optron product line.

VACTEC Complete Line of PHOTODETECTORS

Silicon Photovoltaic Cells

Silicon (solar) cells with controlled low leakage for photometric applications. Excellent stability, lack of fatigue, a minimum of 7% conversion efficiency.

Arrays and special configurations available — Request design assistance.



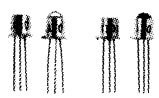
P.N.**	Size (in.)	ma. sht. ckt. output (typ) 100fc 2850°K	ma. @ .4V output (typ) 100mw/cm²*
VTS3011	.087 x .2	.055	1.85
VTS3012	.1 x .2	.065	2.2
VTS3013	.2 x .2	.135	4.6
VTS3014	.2 x .4	.27	9.2
VTS3018	.2 x .8	.55	18
VTS3020	.4 x .4	.6	20
VTS3024	.4 x .8	1.2	41
VTS3028	.8 x .8	2.5	80
VTS3050	1.125 dia.	3.5	110

**Following parts all with 6" #30 Wire Leads.
*2850° source measured with solar radiation standard.

NOTES: Operating temp. −55°C to +125°C.
Open circuit V at 100fc typically 420mv.
Request bulletin VTS.

Silicon Phototransistors

NPN planar epitaxial transistors — base lead is brought out for use as photodiode or for circuit biasing. Wide range of sensitivity — high (current (I_L) for use at low light levels.



Arrays and special configurations available — Request design assistance.

P.N.	Size	Window	I_L^+ (typ)	I_D (max)	BV_{CEO} (min)	V_{CE} (sat) (typ)
VTT1010	TO-18 3 Wire	flat	2ma	25na	30V	.1V
VTT1011	"	flat	1ma	25na	30V	.1V
VTT1012	"	flat	.5ma	25na	40V	.1V
VTT1013	"	flat	4ma	25na	20V	.1V
VTT1110	"	lens	7ma	25na	30V	.1V
VTT1111	"	lens	4ma	25na	30V	.1V
VTT1112	"	lens	2ma	25na	40V	.1V
VTT1113	"	lens	14ma	25na	20V	.1V

NOTES: I_L (light current) measured at 5V V_{CE} and H = 5mw/cm².
I_D (dark current) measured at 10V V_{CE}.
BV_{CEO} (collector-emitter breakdown voltage) measured at I_C = .1ma.
V_{CE} (sat) measured at I_C = 1ma and H = 20mw/cm².
Request bulletin VTT.

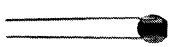
Photoconductive Cells

Six materials ranging from CdS to CdSe at various spectral peaks. Nine packages including hermetic and non-hermetic ceramic packages passivated for use even in protected outdoor environments. Photoconductive cells are the most sensitive type of solid state detector of light. They cover a wide range of illumination from .0001 to thousands of footcandles with an ohmic and fairly linear resistance change. Applications include light measurement, streetlight controls, cameras, etc.

Material & Type	Peak Spectral Response	Description
0 (CdS)	5650A	General Purpose — good stability.
1 (CdSe)	7350A	High Speed — Red Sensitive.
2 (CdS)	5150A	Slow Speed — Blue Sensitive.
3 (CdS)	5500A	High Speed — General Purpose — Excellent Stability.
4 (CdSe)	6750A	Lowest Resistance.
7 (CdSeS)	6150A	Linear at Low Light Level.

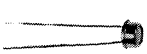
PACKAGES

VT100 Wafer thin (.065" max.) ceramic, 200mw rating, .365" diameter.
Available in all but Type 7 material. Variety of resistance ranges at 2fc in all types.



VT200 TO-18 hermetic, 50mw rating.
Available in all materials in a variety of resistance ranges at 2fc.

VT300 TO-5 hermetic, 125mw rating.
Available in all materials in a variety of resistance ranges at 2fc. Also common lead dual element in Types 0, 1, 3 & 4, and isolated dual cell in Type 3 material.

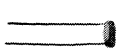


VT500 TO-8 hermetic, 500mw rating.
Available in all materials (except 7) in a variety of resistance ranges at 2fc.

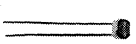
VT700E ½" diameter epoxy encapsulated, 250mw rating.
Available in all materials (except 7) in a limited variety of resistance ranges at 2fc.

VT700 Thin ceramic, .080" thick x .365" diameter, 250mw rating, passivated.
Available in Type 0, 2, 3, 4 & 7 in limited variety of resistance ranges at 2fc.

VT800 Thin ceramic, .080" thick x .266" diameter, 175mw rating, passivated.
Available in Type 0, 2, 3, 4 & 7 in limited variety of resistance ranges at 2fc.



VT900 Thin ceramic, .080" thick x .182" diameter, 80mw rating, passivated.
Available in Types 0, 1, 3 & 4 in limited variety of resistance ranges at 2fc.



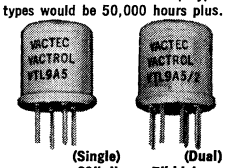
VT800/2 Dual element thin ceramic, .080" thick x .266" dia., 175mw rating, passivated.
Available in Type 1, 3, 4 & 7 in limited variety of resistance ranges at 2fc.
Request Bulletin PCD-6.

Vactrols (Opto-Isolators)

Vactrols consist of an LED, or lamp coupled with a photoconductive cell. Provide a proportional or on-off control for noiseless switching, SCR and triac firing, DC isolators, audio limiting and audio effects. They come in several packages both hermetic and non-hermetic. Most lamp types are rated at 50,000 hour life with a few at 10,000 hours. LED types would be 50,000 hours plus.

VTL9 SERIES

This series contains incandescent and neon lamps and either single cells or two cells for the VTL9/2 series. From 1.2V to 12V for the incandescent types and 80 and 125V neon types. On-resistances as low as 30 ohms are available. Max. cell power is 200mw. Cell to lamp isolation is 500V. Cell dark resistance 1 meg or higher. Request Bulletin VTL9.



(Single) (Dual)
.63" dia. x .7" high
with .040" pin leads.

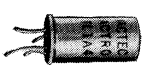
VTL3 SERIES

The VTL3 series contains a range of photoconductive materials coupled with incandescent lamps (1.5 - 12V) or neons. Cell to lamp isolation voltage is 1500V. Maximum cell power is 175 mw. Cell dark resistance 1 meg or higher with on-resistance as low as 25 ohms. Request Bulletin VTL3.

.385" dia. x 1.13" length
axial package.

VTL1 SERIES

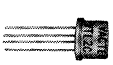
Four incandescent and two neon lamps combined in this series with a photoconductor. Power rating of the cell is 100mw and cell to lamp isolation is 500V. On-resistance of the cell as low as 150 ohms and off-resistance at least 10 megohms. Request Bulletin VTL1.



TO-5 (hermetic)

VTL2 SERIES

LED-photoconductive cell isolators. Four different types. Cell on-resistance as low as 50 ohms with 400K min. off-resistance. Cell-LED isolation is 500V and cell power rating is 100mw. Request Bulletin VTL2.



TO-5 (hermetic)

VTL5 SERIES

LED-photoconductive cell isolators. Four single cell types and two dual cell types combined with an LED. Cell on-resistance as low as 75 ohms with a min. of 400K off-resistance. Isolation voltage cell to LED is 1500V and cell power rating is 175mw. Request Bulletin VTL5.

.37" dia. x .38" length
axial package.

Selenium Photovoltaic Cells

Selenium cells are broad area detectors in the near U-V and visible spectra. Excellent linearity over a 5 decade range from .001 fc up. Can be corrected to the CIE (standard observer curve) by use of a Wratten 102 filter. Work ideally with an operational amplifiar or can directly drive a meter. Used in colorimeters, reflectometers, nephelometers, etc.

A wide variety of round sizes from ¼" diameter to 2" diameter. Some in cases and all available with soldered leads. Also rectangular sizes from .25" x .48" and larger. Typical short circuit sensitivity is 5.4 uA/fc/in² at 2850°K. Peak spectral response is at 5750A. Response time of small cells is 100uS. — Capacitance limited — .25uf/in².

Request Bulletin SPV-5.

Photometer

A portable instrument capable of covering illuminations from .0002 fc to 10,000 fc with suitable probes. This low cost instrument has 5% full scale accuracy and NBS traceable calibration. Can be operated from a 117 VAC line or by internal batteries. Request Bulletin P3100.

Call or Write

VACTEC, INC.

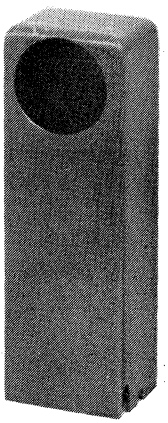
2423 Northline Industrial Blvd.
Maryland Heights, Mo. 63043
Phone (314) 872-8300

BULOVA® OPTICAL SCANNERS*

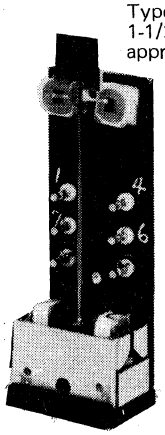
*Patents pending and issued.

Two Basic Types – Frequencies from 5 to 16 KHz Scan Angles to 30°
Available with Drivers

Torsion Bar

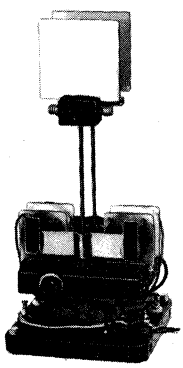


Type L45
1-1/2" x 1-1/2" x
approx. 3" high

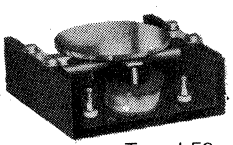


Typical
Removable
Cover

Dual Mirror Torsion Bar



Taut Band



Type L50
1-7/16" x
1-7/16" x 5/8"

Type L44
3/4" x 1" x
approx. 3" high

DRIVERS

The scanners and choppers can be driven in any one of three modes:

1 Closed loop at the natural frequency of the fork, torsion bar or taut band with negative feedback from the pick-up coil;

2 Open loop at the natural frequency; or

3 In a phase lock or frequency lock loop.

Electrical or mechanical dampening can be included to reduce Q. In addition, automatic gain control can be added where extreme precision in amplitude is desired. Drivers can be supplied to operate from a DC source having an AC input. All drivers provide a reference signal for synchronizing other devices and instruments. Furthermore, an isolated pick-up can be incorporated directly in the chopper or scanner as a reference signal source.

Bulova designs and manufactures drivers. However, engineering assistance is offered to customers desiring to build their own drivers.

GENERAL SPECIFICATIONS

(The principle of operation and general features are given on facing page.)

Scanners are produced in two basic types, torsion bar, with single or dual mirrors, and taut band, capable of handling large mirrors.

TORSION BAR

Type L45: Single Mirror
Type L44: Dual Mirror
Frequency: L45, 600 Hz to 16 KHz; L44, 100 Hz to 1000 Hz (any fixed discrete)
Accuracy: ±2% standard
Scan Angle, P to P: 10° max reduces to 2° at higher frequencies. L44, 20° max
Mirror Size: 30mm x 30mm max, reduces as frequency increases
Power: 500 milliwatts, max. with driver

TAUT BAND TYPE L50

Frequency: 5Hz to 400 Hz (any fixed discrete)
Accuracy: ±2% standard
Scan Angle, P to P: 30° max, reduces with frequency increase to 5° at upper end
Mirror Size: 30 x 30mm, standard max. (This type scanner also can mount larger mirrors.) Reduces as frequency increases.
Power: 500 milliwatts max. with driver

MIRRORS

Flatness: 1/2 wavelength standard, 1/4 or better available
Stock Sizes, mm: 30 x 30, 20 x 20, 15 x 15, 10 x 10, 7 x 7, 5 x 5, 2 x 3.

LOW COST LOCK-IN AMPLIFIER

Bulova has designed a low-cost Lock-In Amplifier for use with scanners, choppers and other instruments in applications where it is desired to distinguish and pull out weak signals from high background noise. It is available in three forms: cased as a lab bench instrument, for standard rack mounting or in plug-in modules for OEMs for incorporation in the customer's instrumentation circuitry.

BASIC SPECIFICATIONS

Frequency: Fixed, 5 Hz to 20 KHz (any fixed discrete)
Sensitivity: 10μV to 100 mV rms full scale meter reading
Time Constant: 10 ms to 30 sec.
Reference Modes: Internal, plug-in oscillator. External 1 to 10V rms, sine, square or triangular into amplifiers with Q of 10 x. Input impedance 20 K ohms.
Phase Shifter: 360° in 4 ranges, continuously variable ±45°
Monitor: Input, output, and reference by selection switch
Meter display and recorder connection are provided.

NOTE

Bulova, the originator of mechanical resonance controlled scanners and choppers, maintains a continuing development program for these devices. If your application requires: a) higher frequency; b) lower frequency; c) larger mirrors or apertures, or d) any of these in combination please inquire. We already may have a unit to fit your requirement or can readily modify an existing design.

BULOVA atp BULOVA®
AMERICAN TIME PRODUCTS
ELECTRONICS DIVISION OF BULOVA WATCH COMPANY, INC.
61-20 WOODSIDE AVENUE WOODSIDE, N. Y. 11377 • 212 335-6000

CHOPPERS & MODULATORS* BULOVA

*Patents pending and issued

Three Basic Types – Frequencies from 5 Hz to 10 KHz Many Modulation Patterns Available with Drivers

OPERATING PRINCIPLE AND BASIC FEATURES

The same basic principle, mechanical resonance, is involved in the three basic types of units which are the foundation of Bulova's line of Optical Scanners and Light Choppers.

Application of this principle enables design of optical scanning and chopping devices which have many advantageous properties. Chief of these are:

- Reliability: No rotating parts, no bearings, no lubrication; hence no wear and no service problems
- Excellent Accuracy: ±1% usual, ±0.1 attainable. Can be any discrete fixed frequency, even fractions of a hertz
- Small Size: Down to 0.5 in^3 and less than 0.5 oz.
- Low Power: In milliwatt range.
- Virtually Drift Free: Exceptional stability with time, excellent temperature characteristics
- Reference Signals: Inherently available through driver Also, an optional, isolated pick-up can be incorporated directly in the scanner or chopper as a signal source.
- Environment: Withstand vibration to 20g, shock to 100g; temperature from cryogenic to 250°C; altitude to space vacuum; radiation >2 x 10^{13} NVT.
- Raster Scan: X-Y mounts and slaved units provide synchronized raster scan.

Existence of a broad range of stock designs enables Bulova to supply prototype and production quantities to customer specification on short lead time.

GENERAL SPECIFICATIONS

Choppers and Modulators are available in three basic types: tuning fork, torsion bar and taut band. The torsion bar and taut band mount single vanes, the tuning fork, pairs of vanes. Configuration and mounting positions of the vanes control beam modulation patterns. Typical examples are illustrated but almost any special adaptation can be generated.

TUNING FORK

Type L2: Miniature (.68 W x .35 H x L to 1.7")
Type L8: L2 with integral driver (1.5" W x .38" H x 1.5 L)
Type L40: (.88 W x .63 H x L up to 2.94)
Frequency: 10 Hz to 3000 Hz (any fixed discrete)
Aperture; Max (L40): Width 0.6", length .63". All reduce with increase in frequency
Accuracy: ±1% Standard, special to 0.1%
Power: 500 milliwatts max., with driver

TORSION BAR TYPE L46

Frequency: 400 to 10 KHz, (any fixed discrete)
Accuracy: ±2% standard
P to P: 10° max. reduces with frequency increase to 2° at upper end. Excursion a function of vane length
Vane: Reduce with frequency increase, consult factory for trade-offs.
Power: 500 milliwatts max., with driver

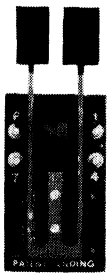
TAUT BAND TYPE L51

Frequency: 5 Hz to 100 Hz (any fixed discrete)
Accuracy: ±2% standard
P to P: 30° max. reduces with frequency increases to 5° at upper end. Excursion a function of vane length
Vane: Length 1 1/2" x 1" max. Can chop 1 or two beams to 0.60" diameter. Reduces with frequency increase to 0.30" dia. max. at 100 Hz.
Power: 500 milliwatts, max., with driver

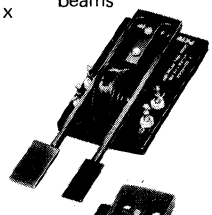
Tuning Fork Types

L2 – Miniature .68" W x 35" H x L up to 1.7"

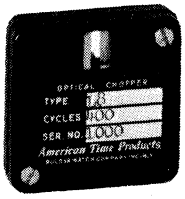
L40 – for Apertures Up to .6" (15mm) .88" W x .63" H x L up to 2.94"



L40 with mirror and vane for switching dual beams



L40 with right angle vanes and parallel chopping

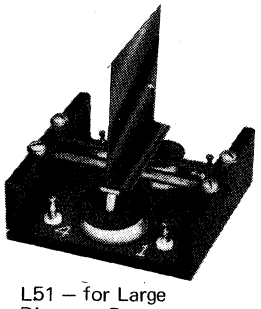


L8 – Miniature With Integral Driver 1.5" W x .38" H x 1.5" L

Torsion Bar

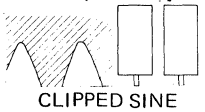
L46 – for Highest Frequencies

Taut Band

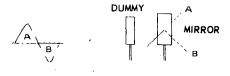


L51 – for Large Diameter Beams

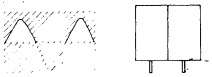
Examples of Beam Modulation Waveforms (For Fully Flooded Apertures)



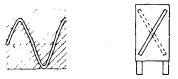
CLIPPED SINE



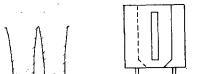
DUAL BEAM SWITCH



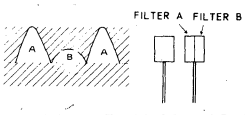
HALF SINE



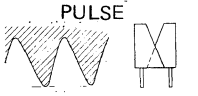
LINE SCAN



PULSE



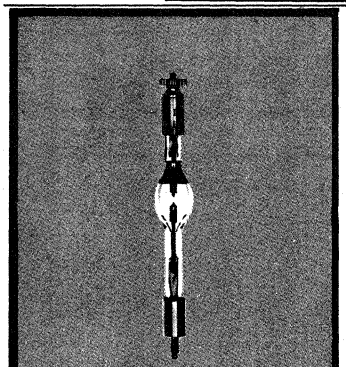
VARIABLE TRANSMISSION



FULL SINE

From Bulova Electronics Division: Frequency Control Components Crystal Oscillators • Crystal Filters • LC Filters • Fork Oscillators • Coils • Servo D.C. Amplifiers • Optical Devices • Time Period Generators • Time of Day Systems • Inverters • Frequency Changers • Frequency Deviation Counters

BULOVA BULOVA atp



LAMPS

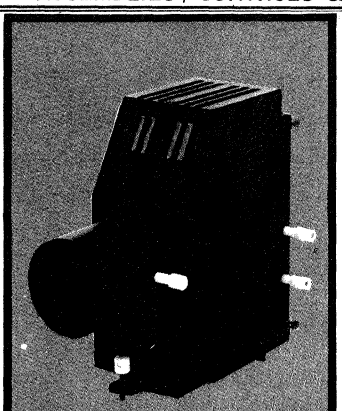
A complete line of mercury short arc lamps including a unique 350-watt model developed for exposing 3" wafers

"**Sunshine from Sunnyvale.**" We're providing light for the semiconductor industry at Illumination Industries. Our complete line of Mercury Short Arc Lamps are proved top-performers, available right off-the-shelf. From 50 to 1,000 watts, we have what the industry needs.

Lamp Type	iii-50	iii-107 iii-112	iii-202
Luminous Flux (Lumens/ minimum)	2,000	2,200	10,000
	iii-350	**iii-500**	**iii-660**
	17,500	30,000	10,000

iii can shed more light, too. We've got light from 50 watts to 20 kilowatts—Capillary Lamps, Xenon Short Arc Lamps, Xenon Flashlamps, and even Medium Pressure Mercury Long Arcs up to 8 feet and 20,000 watts. That's not all, either. We have UV exposure systems, Lamphouses delivering collimated light with 2" or 3" lenses, power supplies and more.

Come see the light. We're in the heartland of Silicon Valley. Come see us, or we'll ship complete details on the lights that shine profitably for you. Get in touch today.



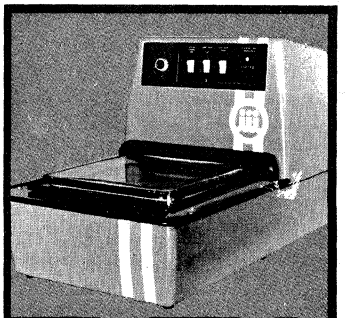
LAMP HOUSES

Houses for Xenon or Mercury short arc lamps delivering collimated light from 2" or 3" lenses

Making light work. Specifically designed for **iii** lamps, these Lamphouses accept mercury or xenon short arc lamps from 35 to 500 watts. Extremely flexible, they can be used in mask alignment photoresist systems, as image projection devices, or as collimating systems with interchangeable pyrex or quartz optics.

You can really see the light. Illumination Industries lamphouses feature a removable back plate which allows visual pre-alignment with the first surface rear mirror. And the spherical mirror provides a light gain of up to 50%. You can order your lamphouse off-the-shelf, or we'll build it custom-tailored to your needs. With collimated light on everything.

Light is our business. At **iii**, we're tracking the semiconductor industry with our product line—with every kind of lamp imaginable, UV exposure systems, power supplies and more. Get in touch today.



FLEX-POSURE

The first collimated light ultraviolet exposure system designed specifically for hybrid micro-circuit, back-side wafer and screen exposures

And there IS light. The tabletop, vacuum-frame Flexposure Systems for **iii** offer as much as 15 times faster exposure for both long runs or quick turnaround jobs. A unique point light source and reflector combination provide better resolution, too, with smaller geometries. Since the continuous pumping vacuum frame insures intimate contact of mask to substrate, there are fewer rejects. And fewer rejects mean increased yields.

Single and double-sided exposure. The Model 2120 is for single-side exposures, and the 2220 Flexposure is the double-sided system for double-sided circuits.

Now, light up at these prices! The Model 2120 Automatic Single-Sided 200 watt power Flexposure System is only $995! The double-sided, automatic 200 watt 2220 is just $1,295. Try to beat those prices. (You can't.) **iii** has modestly priced lamps of all types, flashlamps, lamphouses, power supplies and more. Just turn us on, and we'll light you up. Get in touch today.

FLASHLAMPS

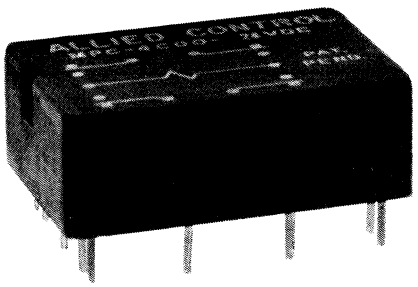
The industry's most complete line of Linear, U-Shaped and Helical Flashlamps with the industry's most detailed instructions on designing your own optimum driving circuits.

"Sunshine from Sunnyvale" lives! iii has the most detailed design procedures ever offered (anytime, anywhere) to help you design your own single-mesh driving circuits. The total design information helps you design perfect circuits . . . faster and better.

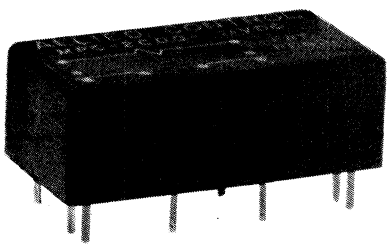
Let the light shine in. After your design, the iii Flashlamp experts really brighten your production picture. Off the shelf, we have full lines of Linear Flashlamps, U-Shapes, Helicals . . . just about anything under the Sun! If we don't have it, nobody does. We'll custom-design *the* Flashlamp that fits your operating parameters perfectly if that's what you need. So let the "Sunshiners from Sunnyvale" shine a little light on your Flashlamp problems. Today.

ILLUMINATION INDUSTRIES INC.
825 E. EVELYN AVE.
SUNNYVALE, CALIFORNIA 94086
PHONE (408) 245-4111
TWX: 910-339-9214

MPC MINIATURE PRINTED CIRCUIT RELAYS



4 FORM C



2 FORM C

FEATURES

- LOW PROFILE
- LONG LIFE ARMATURE DESIGN
- GOOD POWER HANDLING CAPABILITY
- HIGH RELIABILITY
- LOW COST
- MULTI-POLE CONTACTS

Developed with the electronic designer in mind, this new, d.c. operated miniature relay offers space saving comparable to reed relays, but with power handling capability of 50 watts per pole. Its hingeless armature construction assures long service life. All molded parts are of high-impact, solvent-proof thermoplastic. Standard contact material is gold plated silver. Contact configurations from one form C through four form C are available in two basic case sizes. Other contact materials and configurations can be supplied on special order.

TYPICAL CHARACTERISTICS

Operate Time:
3.0 ms

Release Time:
1.0 ms

Bounce Time:
N.C. 5.0ms
N.O. 1.0 ms

Contact Resistance:
50 milliohm max.

Insulation Resistance:
2 x 10^5 megohm

Weight:
8 Grams 4C 11Grams 4C

Pull-in Voltage:
80% of Nominal, max.

Drop-Out Voltage:
5% of Nominal, min.

Sensitivity:
1 or 2 pole 400 mw.
3 or 4 pole 550 mw.

Vibration:
0.6" Double Amplitude,
10-55 Hz 55-1000 Hz

Shock:
30 g

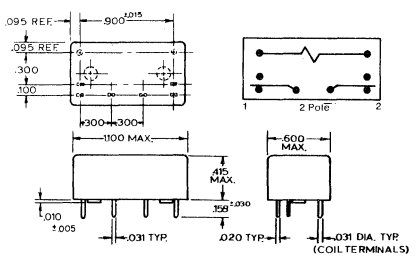
Dielectric:
1000 VRMS Coil to Contacts
500 VRMS Between Contacts
350 VRMS Between Circuits

Capacitance:
Coil to Contacts 1.8 pf.
Between Contacts 1.3 pf.
Between Circuits 2.3 pf.

Temperature:
Operating, —55°C to 80°C
Storage, —55°C to 105°C

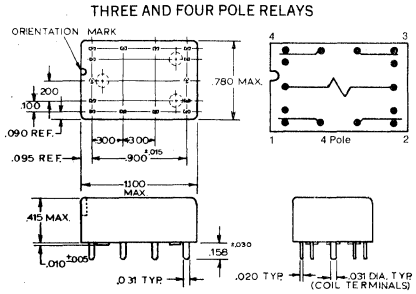
PHYSICAL DIMENSIONS

ONE AND TWO POLE RELAYS



NOTE: TERMINAL LOCATION TOLERANCE ±0.010"
TERMINAL SIZE TOLERANCE ±0.003"

THREE AND FOUR POLE RELAYS



CONTACT LIFE (OPERATIONS)

Low Level (logic circuits, etc.) 10 x 10^6 min.
1 ampere, 28 vdc resistive 1 x 10^6 min.
2 ampere, 28 vdc resistive 1 x 10^5 min.
0.5 ampere, 120 vac resistive 1 x 10^6 min.
1 ampere, 120 vac resistive 1 x 10^5 min.

COIL DATA

AMBIENT TEMPERATURE 20°C						
Coil VDC nominal	5	6	12	24	48	Type
Coil Resistance Ohms + 15%	3.5	50	200	800	3200	1 or 2 Pole
	2.5	38	150	600	2400	3 or 4 Pole
Pull-in VDC max.	4.0	4.8	9.6	19.2	38.4	All
Drop-out VDC min.	0.25	0.3	0.6	1.2	2.4	All

ORDERING INSTRUCTIONS

MODEL		CONTACTS		VOLTAGE
MPC	—	2C	—	12

MPC Relay, 2 Form C Contacts, 12 VDC Operation

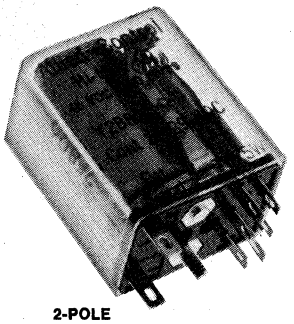
SOLDERING INSTRUCTIONS

For best results, please observe the following precautions:

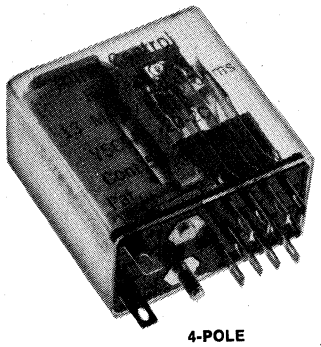
1. When relay is to be mechanically clinched to P.C. Board prior to soldering, use only the coil terminals for this purpose. Do **not** bend the contact terminals.
2. Do not immerse the relay in cleaning solutions.
3. Solder temperature, 270°C (500°F) max. Soldering time, 5 seconds, max.

allied control company, inc.
100 RELAY ROAD, PLANTSVILLE, CONNECTICUT 06479

CRADLE RELAY FAMILY



2-POLE



4-POLE

POWER RELAYS

FEATURES

- Sensitivity—with only 30 milliwatts per pole, switching capability input power loads as high as 150 watts.
- Versatility—selection from three model series (Power, Sensitive, and Ultra-Sensitive) for maximum input sensitivity, selection of contact type and guaranty maximum reliability.
- Life — 10^8 mechanical operations.
- Contacts — configurations up to Form C with selection of 5 types for load switching.
- Terminals — selection offered for solder, printed circuit mounting or mating socket.
- Voltage — 3 to 115 volts DC (AC voltage available — contact factory for additional information).
- U/L recognized — Component Recognition Program of Underwriters' Laboratories (File No. E20604).

SPECIFICATIONS

Maximum Contact Arrangement
8C, eight pole double throw

Ambient Temperature
−55°C to +71°C

Dielectric Strength
1000 volts rms
500 volts rms across open contacts

Insulation Resistance (at +25°C)
1000 megohms minimum

Capacitance
Values shown are maximal for either the energized or de-energized position.

Closed contacts to frame 3.0 pf
Open contacts to frame 3.0 pf
Between open contacts 3.0 pf

Operate Time (at +25°C)
15 milliseconds maximal at nominal voltage

Release Time (at +25°C)
8 milliseconds maximal at nominal voltage

Weight
Dust Cover Relays — 6 ounces max.

COIL RESISTANCE AND OPERATE DATA AT +25°C

	Power Adjustment: For max. of 4C, 6A or 6B contacts		Power Adjustment: For max. of 6C or 8A contacts		Power Adjustment: For max. of 8C or 10A contacts		Max. Pull-in
Volts	Amperes	Ohms* ±10%	Amperes	Ohms* ±10%	Amperes	Ohms* ±10%	Volts
3	.214	10	.50	6	.50	6	2.25
6	.115	52	.24	25	.30	20	4.5
12	.065	185	.133	90	.16	75	9.5
24	.034	700	.056	430	.056	430	18.0
48	.019	2,500	.032	1,550	.038	1,275	36.0
115	.0076	15,000	.013	9,000	.013	9,000	86.0
	Nominal Power: 700 milliwatts		Nominal Power: 1.5 watts		Nominal Power: 1.5 watts		

*Other values upon request, consult factory.

ORDERING SPECIFICATIONS

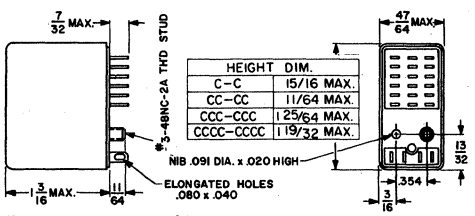
T154 — 2C — 24VDC

Coil Voltage
Specify nominal DC coil voltage

Contact Configuration
2C — two pole, double throw
4C — four pole, double throw
6C — six pole, double throw
8C — eight pole, double throw

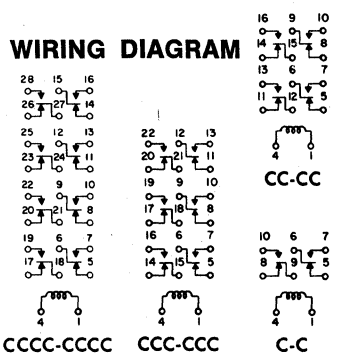
Basic Type
T154 — Single pt. contact; low level up to 2 amp.
TF154 — Single pt. contact; 5 amp.
T163 — Bifurcated contacts; low level up to 2 amp.

DIMENSIONS



Tolerances are ±1/64 inch on fractions, and ±0.010 on decimal.

WIRING DIAGRAM



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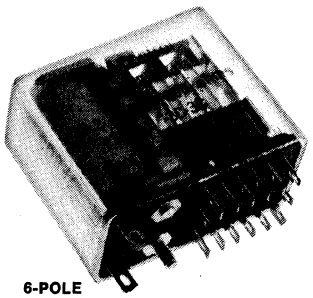
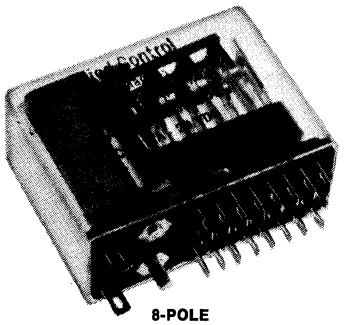
CRADLE RELAY FAMILY



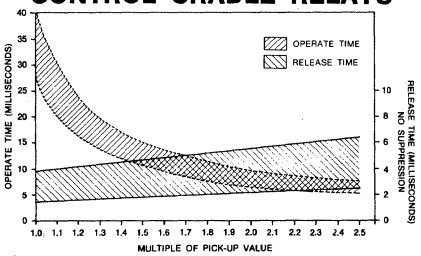
6-POLE



8-POLE

SENSITIVE / ULTRA SENSITIVE

TYPICAL TIMING VS MULTIPLE OF PICK-UP FOR ALLIED CONTROL CRADLE RELAYS



SPECIFICATIONS

Maximum Contact Arrangement
8C, eight pole double throw

Ambient Temperature
−55°C to +71°C

Dielectric Strength
1000 volts rms
500 volts rms across open contacts

Insulation Resistance (at +25°C)
1000 megohms minimum

Capacitance
Values shown are maximal for either the energized or de-energized position.

Closed contacts to frame	3.0 pf
Open contacts to frame	3.0 pf
Between open contacts	3.0 pf

Operate Time (at +25°C)
15 milliseconds maximal at nominal voltage

Release Time (at +25°C)
8 milliseconds maximal at nominal voltage

Weight
Dust Cover Relays — 6 ounces max.

CONTACT LIFE EXPECTANCY WITH RESISTIVE LOAD (Number of Operations)

Contact Type	POWER RELAYS 29 Vdc Operation				115 Vac Operation		
	Switching Current (amperes)				Switching Current (amperes)		
	Level	1	2	5	1	3	5
STD	$5x10^6$	$15x10^6$	$2.5x10^6$	—	$1x10^6$	—	—
BIF	$5x10^7$	$15x10^6$	$2.5x10^6$	$6x10^5$	$1x10^6$	—	—
SCAD	—	—	$2.5x10^6$	$6x10^5$	—	$5x10^5$	$2x10^5$

ORDERING SPECIFICATIONS

TS154 — 2C — 8.5madc

Coil Current
Specify max. pull-in DC current

Contact Configuration
O-C — Single pole, double throw
2C — Two pole, double throw
4C — Four pole, double throw
6C — Six pole, double throw
8C — Eight pole, double throw

Basic Type
TS163 — Bifurcated contacts; low level up to 2 amp. Sensitive adustment
TS163 — Bifurcated contacts low level up to 2 amp. Sensitive adustment
TSS154 — Single pt. contact; low level up to 2 amp. Ultra sensitive adjustment
TSS163 — Bifurcated contacts; low level up to 2 amp. Ultra sensitive adjustment

SENSITIVE DC CURRENT ADJUSTMENT
(Recommended nominal current is at least 10% over pull-in value)
(Contact Rating: Up to 5 Amperes)

Resistance Ohms* ±10%	Maximum Pull-in Current (Milliamperes)				
	O-C	2C	4C	6C	8C
1,000	7.0	8.5	13.0	16.0	20.0
2,500	4.6	5.8	8.4	10.0	13.0
5,000	3.3	4.1	6.2	7.2	9.0
10,000	2.4	3.1	4.5	5.0	6.4
15,000	1.9	2.6	3.5	4.2	5.3
Average Pull-in Power (Milliwatts)	50	85	175	250	400

ULTRA-SENSITIVE DC CURRENT ADJUSTMENT
(Recommended nominal current is at least 10% over pull-in value)
(Contact Rating: Up to 1 Ampere)

Resistance Ohms* ±10%	Maximum Pull-in Current (Milliamperes)		
	O-C	2C	4C
1,000	4.5	6.5	9.0
2,500	2.9	4.1	5.8
5,000	2.1	2.9	4.1
10,000	1.5	2.0	3.0
15,000	1.2	1.7	2.4
Average Pull-in Power (Milliwatts)	20	40	80

*Other values upon request, consult factory.

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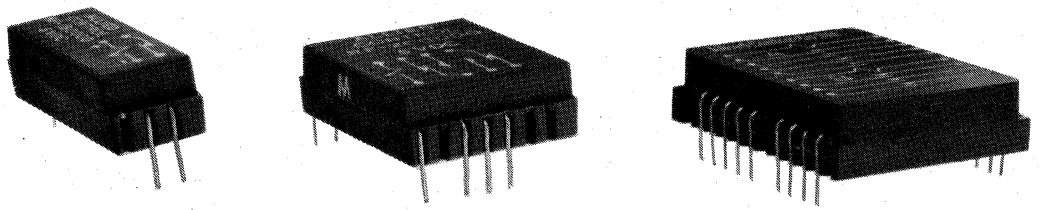
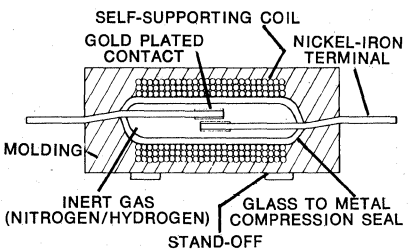
TRI-R DUAL-IN-LINE REED RELAYS



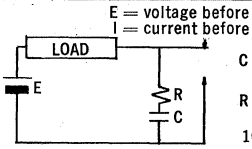
FEATURES

- High speed—operate and release time in microseconds
- Low profile—permits 0.5 inch PC board stacking
- Long life—100 million operations at low level; 20 million operations at 10 watts
- Total encapsulation—eliminates reed breakage even under severe shock
- Magnetic and/or electrostatic shielding for high density packaging
- Solid state circuitry—for input/output protection
- Choice of terminal patterns and schematics
- Self supporting coil—maximum coil efficiency



TIME IN MILLISECONDS		FORM A	FORM B	FORM C
AT NOM. VDC.	Max. Operate Time	1.5	1.0	1.5
	Max. Release Time	0.75	0.5	0.75
	Max. Bounce Time—N.C.		0.5	1.5
	Load: 10 mA, 1.5 VDC—N.O.	0.5		0.5

E = voltage before closing in volts
I = current before opening in amperes

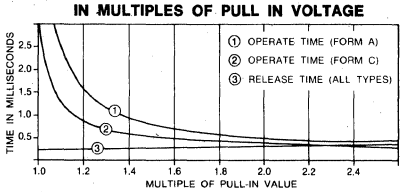


$$C = \frac{I^2}{10}\ mf$$

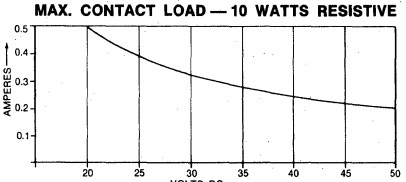
$$R = \frac{E}{10 \times I\left(1 + \frac{50}{E}\right)}\ ohms$$

Contact life expectancy relates directly to contact loads. Adequate arc suppression extends contact load life. Slight adjustment of R and/or C will eliminate arcing. Shown above is a typical arc suppression network available in TRI-R packages (on request). Other methods of arc suppression include diodes, neon glow lamps, and diode and resistor combinations.

TYPICAL TIMING IN MULTIPLES OF PULL IN VOLTAGE



MAX. CONTACT LOAD — 10 WATTS RESISTIVE



OPERATING SPECIFICATIONS

RF SERIES TRI-R REED RELAYS (IFA-IFC)

Nominal Coil Voltage (Vdc)	5	6	12	24
Power Requirement per Pole (mW)	75	75	75	120

Maximum Pull-in Voltage
80% of nominal coil voltage

Minimum Drop-out Voltage
10% of maximum pull-in voltage

Maximum Contact Resistance
0.200 ohm

Contact Rating
Low level up to 10 watts; 200 Vdc or 0.5 A

Minimum Life Expectancy
100 million operations at low level
20 million operations at 10 watts

Insulation Resistance
1000 megohms at 25°C, 65% RH

Dielectric Strength
225 Vrms at 25°C sea level

Temperature Range
−50°C to +85°

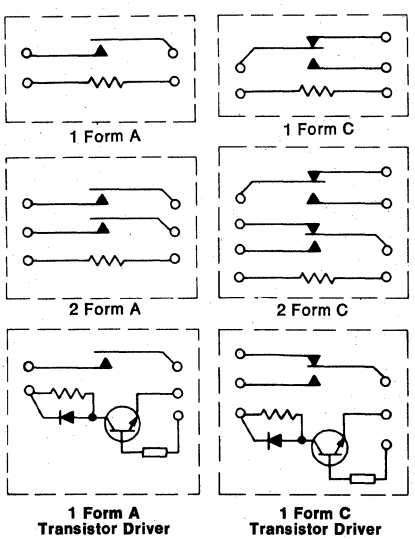
Electrical Timing
See Figure A

Maximum Contact Load
10 watts resistive (see Figure B)

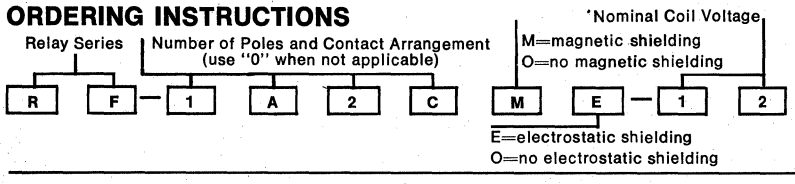
SPECIAL FEATURES

The round wire terminals of the RF Series relays, positioned in the recessed sections of the molded relay body, are spaced 1.0 x 0.1 inch. Lead protection is provided without sacrificing the ability of spot testing from either side of the PC board.

STANDARD SCHEMATICS



ORDERING INSTRUCTIONS



Example: RF1A2CME-12

Description: RF Series relay with single Form A and double Form C contact arrangement for use on nominal coil voltage of 12 Vdc with magnetic and electrostatic shielding

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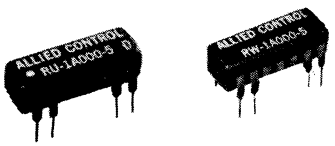
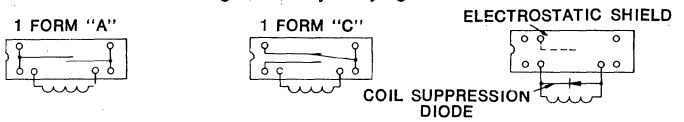
RU/RW 14 PIN DIP REED RELAYS



FEATURES

- Mechanically compatible with integrated circuits
- Operates directly from standard DTL and T²L logic levels
- Suitable for automatic insertion
- Permits 0.3 inch PC-Board stacking
- Electrostatic shielding for applications requiring low capacitance between input and output
- Magnetic shielding permits close stacking
- Terminal interconnects allow high flexibility in laying out PC-Boards.

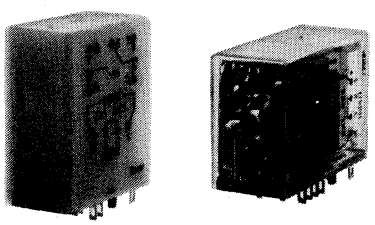
The RU/RW Series has high speed operating and release times. Available in one form A and one form C with sensitivity as low as 50 milliwatts.



OPERATING SPECIFICATIONS

Relay Series:	RUIA (standard)	RUIC (standard)	RWIA (sensitive)
Contact Arrangement:	1 Form "A"	1 Form "C"	1 Form "A"
Contact Rating:	10 watts max	10 watts max	3 watts max
(resistive)	50 Vdc max/	50 Vdc max/	28 Vdc max/
	0.25 Amp max	0.5 Amp max	0.11 Amp max
Initial Contact Resistance:	0.200 Ohm max	0.200 Ohm max	0.200 Ohm max
Minimum Life Expectancy:	1 x 10^8 Ops at low level/	1 x 10^8 Ops at low level/	1 x 10^8 Ops at low level/
	2 x 10^7 Ops at 10 watts	2 x 10^7 Ops at 10 watts	2 x 10^7 Ops at 3 watts
Insulation Resistance @ 25°C	1,000 megaohms min.	1,000 megohms min.	1,000 megohms min.
Dielectric Strength:	225 Vrms min.	150 Vrms min.	200 VDC
Temperature Range:	−50°C/+85°C	−50°C/+85°C	−50°C/+85°C
Shock:	100G's/11 msec	100G's/11 msec	100G's/11 msec
Vibration:	35G's/2000 Hz	35G's/2000 Hz	35G's/2000 Hz
Operate Time:	0.3 msec max	1.5 msec max	0.3 msec max
Release Time:	0.05 msec max	0.75 msec max	0.05 msec max
Bounce Time: N.C.	N/A	0.75 msec Typ.	N/A
N.O.	0.5 msec Typ.	0.5 msec Typ.	0.15 msec Typ.
Sensitivity:			
5 Vdc Nom Coil	125 mW	200 mW	50 mW
6 Vdc Nom Coil	180 mW	290 mW	72 mW
12 Vdc Nom Coil	300 mW	300 mW	N/A
24 Vdc Nom Coil	300 mW	300 mW	N/A
Electrostatic Shielding:	Optional	N/A	Optional
Magnetic Shielding:	Optional	N/A	Optional
Coil Suppression Diode:	Optional	Optional	Optional

TD10 SOLID STATE TIMERS



- miniaturization
- two timing functions for design flexibility
- internal or external adjustable timing
- 2 form C and 4 form C contacts
- no false operation
- reverse polarity protection
- contact selection for low level to 10 amp loads
- mounting and terminal options
- time ranges from 0.1 to 300 seconds
- high reliability at low cost

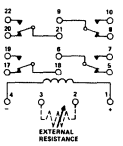
The TD10 Series Solid State Timer is the first economy unit that provides premium operating features available in more expensive times.

Utilizing the highly approved T154 cradle relay with a solid state timing circuit, the TD10 Timer provides timing from 0.1 to 300 seconds with a ±2% repeat accuracy.

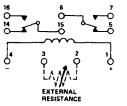
Available as "time delay on energization" and "interval" timing function with optional operating and mounting features, the TD10 Timer Series offers excellent flexibility with other components in circuit design.

GENERAL SPECIFICATIONS

Repeat Accuracy: ± 2%
Reset Time: 70 msec max (DC), 200 msec max (AC)
Temperature Range: 0°C to 55°C
Timing Adjustment: 500 K ohm multi-turn potentiometer for internal adjustment
Any Fixed Time: 0.1 to 300 seconds
Dielectric Strength: 1000 VRMS
Life: Mechanical—100 million operations
Electrical—Refer to T154 life expectancy chart



4 POLE



2 POLE

ORDERING INSTRUCTIONS

TIMER SERIES: TD10

FUNCTION
D—Time Delay To Make
N—Interval

TERMINAL TYPE
A—Plug-In Pins
B—Printed Circuit Pins

TIME ADJUSTMENT
N—Internal potentiometer adjustment
R—Remote adjustment or fixed time
F—Fixed time (internal)
*

TD10	D	B	—	2	C	—	24D	N	D

CONTACT CONFIGURATION
2—2 Form C, DPDT
4—4 Form C, 4PDT

CONTACT TYPE
A—Single Pt; Fine Silver Gold Bonded; for 2 ampere
B—Bifurcated; Fine Silver, Gold Bonded; Low Level under 60ma
C—Single Pt; Silver Cadmium Oxide, Gold Plated; for 3 to 5 amp
D—Heavy Duty, 10 amp.

NOMINAL INPUT VOLTAGE
12D— 12 VDC
24D— 24 VDC
48D— 48 VDC
115A—115 VAC

TIME RANGE
A—0.1 to 1.0
B—0.1 to 10.0 sec
C—1.0 to 50.0 sec
D—1.0 to 100 sec

*Specify timing with 3 digits e.g. 030 = 30seconds

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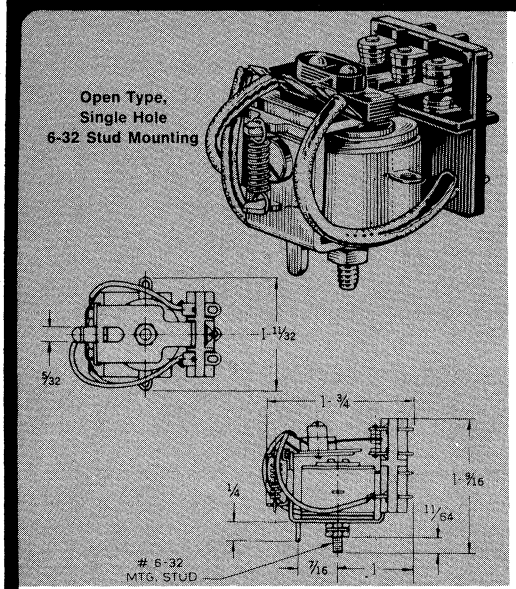
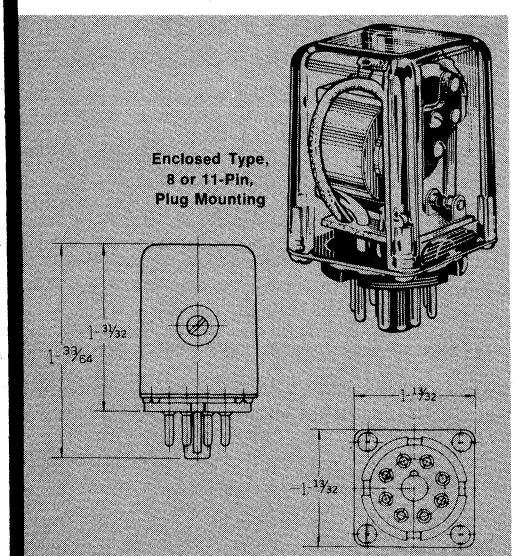
The ALLIED Brand...

General-Purpose Relays





All relays have Nylon bobbins, shock-resistant armature mounting, and corrosion-resistant coil. The open types are U.L. Component-Program Recognized and have 6-32 stud mounting. 8 and 11-pin plug-in types are for applications requiring protection from dust, oil and other foreign substances. Stationary and movable terminal blocks are molded phenolic with ample separation between opposite potentials. All relays are color-coded for voltage and AC, DC or Plate Circuit types by means of colored coil tape. Shpg. wts. open types, 2 oz.; enclosed types, 3 oz. **NOTE: All relays ordered in multiples of 50 will generally be shipped bulk in handy production-line packaging.** Open types are available with Quick-Connect terminals on special order only; require 2 weeks lead time. Order as SO-703, Type Number, adding QC to end of number.

Contact Ratings: 10 Amperes at 120 Volts AC or 32 Volts DC, non-inductive loads. **Contact Material:** Silver alloy, gold-flashed. **Coils:** AC or DC; Nylon bobbins, sealed with a fused wrap; coil leads are braided pigtails. **Insulation:** 1500 Volts RMS between circuits and between circuits and frame. **Life Expectancy:** exceeds 5 million operations. **Mounting:** Open Types, single hole, tapped 6-32 stud; Enclosed Types, SPDT and DPDT, standard 8-pin octal plug; 3PDT, 11-pin plug. **Color Coding:** 12 VAC, Red; 24 VAC, Green; 120 VAC, White; 12 VDC, Blue; 24 VDC, Yellow; 120 VDC, Black; PLATE CIRCUIT TYPES, Brown.

GENERAL-PURPOSE OPEN TYPE 6/32 STUD-MOUNTING RELAYS

*All Color-Coded for Voltage and AC, DC or Plate Circuit Types by Means of Colored Coil Tape

Stock No.	Allied Type No.	Coil Volt./Imp.	Contact Action	Coil mA	Coil Ohms	Color Code*	Each 1-4	5-24	25-49	50-99	100-249	250-499	500-999	1000-1499	1500-Up
703-1000	KN100-1C-12A	12 AC	SPDT	170	20	Red	3.66	3.25	2.92	2.60	2.28	2.11	1.95	1.87	1.79
703-1001	KN100-1C-24A	24 AC	SPDT	85	75	Green	3.66	3.25	2.92	2.60	2.28	2.11	1.95	1.87	1.79
703-1002	KN100-1C-120A	120 AC	SPDT	35	1500	White	3.66	3.25	2.92	2.60	2.28	2.11	1.95	1.87	1.79
703-1014	KN105-1C-12D	12 DC	SPDT	80	150	Blue	3.49	3.10	2.79	2.48	2.17	2.02	1.86	1.78	1.71
703-1015	KN105-1C-24D	24 DC	SPDT	40	600	Yellow	3.49	3.10	2.79	2.48	2.17	2.02	1.86	1.76	1.71
703-1005	KN100-2C-12A	12 AC	DPDT	170	20	Red	4.28	3.80	3.42	3.04	2.66	2.47	2.28	2.18	2.09
703-1006	KN100-2C-24A	24 AC	DPDT	85	75	Green	4.28	3.80	3.42	3.04	2.66	2.47	2.28	2.18	2.09
703-1007	KN100-2C-120A	120 AC	DPDT	35	1500	White	4.28	3.80	3.42	3.04	2.66	2.47	2.28	2.18	2.09
703-1018	KN105-2C-12D	12 AC	DPDT	80	150	Blue	3.88	3.45	3.10	2.76	2.42	2.24	2.07	1.98	1.90
703-1019	KN105-2C-24D	24 DC	DPDT	40	600	Yellow	3.88	3.45	3.10	2.76	2.42	2.24	2.07	1.98	1.90
703-1020	KN105-2C-120D	120 DC	DPDT	11	10000	Black	4.56	4.05	3.64	3.24	2.84	2.63	2.43	2.33	2.23
703-1011	KN100-3C-120A	120 AC	3PDT	35	1500	White	4.84	4.30	3.87	3.44	3.01	2.80	2.58	2.47	2.37
703-1023	KN105-3C-24D	24 DC	3PDT	40	600	Yellow	4.45	3.95	3.56	3.16	2.76	2.57	2.37	2.27	2.17

GENERAL-PURPOSE ENCLOSED TYPE 8-PIN PLUG-IN RELAYS

Stock No.	Allied Type No.	Coil Volt./Imp.	Contact Action	Coil mA	Coil Ohms	Color Code*	Each 1-4	5-24	25-49	50-99	100-249	250-499	500-999	1000-1499	1500-Up
703-1026	KN110-1C-12A	12 AC	SPDT	170	20	Red	6.95	5.55	5.00	4.44	3.88	3.61	3.33	3.19	3.05
703-1027	KN110-1C-24A	24 AC	SPDT	85	75	Green	6.80	5.55	5.00	4.44	3.88	3.61	3.33	3.19	3.05
703-1028	KN110-1C-120A	120 AC	SPDT	35	1500	White	6.25	5.55	5.00	4.44	3.88	3.61	3.33	3.19	3.05
703-1039	KN115-1C-12D	12 DC	SPDT	80	150	Blue	6.87	5.50	4.95	4.40	3.85	3.58	3.30	3.16	3.03
703-1040	KN115-1C-24D	24 DC	SPDT	40	600	Yellow	6.87	5.50	4.95	4.40	3.85	3.58	3.30	3.16	3.03
703-1031	KN110-2C-12A	12 AC	DPDT	170	20	Red	6.92	6.15	5.54	4.92	4.31	4.00	3.69	3.54	3.38
703-1032	KN110-2C-24A	24 AC	DPDT	85	75	Green	6.92	6.15	5.54	4.92	4.31	4.00	3.69	3.54	3.38
703-1033	KN110-2C-120A	120 AC	DPDT	35	1500	White	6.92	6.15	5.54	4.92	4.31	4.00	3.69	3.54	3.38
703-1043	KN115-2C-12D	12 DC	DPDT	80	150	Blue	6.98	6.20	5.58	4.96	4.34	4.03	3.72	3.56	3.41
703-1044	KN115-2C-24D	24 DC	DPDT	40	600	Yellow	6.98	6.20	5.58	4.96	4.34	4.03	3.72	3.56	3.41
703-1045	KN115-2C-120D	120 DC	DPDT	11	10000	Black	7.65	6.80	6.12	5.44	4.76	4.42	4.08	3.91	3.74
703-1048	KN115-2C-2.5K	2500 Ohms	DPDT	10	2500	Brown	6.86	6.10	5.49	4.88	4.27	3.96	3.66	3.51	3.36
703-1049	KN115-2C-5K	5000 Ohms	DPDT	7	5000	Brown	6.98	6.20	5.58	4.96	4.34	4.03	3.72	3.56	3.41
703-1050	KN115-2C-10K	10000 Ohms	DPDT	5	10000	Brown	8.25	6.60	5.94	5.28	4.62	4.29	3.96	3.80	3.63

THREE POLE DOUBLE THROW TYPES (3PDT) 11-PIN PLUG-IN

703-1035	KN110-3C-120A	120 AC	3PDT	35	1500	White	8.55	7.60	6.84	6.08	5.32	4.94	4.56	4.37	4.18
703-1053	KN115-3C-24D	24 DC	3PDT	40	600	Yellow	8.50	7.55	6.80	6.04	5.29	4.91	4.53	4.34	4.15

ALLIED ELECTRONICS' CATALOG NOW AVAILABLE

A comprehensive buying guide to top-quality general-purpose relays. Compiled to meet the needs of industry, schools, institutions and government agencies, it's also the catalog for anyone looking for one dependable source for hard-to-get items . . . one or a thousand. Merchandise is grouped by sections and numerical cover margin tabs guide you quickly to the products you need. Write on company letterhead to: Allied Electronics, Dept. EEM, 2400 West Washington Blvd., Chicago, Ill. 60612.

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The ALLIED Brand . . .

General-Purpose Relays

One, two and three-pole 10-amp contact combinations are available in open and enclosed styles. Clear polycarbonate covers are used on enclosed types. Have 0.187" flat male terminals, quick-connect type, pierced to accommodate solder wiring and spaced for standard plug-in mounting. U.L. Recognized. Life Expectancy: 10 million mechanical operations minimum (without load); 100,000 operations minimum at rated load. Operating Speed: 15 milliseconds and 10 milliseconds release, continuous duty. Av. shpg. wt. 3 oz.

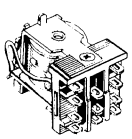
HOW TO ORDER

To Order, Substitute Last Number of Allied Type For Voltage. 1=6VAC, 2=12VAC, 3=24VAC, 4=120VAC, 5=240VAC, 6=6VDC, 7=12VDC, 8=24VDC, 9=110VDC. Ex: Allied Type No. ASD 412 is Stock No. 703-041X and Voltage 12VAC; Stock No. is then 703-0412.

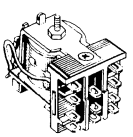
AC AND DC COIL SPECIFICATIONS

DC Coils			(AC Coils) 1 and 2 Pole			(AC Coils) 3 Pole		
(Nominal) Voltage	Current in mA	Resistance Ohms	Voltage (Nominal	Current in mA	Resistance Ohms	Voltage (Nominal)	Current in mA	Resistance Ohms
6	188	32.1	6	335.0	6	6	460.0	4.2
12	100	120.0	12	168.0	21	12	230.0	18.0
24	51	472.0	24	84.0	75	24	115.0	72.0
48	26.6	1800.0	120	17.5	2250	120	24.0	1700.0
110	11.5	10000.0	240	8.75	9110	240	12.0	7200.0

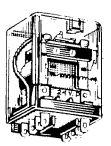
OPEN CONSTRUCTION TAPPED 6-32 HOLES

Stock No.	Allied Type No. ASD-	Construction and Mounting	Voltage	Contact Action	Each 1-24	25-99	50-99	100-249	250-499	500-999	1000-Up
703-040X	401 to 405		6, 12, 24, 120VAC	SPDT	4.15	3.32	3.15	2.45	2.28	2.10	1.93
			240VAC	SPDT	4.67	3.75	3.35	2.76	2.56	2.37	2.17
703-040X	406 to 409		6, 12, 24VDC	SPDT	3.97	3.18	2.84	2.34	2.17	2.01	1.84
			110VDC	SPDT	4.75	3.80	3.40	2.80	2.60	2.40	2.20
703-041X	411 to 415		6, 12, 24, 120VAC	DPDT	5.22	4.18	3.74	3.08	2.86	2.64	2.42
			240VAC	DPDT	5.75	4.60	4.12	3.39	3.15	2.91	2.66
703-041X	416 to 419		6, 12, 24VDC	DPDT	4.62	3.70	3.31	2.73	2.53	2.34	2.14
			110VDC	DPDT	5.45	4.37	3.91	3.22	2.99	2.76	2.53
703-042X	421 to 425		6, 12, 24, 120VAC	3PDT	5.92	4.75	4.25	3.50	3.25	3.00	2.75
			240VAC	3PDT	6.47	5.17	4.63	3.81	3.54	3.27	2.90
703-042X	426 to 429		6, 12, 24VDC	3PDT	5.40	4.32	3.86	3.19	2.95	2.73	2.50
			110VDC	3PDT	5.92	4.75	4.25	3.50	3.25	3.00	2.75

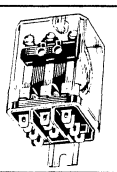
OPEN CONSTRUCTION 6-32 STUD MOUNTING

703-043X	431 to 435		6, 12, 24, 120VAC	SPDT	4.27	3.42	3.06	2.52	2.34	2.16	1.98
			240VAC	SPDT	4.80	3.84	3.44	2.83	2.63	2.43	2.22
703-043X	436 to 439		6, 12, 24VDC	SPDT	4.10	3.27	2.93	2.41	2.24	2.07	1.89
			110VDC	SPDT	4.87	3.89	3.48	2.87	2.66	2.46	2.25
703-044X	441 to 445		6, 12, 24, 120VAC	DPDT	5.35	4.27	3.82	3.15	2.92	2.70	2.47
			240VAC	DPDT	5.87	4.70	4.20	3.46	3.21	2.97	2.72
703-044X	446 to 449		6, 12, 24VDC	DPDT	4.75	3.80	3.40	2.80	2.60	2.40	2.20
			110VDC	DPDT	5.57	4.46	3.99	3.29	3.05	2.82	2.58
703-045X	451 to 455		6, 12, 24, 120VAC	3PDT	6.05	4.84	4.33	3.57	3.31	3.06	2.80
			240VAC	3PDT	6.60	5.27	4.71	3.88	3.60	3.33	3.05
703-045X	456 to 459		6, 12, 24VDC	3PDT	5.52	4.41	3.95	3.25	3.02	2.79	2.55
			110VDC	3PDT	6.05	4.84	4.33	3.57	3.31	3.06	2.80

ENCLOSED CONSTRUCTION PLUG-IN

703-046X	461 to 465		6, 12, 24, 120VAC	SPDT	4.10	3.50	3.20	2.79	2.27	2.09	1.93
			240VAC	SPDT	4.50	3.85	3.46	3.07	2.48	2.30	2.12
703-046X	466 to 469		6, 12, 24VDC	SPDT	3.97	3.40	3.08	2.71	2.20	2.03	1.87
			110VDC	SPDT	4.50	3.85	3.50	3.07	2.49	2.30	2.12
703-047X	471 to 475		6, 12, 24, 120VAC	DPDT	5.02	4.30	3.90	3.43	2.79	2.57	2.37
			240VAC	DPDT	5.55	4.75	4.30	3.79	3.08	2.84	2.61
703-047X	476 to 479		6, 12, 24VDC	DPDT	4.50	3.85	3.50	3.07	2.49	2.30	2.12
			110VDC	DPDT	5.15	4.40	4.00	3.51	2.85	2.63	2.42
703-048X	481 to 485		6, 12, 24, 120VAC	3PDT	5.67	4.85	4.40	3.87	3.14	2.90	2.67
			240VAC	3PDT	6.20	5.30	4.82	4.23	3.44	3.17	2.92
703-048X	486 to 489		6, 12, 24VDC	3PDT	5.15	4.40	4.00	3.51	2.85	2.63	2.42
			110VDC	3PDT	5.67	4.85	4.40	3.87	3.14	2.90	2.67

ENCLOSED CONSTRUCTION BRACKET MOUNTED

703-049X	491 to 495		6, 12, 24, 120VAC	SPDT	4.10	3.61	3.23	2.66	2.47	2.28	2.09
			240VAC	SPDT	4.50	4.03	3.61	2.97	2.76	2.55	2.33
703-049X	496 to 499		6, 12, 24VDC	SPDT	3.97	3.46	3.10	2.55	2.37	2.19	2.00
			110VDC	SPDT	4.50	4.08	3.65	3.01	2.79	2.58	2.36
703-050X	501 to 505		6, 12, 24, 120VAC	DPDT	5.02	4.46	3.99	3.29	3.05	2.82	2.58
			240VAC	DPDT	5.55	4.89	4.37	3.60	3.34	3.09	2.83
703-050X	506 to 509		6, 12, 24VDC	DPDT	4.50	3.99	3.57	2.94	2.73	2.52	2.31
			110VDC	DPDT	5.15	4.65	4.16	3.43	3.18	2.94	2.69
703-051X	511 to 515		6, 12, 24, 120VAC	3PDT	5.67	5.03	4.50	3.71	3.44	3.18	2.91
			240VAC	3PDT	6.20	5.46	4.88	4.02	3.73	3.45	3.16
703-051X	516 to 519		6, 12, 24VDC	3PDT	5.15	4.60	4.12	3.39	3.15	2.91	2.66
			110VDC	3PDT	5.67	5.03	4.50	3.71	3.44	3.18	2.91

SOCKETS FOR ABOVE RELAYS

Stock No.	Termination	Each	Stock No.	Termination	Each
703-0901	Printed Circuit	1.31	703-0904	8-Pin Front Connected	5.77
703-0902	.187" Quick-Disconnect	1.31	703-0905	11-Pin Front Connected	7.35
703-0903	Pierced Solder Terminals	1.31			

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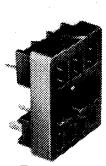
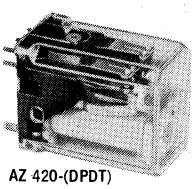
American Zettler, inc.

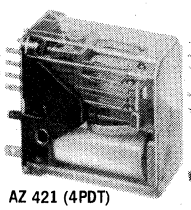
MINIATURE GENERAL-PURPOSE RELAYS

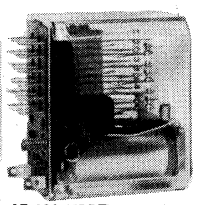
UP TO 6 PDT CONTACTS SERIES AZ 420

General purpose miniature relays in plastic dust cover — Interchangeable with other cradle type relays — Combination solder and plug-in terminals. UL-version listed under UL Component Recognition File 43203.


ST 140-A1


AZ 420-(DPDT)


AZ 421 (4PDT)


AZ 431 (6PDT)

FEATURES

- International Standard type
- Combination plug in/wire or PC terminals
- Low level bifurcated, 2 amp or 5 amp contacts
- Life expectancy more than 100 million operations
- Form A, B, C and D contacts are available
- Molded cradle eliminates phenolic dust inside the relay
- Balanced, spring-held armature allows dependable operation in any position
- Round core and larger coil volume provides more pull force.
- Slim profile mounting with right-angle socket
- Sockets are of unbreakable fiberglass-filled base and have unique knife-type connectors for dependable contact
- Sensitive version for IC-driver 5 V, 16 mA available
- Available from stock.

GENERAL DESCRIPTION

The AZ miniature general-purpose, comb-actuated relay can be used in a wide variety of applications such as computer systems, control and alarm systems, business machines and data processing equipment, etc.

The field-proved, long-life characteristics of the AZ relay, along with its unique plug-in design and integral dust cover, allow it to be used in transistorized systems where space requirements and operational longevity are of prime consideration. The AZ relay requires less than one cubic inch of space. When installed with the AZ right-angle socket, its overall height is only ¾".

AZ miniature relays are available in all contact configurations through 6PDT. The contacts are capable of carrying loads up to 5 amps, as well as low-level signals. For low-level, high reliability switching, bifurcated contacts are available.

All parts of the magnetic circuit are made from armco magnetic ingot iron and aged in the most modern hydrogen annealing equipment ;a process which assures optimal stability of operating data during the life of the relay. All AZ relays are insulated with the highest quality pre-aged phenolic obtainable.

The AZ relays described in this brochure are all of the round-core type. This design feature provides a higher number of turns at the same coil resistance, resulting in greater mechanical force with less coil power. Only one adjustment is needed for any application.

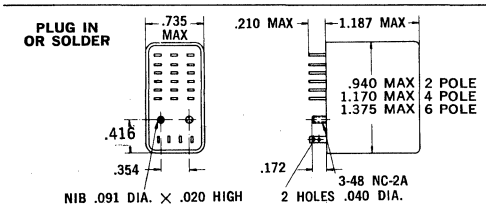
The unique armature retention spring dissipates kinetic energy of the armature resulting in minimum bounce. The molded low-friction cradle results in further reduction of bounce and eliminates the problem of phenolic dust inside of the relay.

Additional features of the AZ420 include a new base and socket design made of unbreakable fiberglass-filled polyurethane, with an insulation resistance of 10^{10} ohms. A unique knife-type connector provides a more secure connection and eliminates flux contamination of contact surfaces during machine soldering.

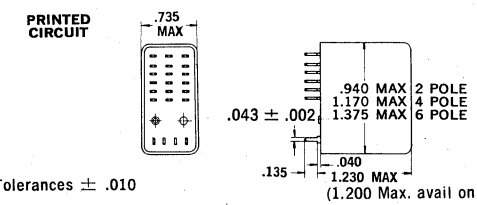
MECHANICAL SPECIFICATIONS

DIMENSIONS (inches)

PLUG IN OR SOLDER



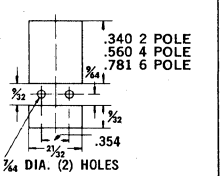
PRINTED CIRCUIT

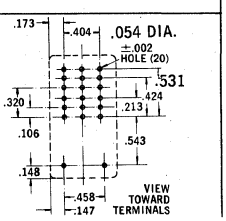


Tolerances ± .010

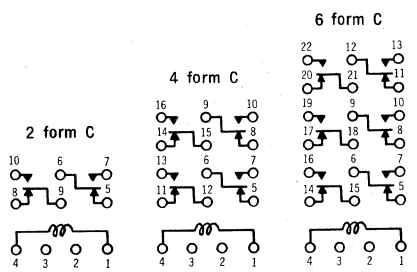
Standard relays have gold plated terminals.

SUGG. PANEL LAYOUT OR P/C BOARD





WIRING DIAGRAM



Terminals 2 + 3 for dual coil version, on single coil not inserted.

ELECTRICAL SPECIFICATIONS

Contact Rating: Noninductive load
Light Duty (Code L): Fine silver goldplated — low level to 2 amps @ 26 VDC or 1 amp @ 115 VAC
Heavy Duty (Code H): Silved cadmium oxide — 5 amp @ 26 VDC or 3 amp @ 115 VAC
Other contact material available

Life Expectancy: Mechanical Operations: 10^8
Electrical: see Table

Contact Resistance: 50 milliohms max. initially
200 milliohms at end of life

Operate Time: At two times "must operate" voltage or current ≤ 8ms

Release Time: At two times "must operate" voltage or current: ≤ 3ms

Contact Bounce: At 10 ma contact current:
2ms typ. at operate, N.O. contacts
3ms typ. at release, N.C. contacts

Dielectric Strength: 1000 Vrms; 500 Vrms across contact gap

Insulation Resistance: 10,000 megohms minimum @ 25°C, 100 VDC, 50% RH; Special insulation with 10^{14} ohms available

Coil Temperature: Max. 105°C (220°F)

Ambient Temperature
Operating: −55°C (−72°F) to 80°C (175°F) @ nominal operating voltage
Storage: −55°C (−72°F) to 105°C (220°F)

Vibration: Operating: .062 DA @ 5-55 Hz; 10 g @ 55-110 Hz
Non-Operating: 10 g @ 5-500 Hz

Shock: Operating: 20 g @ 11ms
Non-Operating: 30 g @ 11ms

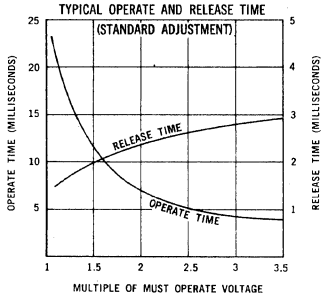
Weight: 23 to 35 grams (approx. 1 oz.)

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

American Zettler, inc.
16881 HALE AVE. ▪ IRVINE, CALIF. 92705 ▪ PHONE (714) 540-4190 ▪ TELEX: 67-8472

American Zettler, inc.

MINIATURE GENERAL PURPOSE RELAYS SERIES AZ 420



Notes: 1. Coils not arc suppressed
2. Switched battery voltage source

Typical Contact Life Expectancy at Resistive Loads

Current	Voltage	Contact	No. of Operations
5A	115 VAC	Heavy Duty	5×10^4
5A	28 VDC	Heavy Duty	1×10^5
3A	30 VDC	Heavy Duty	3×10^5
1A	220 VAC	Heavy Duty	5×10^5
2A	26 VDC	Light Duty	1.5×10^6
100mA	26 VDC	Light Duty	2×10^8
50mA	110 VDC	Light Duty	8×10^6
1mA	.1 VDC	Light Duty	1×10^8

ORDER INFORMATION

1. Select basic relay type from Table I
2. Add coil code from Table IIa, b, or c
3. Add contact code from Table III
4. Add—U for UL version after P/N

FOR EXAMPLE

AZ 431 — 80 — 1L

Plug-in type

430 ohm coil resistance

6 PDT contacts single, light duty

Table I — Basic Types

Mounting	Contact Arrangements		
	2 Form C (DPDT)	4 Form C (4PDT)	6 Form C (6PDT)
Plug-in/Solder	AZ 420	AZ 421	AZ 431
PC Terminals	AZ 428	AZ 429	AZ 439

Table IIa — Standard DC Voltage Version

Nom. Oper. VDC	2 or 4 Form C or D Contacts: Must Operate (Pick-up Max.) 2 pole mA	2 pole VDC	4 pole mA	4 pole VDC	Max. Cont. VDC	Resist Ohms ±10%	Coil Code	6 Form A, B or C Contacts: Must Operate 6 Pole mA	6 Pole VDC	Max. Cont. VDC	Re-sist Ohms ± 10%	Coil Code
3	75	1.2	112	1.8	5	14	21	175	2.1	4.5	11	22
6	37	2.2	57	3.3	10	52	15	106	3.2	7	25	18
12	20	4.1	30	6.1	19	185	1011	59	5.5	14	90	13
18	14	6.6	22	11	29	430	80	40	10	22	230	10
20	12	8.0	18	12	34	600	08	33	13	26	360	09
24	12	9.1	18	14	37	700	70	29	14	29	430	80
26	8.5	10	13	15	44	1K	07	25	17	34	600	08
48	5.4	15	8.3	23	70	2.5K	56	14	27	59	1.8K	06
72	4.2	30	6.3	40	105	5.8K	40	10	40	83	3.6K	05
115	2.4	48	3.5	58	170	15K	035	6.5	62	130	9K	04

For bifurcated and heavy duty contacts, add ⅓ of the listed "Must Operate" Value.

All values at 20°C (1) Inductance for closed armature. For open armature, divide by two. (2) Relay will pull in with less than "must operate" value.

Table IIb — Sensitive DC Voltage Version

Nom. Oper. VDC	Must Oper. VDC	2 Form C or D Resist. Ohms	2 Form C or D Coil Code	4 Form V or D Resist. Ohms	4 Form V or D Coil Code	6 Form A, B or C Resist. Ohms	6 Form A, B or C Coil Code
3	2.25	50	15s	30	18s	20	19s
6	4.5	200	13s	110	12s	80	13s
12	9.0	800	71s	450	80s	320	08s
24	18.0	3.2K	51s	1.8K	06s	1.2K	60s
48	36.0	13K	04s	7.5K	40s	5.2K	045s
72	54.0	28K	30s	16K	035s	13K	04s
115	86.0	50K	02s	40K	025s	30K	03s

Max. Continuous Coil Dissipation 2.3W at 20°C.

Table IIc — Sensitive DC Current Version

Coil Resist. Ohms ±10%	Coil Code	Must Operate Current (mA) 2 Form C or D Pick-up 85mW	4 Form C or D Pick-up 175mW	6 Form A, B or C Pick-up 250mW	Max. Coil Current mA
1K	07	8.5	13	16	46
2.5K	56	5.4	8.3	10	29
5K	045	4.1	6.2	7.2	20
10K	408	3.1	4.5	5.0	14
15K	035	2.4	3.5	4.2	12
30K	03	1.7	2.5	2.9	8.4

Table III — Contact Code

Contact Arrangement	Contact Type: Light Duty 1mA to 2 Amp Single Silver Gold Plated	Light Duty Dry Cir. to 2 Amp Bifurcated Silver Gold Plated	Heavy Duty 100mA to 5 Amp Single Silver Cadmium
2 Form C	4L	40L	4H
4 or 6 Form C	1L	10L	1H

Note:
Ordering information for sockets and hardware — see next page. For free samples or assistance in specifying your relay, contact our office or your nearest engineering representative listed in the yellow section. If the type relay you want is not listed in this short-form catalog, write directly to us. Refer to AZ 420 Series and provide information as to coil resistance, operating data (voltage or current), contact configuration, contact load, and approximate life requirements. Double-coil versions and A, B, and D contacts available on request. AC-coils available on request.

HARDWARE FOR CRADLE-TYPE RELAYS

GENERAL DESCRIPTION

The Series ST Sockets and Hardware described in this bulletin will accommodate most cradle-type relays available, and specifically, American Zettler's AZ 420 and AZ 430 General Purpose Relays. Unique in design, these ST sockets open new applications for cradle-type relays and the unbreakable fiberglass-filled polyurethane base provides stability under extreme environmental conditions, enhancing the reliability of the relay itself.

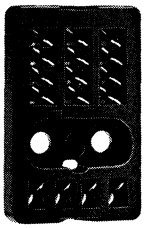
Outstanding design features offered by the new ST Series are the insulation resistance of more than 10,000 megohms. the unique knife-type connector that assures a positive contact, and the slim-profile mounting. Right-angle sockets with relays mounted extend to only ¾-inches in height above the PC board. All right angle sockets are enforced by a stable nickel plated steel bracket which also provides ground connection.

Other features include a molded riser to provide a gap between the sockets base and the PC board to eliminate flux contamination during machine soldering operations; universal terminal spacing format for accommodating 0.1- and 0.2-inch grids.

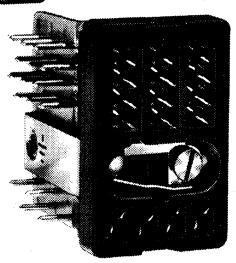
CONTINUED ON FOLLOWING PAGE

American Zettler, inc.

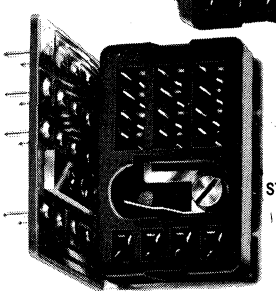
HARDWARE FOR CRADLE-TYPE RELAYS



ST-141-A1
4 POLE



ST-350-A1
4 POLE



ST-343-A1
4 POLE

PART NO.	NO. OF POLES	DIMENSIONS (inches)	SUGGESTED PANEL LAYOUT OR P/C BOARD
ST-140-A1 FOR AZ 420 ST-141-A1 FOR AZ 421 ST-345-A1 FOR AZ 431	2 4 6	SOCKET FOR WIRING OR PC — Diagram A	2 POLE 1 1/32, 4 POLE 3/16, 6 POLE 25/32; 3/32, 3/4, 1/32, .354, 21/32, 3/4 DIA. (2) HOLES; 2 POLE, 4 POLE, 6 POLE, .10 GRID SPACING
ST-342-A1 FOR AZ 420 ST-350-A1 FOR AZ 421 N.A.	2 4 6	RIGHT-ANGLE SOCKET FOR PC — Diagram B	2 POLE, 4 POLE, 6 POLE, FOR GROUNDING CLIP; VIEW TOWARD TERMINALS; .054 ± .002 DIA. HOLE
ST-349-A1 FOR AZ 420 ST-343-A1 FOR AZ 421 ST-354-A1 FOR AZ 431	2 4 6	RIGHT-ANGLE SOCKET FOR PC — Diagram C; *PINS ON 4 POLE SOCKET ONLY	2 POLE, 4 POLE, 6 POLE; GRID SPACING .200; .054 ± .002 DIA. HOLE; .110 DIA. HOLE FOR GROUND SCREW ONLY; VIEW TOWARD TERMINALS

TOLERANCES: ±.010 Standard sockets have silver-plated terminals and are dipped in flux for easy machine soldering.

ELECTRICAL SPECIFICATIONS

Dielectric Strength:
1500 Vrms between all elements;
500 Vrms for right-angle sockets only

Insulation Resistance:
10,000 megohms minimum @ 25°C,
100 VDC, 50% RH;
1,000 megohms for right-angle sockets

Current Rating:
5 amps maximum, continuous;
2 amps for right-angle sockets

Ambient Temperature:
−55°C (−72°F) to 105°C (220°F)
For machine soldering maximum 240°C (460°F)

Vibration: 10 g @ 5-55 Hz (socket soldered into PC board with relay plugged-in and held in place with retainer)

Shock: 50 g any position (socket soldered onto PC board with relay plugged-in and held in place with retainer)

Terminals: Combination type facilitates hand wiring or printed circuit mounting. Right-angle sockets for printed circuit mounting only.

ORDER INFORMATION

AZ Type	Description	Diagram Identification	Contacts
ST-140-A1	Socket	A	DPDT
ST-342-A1	Right Angle for PC	B	DPDT
ST-349-A1	Right Angle for PC	C	DPDT
ST-140-1	Retainer		DPDT
ST-141-A1	Socket	A	4PDT
ST-343-A1	Right Angle for PC	C	4PDT
ST-350-A1	Right Angle for PC	B	4PDT
ST-141-1	Retainer		4PDT

AZ Type	Description	Diagram Identification	Contacts
ST-345-A1	Socket	A	6PDT
ST-354-A1	Right Angle for PC	C	6PDT
ST-345-1	Retainer		6PDT
ST-140-2	Ground Clip for all		

Order socket, retainer and grounding clip (if desired) by separate part numbers. To specify sockets with gold plated terminals, substitute -A2 for -A1.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

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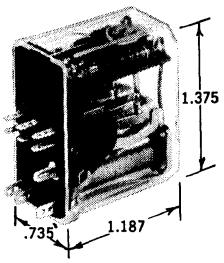
American Zettler, inc.

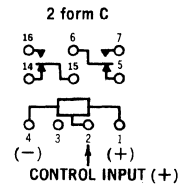
HYBRIDS
SERIES AZ 1400

GENERAL DESCRIPTION

The Hybrid Series AZ 1400 combines the advantages of mechanical contacts for the output and the most advanced electronic circuitry for the input to provide a highly reliable, yet most flexible switching device. There is complete galvanic isolation between input and output. The mechanical side consists of the proven cradle type relay AZ 420, with DPDT, 2 or 5 Amp contacts. The electronic part utilizes a unijunction transistor, a thyristor, and tantalum capacitors. The units are completely enclosed in a polycarbonate dustcover and have wire or plug-in terminals which fit standard relay sockets. The following basic types are available:

1. Voltage Sensor
2. Variable Time Delay Relay (on operate)
3. Variable Time Delay Relay (on release)
4. Variable Impulse Limiter
5. Variable Impulse Stretcher (monoflop)
6. Variable Impulse Generator (multiflop)
7. Alternate Action Impulse Relay (flip flop)





ELECTRICAL SPECIFICATIONS

Contact Rating: Non inductive

Light Duty (Code L): Fine silver gold plated — low level to 2 amps at 26VDC or 1 amp at 115VAC

Heavy Duty (Code H): Silver cadmium oxide — 2 to 5 amp at 26VDC or 3 amp at 115VAC

Contact Configuration: DPDT is standard, other types on request.

Dielectric Strength: 500 Vrms

Insulation Resistance: 10^9 ohms at 25°C 50% RH

Temperature Range: 0° to 40°C (Storage: −30° to +85°C)

Repeatability: ±2%

Polarity Protection: Yes, (except voltage sensor)

Accuracy: Max: +10% −15% at ±5% Volt variation and at 0° to 40°C

Transient Protection: +50 V 1 ms

Vibration: .062 DA at 5-55 Hz

Shock: 20 g at 11 ms

Weight: 35 gr. (1¼ oz)

Description	Operate Voltage or Current	Variation Range	Contact Code	Order No.
VOLTAGE SENSOR, energizes the relay section at a predetermined voltage. This voltage is adjustable with a built-in pot within the variation range. It deenergizes 30 mV below the set voltage. A Zener diode is used for the reference voltage.	70 mA Max.	9 to 15VDC	L	AZ 1435-10-4L-15
			H	AZ 1435-10-4H-15
	45 mA Max.	18 to 30VDC	L	AZ 1435-70-4L-30
			H	AZ 1435-70-4H-30
VARIABLE TIME DELAY (on operate) energizes the built-in relay after the operating voltage is applied to terminal #1 and 4, and after elapse of the predetermined time. This time is adjustable within the variation range. The recovery time is less than 150 ms. No false operation.	24VDC +10% −15% 30 mA	1 to 10 sec	L	AZ 1436-07-4L-10
			H	AZ 1436-07-4H-10
		3 to 30 sec	L	AZ 1436-07-4L-30
			H	AZ 1436-07-4H-30
VARIABLE TIME DELAY (on release) pulls in less than 50 ms after a positive control voltage of more than 20VDC is applied to terminal #2. The release time starts when the control voltage is switched off. The operate voltage remains on terminal 1 (+) and 4 (−) as auxiliary voltage. The release time is adjustable within the variation range. No false operation.	24VDC +10% −15% 30 mA	1 to 10 sec	L	AZ 1437-07-4L-10
			H	AZ 1437-07-4H-10
		3 to 30 sec	L	AZ 1437-07-4L-30
			H	AZ 1437-07-4H-30
VARIABLE IMPULSE LIMITER activates the built-in relay immediately after the operate voltage is applied, and releases after elapse of preset time. This time is adjustable within the variation range. The recovery time is less than 150 ms.	24VDC +10% −15% 50 mA	50 to 150 ms	L	AZ 1438-08-4L-0.15
			H	AZ 1438-08-4H-0.15
		150 to 450 ms	L	AZ 1438-08-4L-0.45
			H	AZ 1438-08-4H-0.45
		450 to 1500 ms	L	AZ 1438-08-4L-1.5
			H	AZ 1438-08-4H-1.5
VARIABLE IMPULSE STRETCHER energizes the relay section for a defined time independent from the length of the incoming positive trigger impulse. The closing time of the relay is adjustable within the variation range. The trigger impulse (min 10 μsec) must be more than 5VDC, but less than 30V. The operate voltage remains on terminal #1 (+) and #4 (−) as auxiliary voltage.	24VDC +10% −15% 50 mA	50 to 150 ms	L	AZ 1439-08-4L-0.15
			H	AZ 1439-08-4H-0.15
		150 to 450 ms	L	AZ 1439-08-4L-0.45
			H	AZ 1439-08-4H-0.45
		450 to 1500 ms	L	AZ 1439-08-4L-1.5
			H	AZ 1439-08-4H-1.5
VARIABLE IMPULSE GENERATOR pulses the relay at equal on and off time regardless of the frequency. The length of the impulse can be adjusted within the variation range.	24VDC +10% −15% 30 mA	1 to 1 sec	L	AZ 1440-07-4L-1
			H	AZ 1440-07-4H-1
		1 to 10 sec	L	AZ 1440-07-4L-10
			H	AZ 1440-07-4H-10
		3 to 30 sec	L	AZ 1440-07-4L-30
			H	AZ 1440-07-4H-30
ALTERNATE ACTION IMPULSE RELAY (bistable) can be switched in the opposite position by a positive trigger impulse applied to terminal #2, The trigger impulse (min 10 μsec) must be more than 5VDC, but less than 30VDC. The operate voltage remains on terminal #1 (+) and #4 (−) as auxiliary voltage. This is not a magnetic latching relay.	24VDC +10% −15% 30 mA		L	AZ 1441-07-4L
			H	AZ 1441-07-4H
Socket / Retainer — See Hardware page for cradle type relays.				ST 345-A1 / ST 345-1

*** FOR FURTHER DETAILED DIMENSIONS SEE AZ 420 SERIES 6PDT**

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

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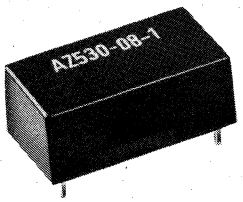
American Zettler, inc.

THINPAK™ MINIATURE RELAYS SERIES AZ 530 SPDT CONTACTS

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N.Y. STATE CALL COLLECT (516) 294-0990)



ACTUAL SIZE

FEATURES

- 0.415″ high for 0.6″ standard pc board spacing
- Up to 5 Amp SPDT contacts
- 0.1″ Grid Terminal spacing
- Insulation resistance greater than 10^{10} ohms
- Contact resistance less than 50×10^{-3}
- No phenolic insulation used
- 2500 Vrms contact to coil
- Plug into PC-board after cleaning (recom. AMP-pin 2-332070-3)
- Sensitive version for IC-Driver

GENERAL DESCRIPTION

The AZ miniature THINPAK relay, Series 530, has been designed for applications with either demanding space limitations, such as 0.6″ center-to-center PC card mounting, or operating requirements that cannot be met by reed relays or conventional contact type relays. The high pressure SPDT 1, 2 or 5 amp contacts operating at 26 VDC enables the unit to switch capacitance or lamp loads with current spikes that would normally weld the contacts of reed relays. The high sensitivity of 125 mW pull-in, long life and insulation resistance of more than 10^{10} ohms makes it an ideal unit for galvanic separation between electronic circuits. The AZ-530 THINPAK is available in standard coil voltages from 6 to 100 VDC with an operate and release time of less than 5 ms. It has PC terminals in 0.10″ grid spacing. A black polycarbonate dust cover with a bottom plate is provided.

ELECTRICAL SPECIFICATIONS

Contact Rating: noninductive load
Light Duty: Fine silver goldplated
1 Amp @ 26 VDC or
0.5 Amp @ 115 VAC
Medium Duty: Silver Cadmium-Oxide
2 Amp @ 26 VDC or
1 Amp @ 115 VAC
Heavy Duty: Silver Cadmium-Oxide
5 Amp @ 26 VDC or
3 Amp @ 115 VAC or
2 Amp @ 220 VAC
Life Expectancy: Mechanical Operations: 10^7
Operations at Rated Load: 10^5
Contact Resistance: 50 milliohms max. initially
Operate Time: (Typical) 5 ms at Nominal Voltage
Release Time: (Typical) 2 ms at Nominal Voltage
Contact Bounce: (Typical) at 10 mA contact current:
2 ms at operate N.O. side
6 ms at release N.C. side
Capacitance: typical: NC to Movable 0.6 pF
NO to Movable 0.9 pF
contact to coil 12 pF

Dielectric Strength:	AZ 530	AZ 535
Contact — Contact	500 Vrms	1000 Vrms
Contact — Coil	500 Vrms	2500 Vrms

Insulation Resistance: 10,000 Megohms min. @ 20°C
100 VDC, 50% RH

Drop-Out: 10% minimum of must operate-voltage or current
Coil Power: Pick up typical:
Light duty type: 125 mW
Medium duty type: 250 mW
Heavy duty type: 400 mW
Max. Continuous Dissipation:
AZ 530: 1.6 W @ 20°C (68°F) ambient
1.2 W @ 40°C (105°F) ambient
Temperature Rise: appr. 55°C per watt
AZ 535: 2.3 W @ 20°C (68°F) ambient
1.9 W @ 40°C (105°F) ambient
Temperature Rise: appr. 35°C per watt
Coil Temperature: Max. 105°C (220°F)
Ambient Temperature:
Operating: −55°C (−72°F) to 70°C (158°F) light duty type
to 60°C (140°F) medium and heavy duty type @ nominal operating voltage
Storage: −55°C (−72°F) to 105°C (220°F)
Vibration: 0.062 DA @ 10-55 Hz
Shock: 20 g
Enclosure: Black polycarbonate cover with mylar bottom plate
Terminals: Printed circuit board terminals goldplated in 0.10″ standard grid space
Weight: Approx. 10 gr. (AZ 530)
Approx. 20 gr. (AZ 535)

Standard Relays with light duty contacts (1 Amp)

Nom. Coil VDC	Max. Contin. VDC	Resist. Ohm ±10%	Must Operate* mA	Must Operate* VDC	Part No.
5	9.5	64	50	3.5	AZ 530-12-1
6	11	90	42	4.1	AZ 530-11-1
12	21	310	23	7.7	AZ 530-08-1
24	37	950	13	14	AZ 530-06-1
48	80	4,500	6.3	31	AZ 530-04-1
100	143	14,300	3.5	55	AZ 530-03-1

Standard Relays with medium duty contacts (2 Amp)

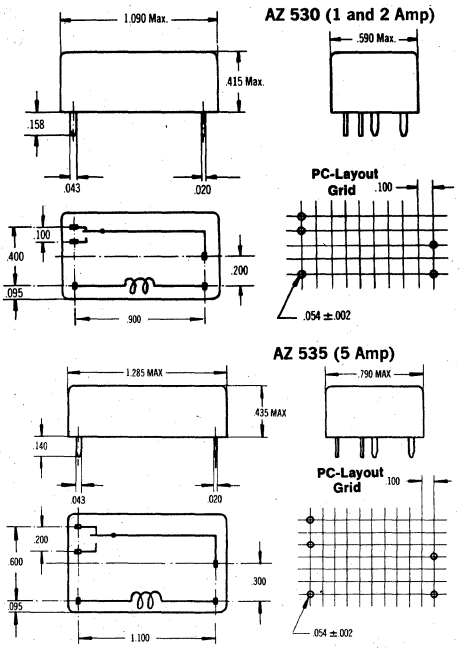
5	7.1	35	93	3.6	AZ 530-14-2
6	9.5	64	69	4.9	AZ 530-12-2
12	17	200	41	9.0	AZ 530-09-2
24	37	950	18	19	AZ 530-06-2
48	66	3,000	11	35	AZ 530-045-2
100	143	14,300	4.8	75	AZ 530-03-2

Standard Relays with heavy duty contacts (5 Amp)

5	7.5	29	123	3.6	AZ 535-16-2
6	8.5	37	110	4.5	AZ 535-15-2
12	16	125	61	8.5	AZ 535-11-2
24	30	440	33	16	AZ 535-08-2
48	63	1,930	16	33	AZ 535-055-2
100	147	10,500	7.2	83	AZ 535-035-2

All values at 20°C. Sensitive version for IC driver 5 V, 16 mA is available.
* Relay will pull in with less than "must operate" value.
There will be a change of less than 10% in must operate if several relays are mounted close together.

Note: To fasten relay on PC board do not bend contact terminals as this damages adjustment. Use coil terminals only. After soldering relay to board, do not dip the board into a cleaning solution.
Solder temperature: Max. 270°C (500°F)
Soldering time: Max. 5 sec.



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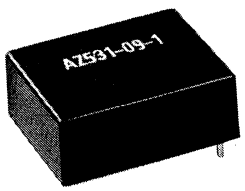
THINPAK™ MINIATURE RELAY SERIES AZ 531 DPDT CONTACTS



ACTUAL SIZE

FEATURES

- 1 or 2 Amp DPDT contacts
- 0.415″ high for 0.6″ standard PC board spacing
- 0.1″ Grid Terminal spacing
- Insulation resistance greater than 10^{10} ohms
- Contact resistance less than 50 x 10^{-3}
- No phenolic insulation used
- Plug into PC-board after cleaning (recom. AMP-pin 2-332070-3)

GENERAL DESCRIPTION

The miniature AZ-Thinpak relay, Series AZ 531, is the DPDT version of the field proven Series AZ 530 relay. The high pressure DPDT (2 form C) 1 or 2 amp contacts, enables the unit to switch capacitance or lamp loads with current spikes that would normally weld the contacts of reed relays. The high insulation resistance of more than 10^{10} ohms and the low contact resistance of less than 50 milliohms makes it an economical unit for galvanic separation between electronic circuits. A black polycarbonate dust cover with a bottom plate is provided.

ELECTRICAL SPECIFICATIONS

Contact Arrangement: DPDT

Conductive Rating: Noninductive load
Light Duty: Fine silver goldplated
1 Amp @ 26 VDC or
0.5 Amp @ 115 VAC
Medium Duty: Silver Cadmium-Oxide
2 Amp @ 26 VDC or
1 Amp @ 115 VAC

Life Expectancy: Mechanical Operations: 10^7
Operations at Rated Load: 10^5

Contact Resistance: 50 milliohms max. initially

Operate Time: (Typical) 6 ms at Nominal Voltage

Release Time: (Typical) 3 ms at Nominal Voltage

Contact Bounce: (Typical) at 10 mA contact current:
2 ms at operate N.O. side
6 ms at release N.C. side

Capacitance: Typical: N.C. to Movable 0.6 pF
N.O. to Movable 0.9 pF
Contact to coil 12 pF
Contact to contact 6 pF

Dielectric Strength:
Contact to contact 500 Vrms
Contact to coil 500 Vrms

Insulation Resistance: 10,000 Megohms min. @ 20°C.
100 VDC, 50% RH

Drop Out: 10% minimum of must operate-voltage or current

Coil Power: Pickup Typical:
Light Duty Type: 270 mW
Medium Duty Type: 400 mW
Max. Continuous Dissipation: 2 W @ 20°C (68°F) ambient
Temperature Rise: Approx. 40°C per watt

Coil Temperature: Max. 105°C (220°F)

Ambient Temperature:
Operating: −55°C (−72°F) to 75°C (167°F) light duty type
to 65°C (149°F) medium duty type @ nominal operating voltage
Storage: −55°C (−72°F) to 105°C (220°F)

Vibration: 0.062 DA @ 10-55 Hz

Shock: 20 g

Enclosure: Black polycarbonate cover with mylar bottom plate

Terminals: Printed circuit board terminals goldplated in 0.10″ standard grid space

Weight: Approx. 14 gr. (½ oz.)

Standard Relays with light duty contacts (1 Amp)

Nom. Coil VDC	Max. Contin. VDC	Resist. Ohm ±10%	Must Operate* mA	Must Operate* VDC	Part No.
6	10	60	68	4.5	AZ 531-13-1
12	21	260	34	9.7	AZ 531-09-1
24	35	670	21	16	AZ 531-07-1
48	82	3,800	9.0	38	AZ 531-045-1
60	100	6,000	7.2	47	AZ 531-04-1
110	180	19,000	4.0	84	AZ 531-03-1

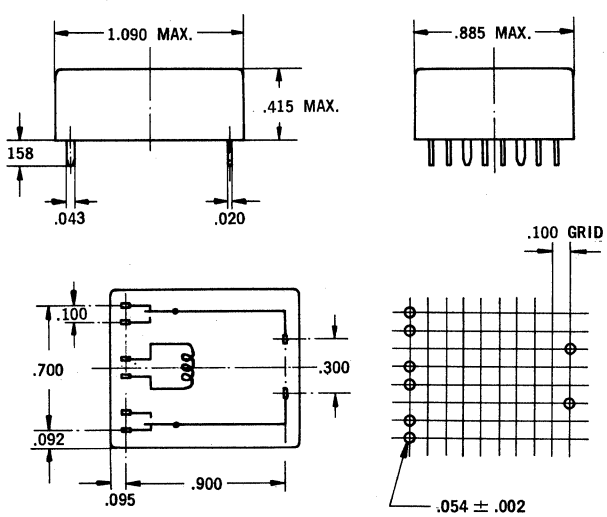
Standard Relays with medium duty contacts (2 Amp)

6	9	45	96	4.7	AZ 531-14-2
12	17	170	49	9.2	AZ 531-10-2
24	35	670	25	19	AZ 531-07-2
48	67	2,500	13	36	AZ 531-05-2
60	82	3,800	11	46	AZ 531-045-2
100	134	10,000	7.0	76	AZ 531-035-2

All values at 20°C

* Relay will pull in with less than "must operate" value. Simultaneous operation of both contacts is not guaranteed.

Note: To fasten relay on PC board do not bend contact terminals as this damages adjustment. Use coil terminals only. After soldering relay to board, do not dip the board into a cleaning solution.
Solder temperature: Max. 270°C (500°F)
Soldering time: Max. 5 sec.



For 4PDT and Latching Thinpak Relays see Vol. 4

American Zettler, inc.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N.Y. STATE CALL COLLECT (516) 294-0990)

GENERAL PURPOSE RELAYS SERIES AZ 480

10 AMP CONTACTS

GENERAL DESCRIPTION

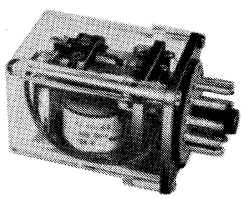
Commercial/industrial in application, these general-purpose relays feature the highest production quality at modest prices due to mass production techniques. The series AZ 480 finds broad application in the fields of motor controls, alarm systems, lighting and solenoid control, communications equipment, automated or semi-automated commercial controls, etc.

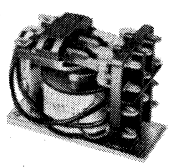
AZ 480 relays are available in either an open or plastic enclosed version. The open relay, with either solder or PC terminals, can be mounted with an attached base plate or with a 6-32 tapped hole in the core. It also can be supplied with a 6-32 mounting stud and locating tab. The relay enclosed in a plastic dust-cover is available either as a plug-in version with octal type socket (8 or 11 pins), or with PC terminals. AZ 480 relays are interchangeable with other manufacturer's types.

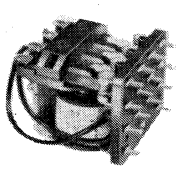
The standard AZ 480 relays have silver-cadmium-oxide 10-amp contacts in SPDT through 4PDT (5-amp contacts on request). The clean snappy action contacts operate with minimum bounce, resulting in greater reliability and longer life. A special plastic holding device prevents the armature from unseating itself during transportation or operation. The moveable contacts are securely mounted to the armature by a block of thermosetting plastic to ensure no change in adjustment during relay life. The stationary contacts are tightly stacked into a terminal block, which has barriers molded on both sides. UL-version listed under UL Component Recognition File E44211.

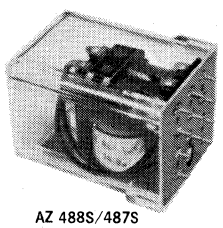
FEATURES

- American Standard Type
- AC or DC coils up to 220V
- Up to 4 PDT 10 AMP contacts
- Plug-in, wiring or PC board mounting
- Designed to meet UL requirements
- Life expectancy to 10 million operations


AZ 480/481


AZ 482/483


AZ 488/487


AZ 488S/487S

ELECTRICAL SPECIFICATIONS

Contact Rating: 10 amp @ 115 volts AC 60 Hz non inductive
Contact Material: Silver-cadmium-oxide
Contact Arrangement: 1, 2, 3 and 4 form C (up to 4PDT)
Life Expectancy: Mechanical: 10 million operations
Rated Load: ¼ million operations
Dielectric Strength: 1500 Vrms
500 Vrms across contact gap
Insulation Resistance: 100 megohms minimum
Coil Voltage: To 280 volts AC
Coil Power: Nominal — DC: 1.2 watts — AC: 2.5 VA
Max. Continuous Dissipation: 2.5 watts @ 35°C (95°F) ambient

Ambient Temperature: Open relay −45°C (−50°F) to 70°C (158°F) (at nominal operate voltage)
Enclosed relay −45°C (−50°F) to 55°C (132°F) (at nominal operate voltage)
Operate Time: Less than 15 ms at nominal operate voltage (DC coils only)
Release Time: Less than 8ms at nominal operate voltage (DC coils only)
Weight: Open Relay: 2.3 oz (65 gr.) — Enclosed Relay: 3 oz (85 gr.)
Terminals: Open Relay: Pieced solder lugs
Enclosed Relay: Octal plug-in
Mounting: See mechanical specifications
Enclosure: Heat and shock resistant clear plastic

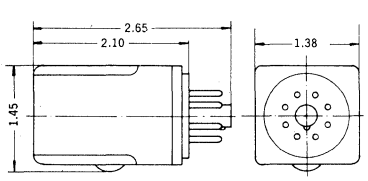
STANDARD RELAYS AC-ACTUATED

Coil Specifications					Order Number			
					Open		Enclosed	
Voltage, VAC			Nom. Current	Con-	Wire	PC	Octal	PC
Nom.	Max.	Min.	(mA)	tact	Terminals	Terminals	Plug In	Terminals
6AC	9	5	410	SPDT	AZ 483-2-1	AZ 487-2-1	AZ 481-2-1	AZ 487S-2-1
12AC	19	10	205	SPDT	AZ 483-3-1	AZ 487-3-1	AZ 481-3-1	AZ 487S-3-1
24AC	37	21	100	SPDT	AZ 483-4-1	AZ 487-4-1	AZ 481-4-1	AZ 487S-4-1
120AC	184	102	20	SPDT	AZ 483-7-1	AZ 487-7-1	AZ 481-7-1	AZ 487S-7-1
220AC	280	187	11	SPDT	AZ 483-9-1	AZ 487-9-1	AZ 481-9-1	AZ 487S-9-1
6AC	9	5	410	DPDT	AZ 483-2-2	AZ 487-2-2	AZ 481-2-2	AZ 487S-2-2
12AC	19	10	205	DPDT	AZ 483-3-2	AZ 487-3-2	AZ 481-3-2	AZ 487S-3-2
24AC	37	21	100	DPDT	AZ 483-4-2	AZ 487-4-2	AZ 481-4-2	AZ 487S-4-2
120AC	184	102	20	DPDT	AZ 483-7-2	AZ 487-7-2	AZ 481-7-2	AZ 487S-7-2
220AC	280	187	11	DPDT	AZ 483-9-2	AZ 487-9-2	AZ 481-9-2	AZ 487S-9-2
6AC	9	5	410	3PDT	AZ 483-2-3	AZ 487-2-3	AZ 481-2-3	AZ 487S-2-3
12AC	19	10	205	3PDT	AZ 483-3-3	AZ 487-3-3	AZ 481-3-3	AZ 487S-3-3
24AC	37	21	100	3PDT	AZ 483-4-3	AZ 487-4-3	AZ 481-4-3	AZ 487S-4-3
120AC	184	102	20	3PDT	AZ 483-7-3	AZ 487 7-3	AZ 481-7-3	AZ 487S-7-3
220AC	280	187	11	3PDT	AZ 483-9-3	AZ 487-9-3	AZ 481-9-3	AZ 487S-9-3
6AC	9	5	410	4PDT	AZ 483-2-8	AZ 487-2-8		
12AC	19	10	205	4PDT	AZ 483-3-8	AZ 487-3-8		
24AC	37	21	100	4PDT	AZ 483-4-8	AZ 487-4-8		
120AC	184	102	20	4PDT	AZ 483-7-8	AZ 487-7-8		
220AC	280	187	11	4PDT	AZ 483-9-8	AZ 487-9-8		

STANDARD RELAYS DC-ACTUATED

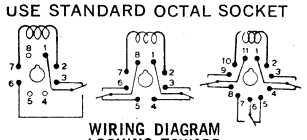
Coil Specifications					Order Number			
					Open		Enclosed	
Voltage, VDC			Resist. (Ohms)	Con-	Wire	PC	Octal	PC
Nom.	Max.	Min.	±10%	tact	Terminals	Terminals	Plug In	Terminals
6DC	9	4.5	32	SPDT	AZ 482-2-1	AZ 488-2-1	AZ 480-2-1	AZ 488S-2-1
12DC	19	9	130	SPDT	AZ 482-3-1	AZ 488-3-1	AZ 480-3-1	AZ 488S-3-1
24DC	37	18	500	SPDT	AZ 482-4-1	AZ 488-4-1	AZ 480-4-1	AZ 488S-4-1
48DC	75	36	2,100	SPDT	AZ 482-6-1	AZ 488-6-1	AZ 480-6-1	AZ 488S-6-1
110DC	165	83	10,500	SPDT	AZ 482-9-1	AZ 488-9-1	AZ 480-9-1	AZ 488S-9-1
6DC	9	4.5	32	DPDT	AZ 482-2-2	AZ 488-2-2	AZ 480-2-2	AZ 488S-2-2
12DC	19	9	130	DPDT	AZ 482-3-2	AZ 488-3-2	AZ 480-3-2	AZ 488S-3-2
24DC	37	18	500	DPDT	AZ 482-4-2	AZ 488-4-2	AZ 480-4-2	AZ 488S-4-2
48DC	75	36	2,100	DPDT	AZ 482-6-2	AZ 488-6-2	AZ 480-6-2	AZ 488S-6-2
110DC	165	83	10,500	DPDT	AZ 482-9-2	AZ 488-9-2	AZ 480-9-2	AZ 488S-9-2
6DC	9	4.5	32	3PDT	AZ 482-2-3	AZ 488-2-3	AZ 480-2-3	AZ 488S-2-3
12DC	19	9	130	3PDT	AZ 482-3-3	AZ 488-3-3	AZ 480-3-3	AZ 488S-3-3
24DC	37	18	500	3PDT	AZ 482-4-3	AZ 488-4-3	AZ 480-4-3	AZ 488S-4-3
48DC	75	36	2,100	3PDT	AZ 482-6-3	AZ 488-6-3	AZ 480-6-3	AZ 488S-6-3
110DC	165	83	10,500	3PDT	AZ 482-9-3	AZ 488-9-3	AZ 480-9-3	AZ 488S-9-3
6DC	9	4.5	32	4PDT	AZ 482-2-8	AZ 488-2-8		
12DC	19	9	130	4PDT	AZ 482-3-8	AZ 488-3-8		
24DC	37	18	500	4PDT	AZ 482-4-8	AZ 488-4-8		
48DC	75	36	2,100	4PDT	AZ 482-6-8	AZ 488-6-8		
110DC	165	83	10,500	4PDT	AZ 482-9-8	AZ 488-9-8		

MECHANICAL SPECIFICATIONS

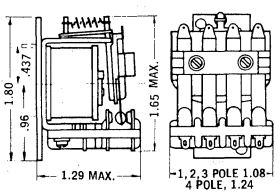


USE STANDARD OCTAL SOCKET

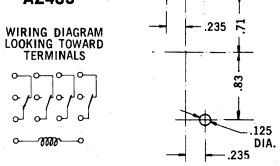
AZ480
AZ481



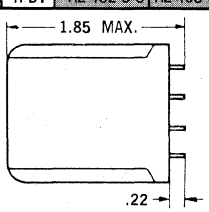
WIRING DIAGRAM LOOKING TOWARD TERMINALS

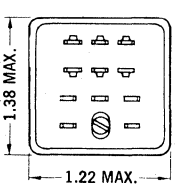


AZ482*
AZ483*

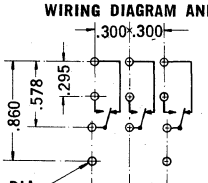


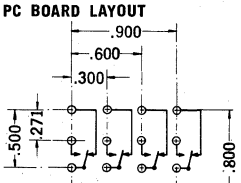
AZ487S
AZ488S





WIRING DIAGRAM AND PC BOARD LAYOUT

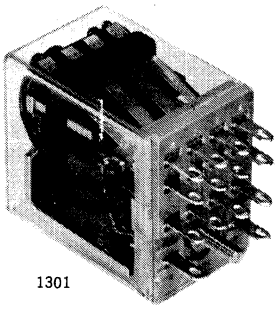


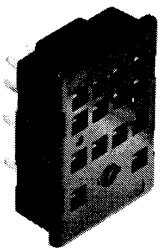


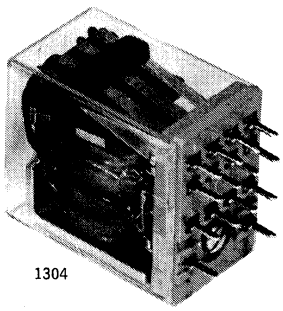
* Also available with #6-32 UNC-2A mounting stud and locating tab (add Letter "A" to part no.) or with #6-32 UNC-2B tapped core and locating tab (add Letter "B" to part no.) Tolerances ±.01

American Zettler, inc.

MINIATURE AC, DC RELAYS
SERIES TEC 1300


1301




1304

FEATURES

- AC or DC coils
- Less than 1 watt operating power
- 4PDT 5 amp contacts, gold plated
- Longer life expectancy due to unique contact blade design
- 1 Million operations at 3 amp 26VDC
- Polycarbonate dust cover
- Listed under UL Recognition File E45020

GENERAL DESCRIPTION

The miniature relay series 1300 with AC or DC coils and 4PDT contacts, available with either plug-in or PC terminals, is ideally suited for use in alarm systems, communications, and data processing equipment. Due to the low price, less than 50 cents per transfer contact, (considerably less expensive than solid state techniques) these units are finding broad acceptance in consumer type products. The rugged construction assures longer life than other similar relays. The unique design of the support for the contact blade provides better wiping action and less bounce. Strict quality control, in compliance with stringent Western European practices, guarantees uniform characteristics in high production quantities.

ELECTRICAL SPECIFICATIONS

Contact Rating: Resistive Load 5 amp at 26 VDC or 115 VAC*

Contact Material: Silver gold plated. Other contact material available

Contact Arrangement: 4 form C (4PDT)

Life Expectancy: Mechanical operations: 10^8

Electrical Operations: At Rated Load: 5×10^4
At 3 Amp 26 VDC or 115 VAC: 10^6

Contact Resistance: 50 Milliohms typical

Time Values: At nominal voltage @ 20°C
13 ms max. operate
10 ms max. release

Dielectric Strength: 1500 Vrms; 500 Vrms across contact gap

Insulation Resistance: 1500 Megohms, min. @ 20°C, 100 VDC, 50% RH

Coil Power at 20°C: AC: 1.20 Va nom. ; 2 Va max. continuous
DC: .90 Watts nom. ; 2 Watts max. continuous

Coil Temperature: Max. 105°C

Ambient Temperature: Operating: −45°C to +70°C at nom. voltage
Storage: −45°C to +100°C

Temperature Rise: 35°C at nom. voltage

Vibration: .062 DA @ 10-55 Hz

Weight: Approx. 42 gr. (1.5 oz)

Terminals: Solder lug/plug-in or PC on relay
Solder lug or PC on socket

Enclosure: Clear, high impact polycarbonate cover

STANDARD RELAYS AC ACTUATED

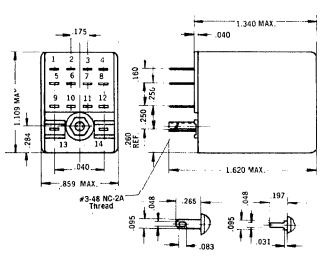
Coil Specifications			Nom. Curr. (Average (mA)	Order No.	
Voltage VAC					
Nom.	Max.	Min.		Plug in Terminals	PC Terminals
6VAC	7.1	5.1	200	1301-3191	1304-3191
12VAC	14.2	10.2	100	1301-3291	1304-3291
24VAC	28.5	20.4	50	1301-3391	1304-3391
36VAC	42	30.6	33	1301-3491	1304-3491
48VAC	57	40.8	25	1301-3591	1304-3591
60VAC	71	51	20	1301-3691	1304-3691
115VAC	130	94	11	1301-3791	1304-3791
127VAC	150	108	9.5	1301-3891	1304-3891

All data at 20°C
* For low level switching AZ 420 series with bifurcated contacts recommended

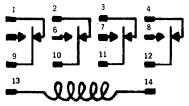
STANDARD RELAYS DC ACTUATED

Coil Specifications				Order No.	
Voltage VDC			Resistance		
Nom.	Max.	Min.	(ohms) ±10%	Plug in Terminals	PC Terminals
6VDC	8	4.5	40	1301-7191	1304-7191
12VDC	16	9	160	1301-7291	1304-7291
24VDC	32	18	650	1301-7391	1304-7391
36VDC	48	27	1400	1301-7491	1304-7491
48VDC	64	36	2600	1301-7591	1304-7591
60VDC	80	45	3600	1301-7691	1304-7691
110VDC	146	83	13000	1301-7791	1304-7791

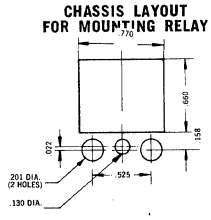
MECHANICAL DIMENSIONS



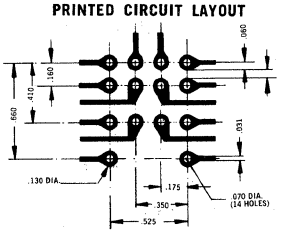
WIRING DIAGRAM

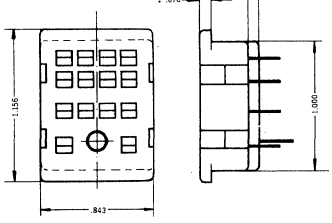


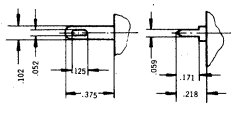
CHASSIS LAYOUT FOR MOUNTING RELAY



PRINTED CIRCUIT LAYOUT



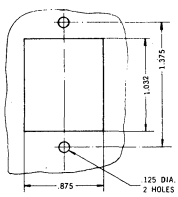




SOCKET ORDER INFORMATION:

Pierced Solder Terminals:	ROF14
PC Terminals:	RS14
Retainer for Relay:	HF163

CHASSIS LAYOUT FOR MOUNTING SOCKET



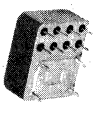
Recommended Chassis Thickness .031 to .062

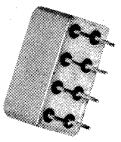
American Zettler, inc.
16881 HALE AVE. ▪ IRVINE, CALIF. 92705 ▪ PHONE (714) 540-4190 ▪ TELEX: 67-8472

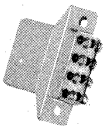
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)
See YELLOW SECTION for Local Sales and Distributors' Offices

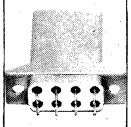
DEUTSCH RELAYS, INC.

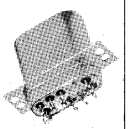
65 DALY RD • EAST NORTHPORT, NEW YORK 11731 • PHONE (516) 864-6000 • TWX: (510) 226-0233











SERIES DESIGNATION	A	AV	DJ	DJW	G	H	V	J	JW	JV	P
Catalog Bulletin No.	108		105		112	111		112		104	112
Special Features	low profile for PC boards and high densities	AV-1 amp. version of "A" series -sensitive	quick acting half-size crystal case	DJW-1amp. sensitive - similar to DJ	Crystal case size for severe environments	4 and 6 pole, dt - 1" dia. can	V - 4 & 6 pole for severe environments	Crystal case for a.c. and d.c.	JW - the sensitive version of "J" series	Ultra-sensitive version of "J" series	Similar to J differs in headers
GENERAL INFORMATION	NOTE: Latching versions are available of series DJ (DJL, H , (LL, bulletin no. 101), P (PL, bulletin no.										
Rating, Amperes	2	1	2	1	2	2		2		2	2
Contact Arrangement	dpdt		dpdt		dpdt	4 & 6 dpdt		dpdt		dpdt	dpdt
Weight in ounces	0.8	1.2	0.3		0.8	2.3	2.4	0.7		1.1	0.7
Arc Suppression	available		available		available	available		available		available	available
Applicable MIL Specification	MIL-R-5757		MIL-R-5757		MIL-R-5757	MIL-R-5757		MIL-R-5757		MIL-R-5757	MIL-R-5757
PERFORMANCE											
Operate Time, milliseconds	6	15	4	6	5	10		5	10	15	5
Release Time, milliseconds	5	15	4	6	5	10	6	5	10	15	5
Release Time, Arc Suppressed, milliseconds	15	30	15	18	10	20		10	20	30	15
Power Required, Pickup, mW	270	40	220	80	300	1200	750	300	100	40	330
Vibration, gs	20g to 2000 Hz	15g	30g to 3000 Hz	20g	50g to 3000 Hz	10g 2000 Hz	20g 3000 Hz	30g to 3000 Hz		15g to 3000 Hz	20g to 2000 Hz
Shock, gs	100	50	150	50	250	50	100	150		50	100
Acceleration, gs	100	20	100	35	100	20	100	100		20	100
Temperature Range, °C	-65 to +125		-65 to +125		-65 to +125	-65 to +125		-65 to +125		-65 to +125	-65 to +125

DEUTSCH RELAYS, INC.

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								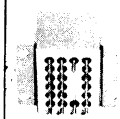	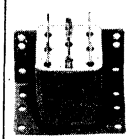
S	300 | 350	400 & 410	3100 | 3101	3111 | 3114	85 | 100 | 200	E210	E410	E610	G11, G12
106	123	123	118	121	123	122	122	122	117, 114, 115 116, 120
Current adjusted oversize crystal case	6-pole and 4-pole "Wedge-Action" Smaller than 85, 100 or 200 models	dpdt versions of the "Wedge-Action" type	SPDT weighs only 0.10 Oz. very rugged 3101-dpdt version of 3100 model	very compact has convenient 0.1 grid space 3114- is 2 ampere version of model 3111	6-pole, "Wedge-Action" differing in temperature range	Internal arc barriers for switching 3 Ø	4-pole version of E series	6-pole version of E series	suitable for heavy duty-various contact ratings & arrange-ments
bulletin no. 109, and 4 pole DL, bulletin no. 107), E (EL210 and EL410, bulletin no. 125), 102), and 3111/3114 (3102/3104, bulletin no. 119).									
2	2	2	1	1 | 2	2	10	10	10	5, 10, 15, 25
dpdt	6pdt | 4pdt	dpdt	spdt | dpdt	dpdt	6pdt	dpdt	4 pdt	6 pdt	spdt, dpdt, 4pdt, 6pdt
0.9	2.2	1.5	0.1	0.1	4.3	1.16	2.8	4.0	0.78 to 12.8
—	—	—	—	—	—	available	available	available	available
MIL-R-5757	MIL-R-5757	MIL-R-5757	MIL-R-5757	MIL-R-5757	MIL-R-5757	MIL-R-5757 MIL-R-6106	MIL-R-5757 MIL-R-6106	MIL-R-5757 MIL-R-6106	MIL-R-5757 MIL-R-6106
6	10	10	4	4	15	15	15	15	20, 10
5	10	10	4	4	15	15	15	15	20, 10
10	-	-	-	-	-	-	-	-	-
190	-	-	100 | 160	130 | 200	-	-	-	-	-
15g to 2000 Hz	20g to 2000 Hz	15g to 2000 Hz	30g to 3000 Hz	20g (2000 Hz) | 30g (3000 Hz)	30g to 2000 Hz	30g to 2000 Hz	30g to 2000 Hz	20g to 2000 Hz	10g, 20g 1500 Hz
50	50	50	100	50	100	200	200	50	25, 50
20	-	-	-	-	-	15	15	15	15, 25
-65 to +125	-65 to +125	-65 to +125	-65 to +125	-65 to +125	-55 to +85 | -65 to +125 | -65 to +200	-70 to +125	-70 to +125	-70 to +125	-70 to +125

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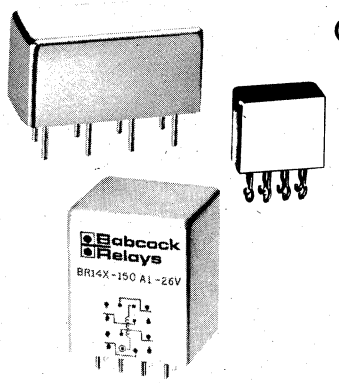
AEROSPACE AND MILITARY RELAYS

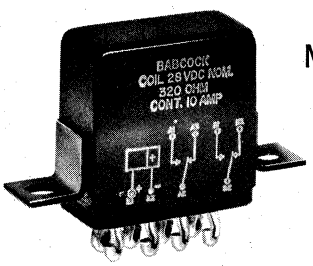


CRYSTAL CAN RELAYS (MIL-R-5757)

MINIATURE RELAYS... Transistor can and 1/6-size crystal can units, SPDT and DPDT, 1 amp, voltage ranges of 6 to 26 VDC, a min. life of 100,000 operations, temperatures from −65°C to +125°C, and shock and vibration of 50 g's and 30 g's respectively.

HALF-SIZE RELAYS... Latching, non-latching and coaxial, DPDT and DPDT (RF), 2 amp welded versions, voltages of 6, 12 and 26 VDC, Life of 100,000 operations, and temperatures of −65°C to +125°C.

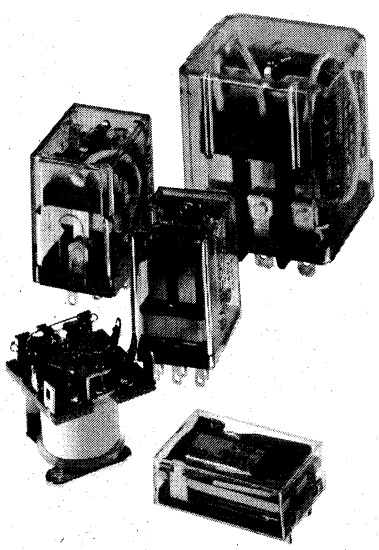
FULL-SIZE RELAYS... Full and "Twice" size latching and non-latching models, DPDT and 4PDT, with 2, 3, 5, 7.5 and 10 amp ratings, voltages of 6 to 48 VDC and 115 VAC, temperatures of −65°C to +125°C, and life of 100,000 cycles.



MINIATURE AIRCRAFT RELAYS (MIL-R-6106)

DPDT and 4PDT, 10 and 15 amp welded relays, with voltages of 6, 12 and 28 VDC and 115 VAC, 200 g's shock, temperatures from −70°C to +125°C, and a min. life of 100,000 cycles.

INDUSTRIAL/GENERAL PURPOSE RELAYS

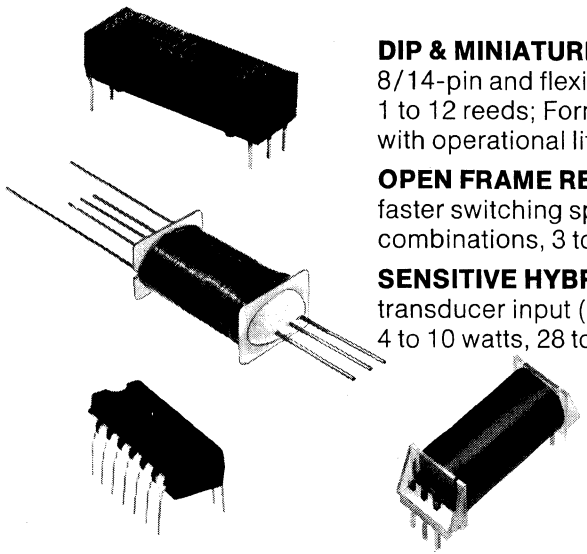


SUBMINIATURE RELAYS... Unique DIP, flatpack and sensitive PC board relays, SPDT, DPDT and 4PDT, with ratings of 0.25 to 5 amps, 3 to 60 VDC, temperatures of −40°C to +65°C, and min. life to 10^8 operations.

MINIATURE RELAYS... PC board and socket mounted SPDT, DPDT 4PDT and 6PDT versions, ratings of 3, 5, 7 and 10 amps, and voltages of 6 to 110 VDC and 6 to 240 VAC; life of 10^7 operations, at temperatures of −50°C to +80°C.

POWER RELAYS... Large capacity AC and DC PC board and socket mounted models, with ratings to 20 amps and 1.5 KW 3-phase, voltages to 110 VDC and 240 VAC, over a life of 10^7 operations at temperatures of −50°C to +80°C.

DRY-REED RELAYS

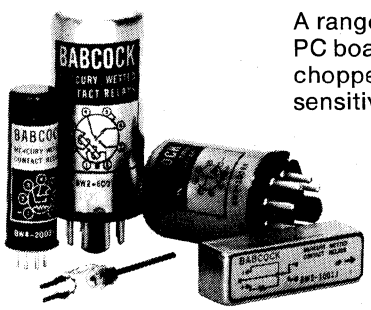


DIP & MINIATURE PC BOARD RELAYS . . . Dual In-Line Packages, 8/14-pin and flexible plug-in versions, in selectable combinations of 1 to 12 reeds; Forms A, B, C and 2 Form A, 3 to 10 watts, 3 to 250 VDC, with operational life to 10^8 cycles.

OPEN FRAME RELAYS . . . Axial lead and plug-in low-cost models, with faster switching speeds, for high-density packaging; Form A. B. C and combinations, 3 to 10 watts, 5 to 24 VDC, with life of 10^8 operations.

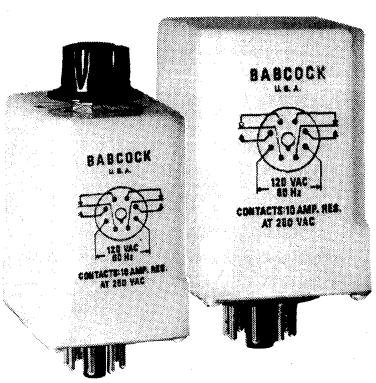
SENSITIVE HYBRID RELAY . . . PC board relay for direct low-level transducer input (as low as 1 mv), available in 1 or 2 reed combinations; 4 to 10 watts, 28 to 250 VDC, with a life expectancy of 10^8 cycles.

MERCURY-WETTED RELAYS



A range of 1 amp and 2 amp models are available for chassis plug-in and PC board mounting; single-side and bi-stable, SPDT units (with chopper adjustment) feature billions of operations, to 500 volts, with high sensitivity and fast switching.

INDUSTRIAL TIMERS



A series of industrial time delay relays—with fixed, resistor-adjustable and knob adjustable delays—with ranges from 0.050 to 360 sec., accuracies of ±5%, 18 to 32 VDC and 125 VAC, 1.5 to 15 amps, for operation from −55°C to +125°C.
A line of voltage, frequency and phase sensors is also offered in AC and DC versions, in SPDT and DPDT arrangements for circuit protection.

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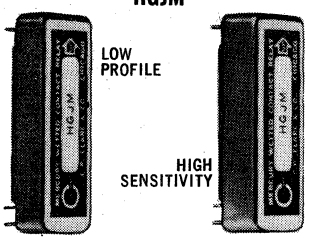
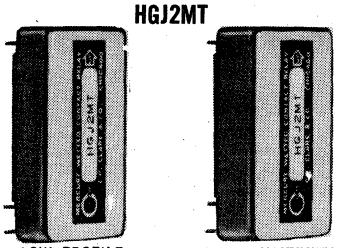
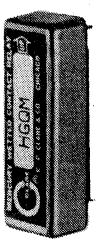
HGJM



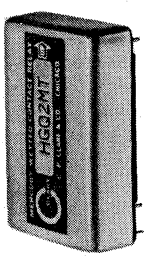
HGJ2MT



HGQM



HGQ2MT



HGJM

Clare HGJM relays have established new industry standards for quiet, fast and stable operation. HGJM Series SPDT relays have the 100VA load and multi-billion operation reliability characteristic of our HGSM and are recommended for all new applications.

Response times approach 1ms speeds, noise levels are less than 5μV at 5ms after coil energization (10kHz bandwidth) and the relays are ultra-stable to 250Hz. The 1 Form C contact will switch μV, nanoampere loads to 2A or 500V loads (100VA max, ac or dc). The relays are offered in 0.400″ height high sensitivity models and 0.350″ height low profile versions. Both mount on staggered 0.100″ PCB grid patterns. The low profile models permit 0.5″ board centers.

HGJ2MT

Clare HGJ2MT relays feature the same outstanding electrical characteristics as the HGJM relays in a DPDT (2 Form C) package. High sensitivity HGJ2MT relays have common open time durations to 50μs at 100Hz for capacitor transfer technique applications. Electrostatic shielding is standard on all models.

HGQM

Clare HGQM relays for PCB mounting have the fastest response times in the industry for mercury-wetted relays. The contact form is a SPDT transfer-contact configuration. Typical response times range from 0.8 to 1.0ms and noise levels are under 5μV within 1.5ms after coil energization (1000Hz bandwidth). HGQM relays are ultra-stable at switching speeds to 500Hz (bistable) and 400Hz (single-side-stable). Switching capabilities range from signal levels to 1A or 500V loads (50VA max).

The HGQM package is only 0.580″ high and mounts on convenient staggered 0.100″ grid patterns. An ideal companion for HGJM relays in many applications requiring low level sensor-based analog signal switching or process control for data logging/acquisition.

HGQ2MT

The HGQ2MT relays feature the same electrical characteristics as the HGQM relay with transfer contact switching but in a DPDT package. This ultra-high speed two pole relay is ideal for low level switching applications.

Contact noise is less than 10μV within 2ms after coil energization — three times faster than the industry standard. Thermal emf levels are 15μV maximum.

SPECIFICATIONS — HGJM & HGJ2MT

CONTACT RATING (Resistive Load): Power — 100VA, max. Voltage — 500V, dc or ac, max. Current — 2A switched, max., 5A carry only, max.

CONTACT RESISTANCE (ON impedance): 15 to 25 milliohms, ±2.0 millioms

LIFE EXPECTANCY: Greater than 10 x 10^9 operations at rated load

OPERATE TIME: 1.25ms response time — Switching up to 250Hz (4.0ms period)

BREAKDOWN VOLTAGE: 1,000V rms 60Hz min. between all mutually insulated terminals, except between windings of double wound coils, 200Vdc

INSULATION RESISTANCE (OFF impedance): HGJM Series, Standard Value 100 megohms. Available, 100,000 megohms — HGJ2MT Series, Standard Value, 10,000 megohms. Available 100,000 megohms (Measured across open contacts at 25°C, 40% relative humidity)

ENVIRONMENTAL: Vibration — 10 to 500Hz 0.06″ d.a. or 5g's. Shock — 30g, 11 ±1ms, ½ sinewave (no mechanical damage, non-operating test). Temperature — −38.8°C to +105°C (operating)

SPECIFICATIONS — HGQM & HGQ2MT

CONTACT RATING (Resistive Load): Power — 50VA, max. Voltage — 250V, dc or ac, max. Current — 1A switched, max. 5A carry only, max.

CONTACT RESISTANCE (ON impedance): Initial — 15 to 25 milliohms, ±2.0 milliohms

LIFE EXPECTANCY: Greater than 2 x 10^9 operations at rated load

OPERATE TIME: 1000μs. Switching up to 500Hz (2.0ms period) bistable and to 400Hz single-side-stable

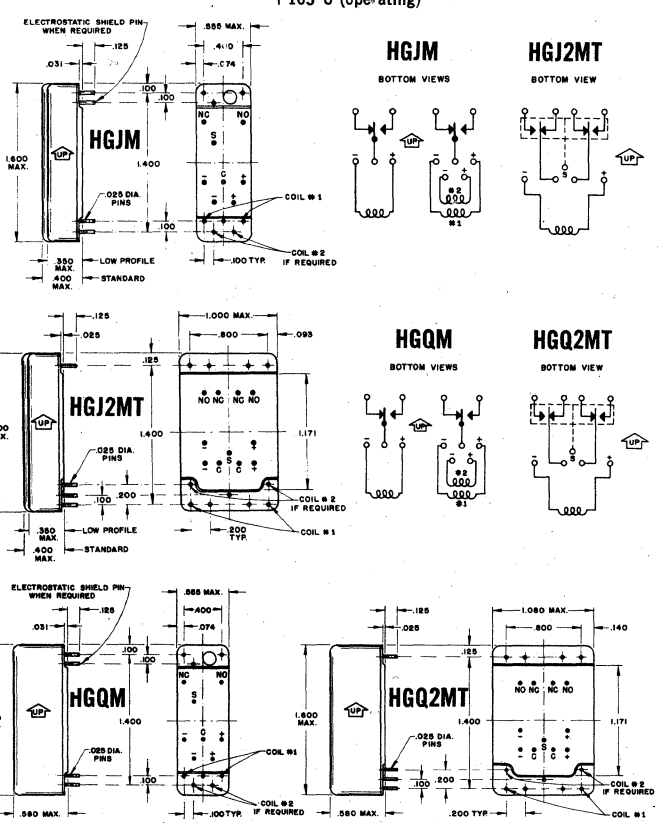
BREAKDOWN VOLTAGE: 1,000V rms 60Hz min. between all mutually insulated terminals, except between windings of double wound coils, 200Vdc

INSULATION RESISTANCE (OFF impedance): HGQM Series — Standard Value, 100 megohms. Available 100,000 megohms — HGQ2MT Series, Standard Value, 10,000 megohms. Available 100,000 megohms (Measured across open contacts at 25°C, 40% relative humidity)

ENVIRONMENTAL: Vibration — 10 to 500Hz 0.06″ d.a. or 5g's. Shock — 30g, 11 ±1ms, ½ sinewave (non-operating). Temperature — −38.8°C to +105°C (operating)

Part No.	List Price	Nom. Coil Voltage (Vdc)	Coil Res. ±10% at 25°C (Ohms)	Operate Voltage (Vdc)	Release Voltage (Vdc)	Max. Voltage (Vdc)	Typical Relay Ind. (mH)
SPDT LOW PROFILE SINGLE-SIDE-STABLE							
HGJM 51131 J00	$13.60	5.0	68	2.7	.58	11	7.4
HGJM 51131 N00	13.60	12	375	6.5	1.4	26	45
HGJM 51131 R00	13.60	24	1425	13	2.7	50	155
SPDT HIGH SENSITIVITY SINGLE-SIDE-STABLE							
HGJM 51111 K00	$13.00	5.0	125	2.9	.61	15	34
HGJM 51111 P00	13.00	12	685	7.1	1.5	35	161
HGJM 51111 T00	13.00	24	2650	14	3.0	68	630
DPDT LOW PROFILE SINGLE-SIDE-STABLE							
HGJ2MT 51231 E00	$25.35	5.0	27	2.6	.54	9.7	2.1
HGJ2MT 51231 K00	25.35	12	230	6.7	1.4	28	24
HGJ2MT 51231 N00	25.35	24	750	12	2.4	53	90
DPDT HIGH SENSITIVITY SINGLE-SIDE-STABLE							
HGJ2MT 54211 G00	$24.35	5.0	55	2.6	.55	14	11
HGJ2MT 54211 L00	24.35	12	370	6.7	1.4	36	75
HGJ2MT 54211 P00	24.35	24	1370	13	2.7	69	277
SPDT SINGLE-SIDE-STABLE							
HGQM 91111 J00	$13.60	5	86	2.5	0.5	11.6	32
HGQM 91111 N00	13.60	12	620	6	1.25	31.3	260
HGQM 91111 R00	13.60	24	2430	12	2.5	61.9	980
DPDT SINGLE-SIDE-STABLE							
HGQ2MT 91211 F00	$24.35	5	48	2.75	0.5	12	19
HGQ2MT 91211 K00	24.35	12	280	7	1.25	30	105
HGQ2MT 91211 N00	24.35	24	1240	14	2.5	62	475

Part No.	List Price	Nom. Coil Voltage (Vdc)	Coil Res. ±10% (Ohms)	Set Volt., Either Wind. (Vdc)	Reset Volt., Either Wind. (Vdc)	Max. Volt., One Wind. Only (Vdc)	Typ. Relay Ind. (mH)
SPDT HIGH SENSITIVITY BISTABLE (DOUBLE WOUND COIL)							
HGJM 52112 N00	$13.00	5.0	205/205	15	15	19	26
SPDT BISTABLE (DOUBLE WOUND COIL)							
HGQM 92112 M00	$13.60	5	190/190	12	12	17	40



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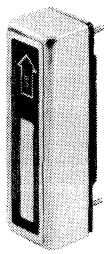
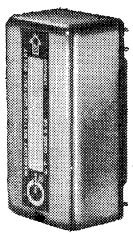
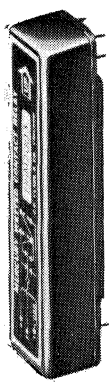
a GENERAL INSTRUMENT company



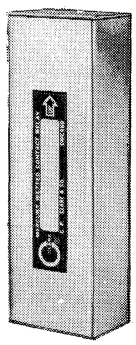
HGSM



HGS2MT



HGM



HG2M

HGSM

Clare HGSM relays are PCB mount models with 2A or 500V (100VA max.) switching capabilities. The HGSM series SPDT relay is recommended for replacement applications only. New applications should specify the faster HGJM series with the same load switching capabilities, life expectancy and lower noise. The HGSM package is 5/8" high and mounts on staggered 0.100" grid patterns.

HGS2MT

Clare HGS2MT relays have the same ratings and life expectancy as the HGSM series in a DPDT model. The HGS2MT relay is also recommended for replacement purposes only. HGJ2MT relays are recommended for all new applications requiring 100VA (per pole) switching capabilities in DPDT configurations.

HGM

HGM relays are Clare standard HG switch capsules in module form, are provided with plated steel covers for excellent mechanical protection and magnetic shielding. The standard HG switch in the HGM is not polarity sensitive. Contacts are SPDT make-before-break rated at 5 amps, 500 Volts, 250VA maximum. Life expectancy is 22 x 10^9 at specified ratings.

HG2M

HG2M has the same characteristics as the HGM but contains 2 capsules to give you double-pole, double-throw configuration make-before-break. This results in saving space and cost over single element units. Contacts are rated at 5 amps 500 Volts, 100VA maximum with life expectancy of 22 x 10^9.

SPECIFICATIONS — HGSM, HGS2MT, HGM, HG2M

CONTACT RATING (resistive load):
- Power: 250VA max., HGM, HG2M
- Voltage: 100VA max., HGSM, HGS2MT
- Current: 5A max; HGM, HG2M; 2A max; HGSM, HGS2MT

CONTACT RESISTANCE (ON impedance):
30 milliohms typical

LIFE EXPECTANCY:
22 x 10^9 operations

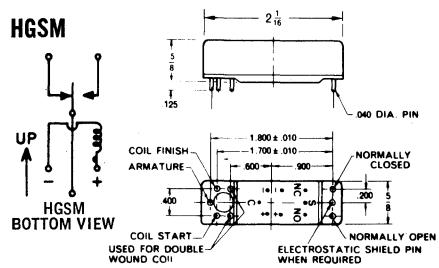
OPERATE TIME:
3ms typical

BREAKDOWN VOLTAGE:
1000Vac, rms, 60Hz between all mutually insulated terminals

ENVIRONMENTAL:
- Vibration: 10-500Hz, 0.06" d.a. or 10g's
- Shock: 30g's, 11 ±1ms, ½ sinewave
- Temperature: −38° to +105°C (operating)

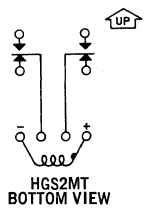
DIMENSIONS

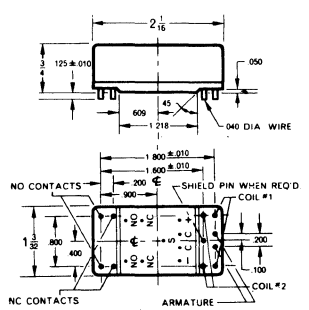
HGSM



Stock Form D Part No.	Stock Form C Part No.	Rec. Nom. Coil Vdc	Coil Res. (Ohms)	Must Operate Vdc	Max. Vdc	List Price
SPDT SINGLE-SIDE-STABLE						
HGSM 1008	HGSM 5008	5	115	3.8	15.1	$11.80
HGSM 1009	HGSM 5035	12	275	5.2	23.4	11.80
HGSM 1010	HGSM 5009	12	450	6.4	30.0	11.80
HGSM 1011	HGSM 5010	12	675	8.6	36.7	11.80
HGSM 1002	HGSM 5011	15	940	10.5	43.3	11.80
HGSM 1001	HGSM 5001	24	1425	13	53.4	11.80
HGSM 1003	HGSM 5064	24	2400	20.6	69.2	11.80
SPDT BISTABLE (DOUBLE WOUND COIL)						
HGSM 12112 N00	HGSM 52112 N00	—	325/325	±2.5 (Either Winding)	26.0 (One Winding Only)	$11.80
HGSM 1016	HGSM 5003	—	1100/1100	±8.77/±6.9	46.9	11.80

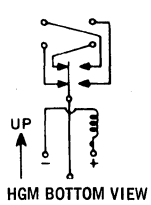
HGS2MT

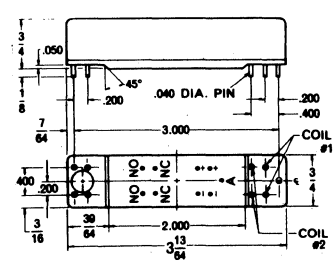




New Part Number	Old Part Number (Reference Only)	Nom. Volts (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	List Price
HGS2MT51111F00	HGS2MT5001	6	130	3.0	0.5	$22.15
HGS2MT51111J00	HGS2MT5008	12	520	5.3	1.1	22.15
HGS2MT51111M00	HGS2MT5009	24	2200	11.0	2.2	22.15

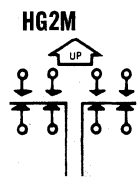
HGM

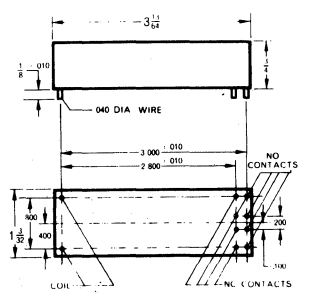




Part No.	Rec. Nom. Coil Volt. (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	List Price
HGM 1005	12	40	5.24	12.6	$13.70
HGM 1008	—	150	8.75	24	13.70
HGM 1002	24	450	16.3	42	13.70
HGM 1001	24	750	15.4	55	13.70
HGM 1012	—	1100	26.2	66	13.70

HG2M





Part No.	Rec. Nom. Coil Voltage (dc)	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	List Price
HG2M 1007	12	90	8.2	19	$18.65
HG2M 1008	24	350	16.2	37	18.65
HG2M 1020	—	580	20.7	48	18.65
HG2M 1026	—	1250	31.8	70	18.65

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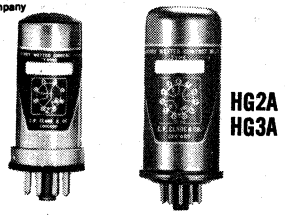
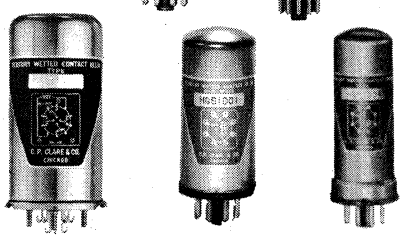




HG, HG2A, HG3A, HG4A

HG relays have SPDT make-before-break form D contacts rated at 5 amps, 500 volts, 250VA max. Operating time can be as short as 2 milliseconds. The Series HG2 relay utilizes two switch capsules to furnish DPDT operating time can be as short as 2¼ milliseconds. Series HG3 relay utilizes three capsules providing 3 PDT, operating time can be as short as 2½ milliseconds. Series HG4 relay utilizes four capsules providing 4 PDT, operating time can be as short as 3¾ milliseconds. Life expectancy is 22 x 10^9 at specified ratings. Resistance, ±10% tolerance at 25 degrees C. Typical applications include computers, data logging and low-level dry circuits.

HGS

HGS Mercury-wetted relay offer increased speed and reliability along with high sensitivity. HGS 1000 Series provide SPDT make-before-break and HGS 5000 Series provides SPDT break-before-make. Both are rated at 2 amps, 500 Volts, 100VA max. Operate time as fast as 1 millisecond. Standard design available only in single element assemblies, they come in the following, single-side-stable, bi-stable and chopper. Life expectancy is 22 x 10^9 at specified ratings.

HGP

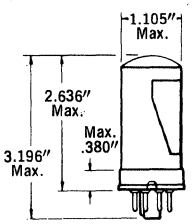
HGP is similar to the HG series except for the inclusion of permanent magnets making a slight increase in height. Magnets provide increased sensitivity. Contacts are SPDT make-before-break rated at 5 amps, 500 Volts, 250VA maximum with operate time as short as 2 milliseconds. Life expectancy is 22 x 10^9 at specified rating.

SPECIFICATIONS — HG, HGS, HGP

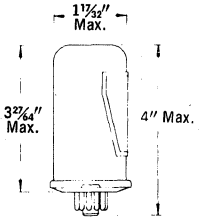
CONTACT RATING (Resistive Load): Power — HG, HG2A, HG3A, HG4A, HGP, 250VA; HGS, 100VA. Voltage — HG, HG2A, HG3A, HG4A, HGP & HGS, 500V. Current — HG, HG2A, HG3A, HG4A, HGP, 5A; HGS, 2A. CONTACT RESISTANCE (On Impedance): 40 milliohms typical. LIFE EXPECANCY: 22 x 10^9 Operations. OPERATE TIME: See description. BREAKDOWN VOLTAGE: 1000Vac, rms, 60Hz between mutually insulated terminals. ENVIRONMENTAL: Vibration: 10-500 Hz, 0.06″ d.a. or 10g's. Shock: 30g's, 11 ±1ms. Temperature: −38.8° to +100°C.

Stock Part No.	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	Base Figure	List Price
HG					
HG 1019	40	2.9	11	4	$17.65
HG 1012	130	5.4	20	4	17.65
HG 1026	500	11	39	1	17.65
HG 1004	700	15	45	1	17.65
HG 1051	700	15	45	1	17.65
HG 1043	1000	17	55	1	17.65
HG 1001	2500	28	87	1	17.65
HG 1002	4000	33	110	1	17.65
HG 1017	4000	33	110	4	17.65
HG 1009	7000	45	145	1	17.65
HG 1011	11,000	61	180	1	17.65
HG 1024	25,000	94	275	1	17.65
HG 1003†	700/3300	25/47	46/99	2	17.65
HG2A 1008	50	6	14	2A2	28.60
HG2A 1042	140	10	24	2A1	28.60
HG2A 1003	315	15	36	2A2	28.60
HG2A 1017	500	19	45	2A2	28.60
HG2A 1009	700	24	53	2A1	28.60
HG2A 1002	700	24	53	2A2	28.60
HG2A 1015	1250	30	71	2A2	28.60
HG2A 1068	2500	46	100	2A1	28.60
HG2A 1001	5000	62	142	2A1	28.60
HG2A 1004	5000	62	142	2A2	28.60
HG2A 1013	10,000	94	200	2A2	28.60
HG3A 1004	315	15	36	2A1	37.10
HG3A 1006	500	19	45	2A2	37.10
HG3A 1002	700	24	53	3A1	37.10
HG3A 1008	1250	30	71	3A1	37.10
HG3A 1005	2500	46	100	3A1	37.10
HG3A 1003	5000	62	142	3A1	37.10
HG3A 1010	10,000	94	200	3A1	37.10
HG4A 1013	65	7.2	16	4A1	47.70
HG4A 1011	390	18	40	4A1	47.70
HG4A 1001	700	27	53	4A1	47.70
HG4A 1007	1400	35	75	4A1	47.70
HG4A 1003	4000	69	126	4A1	47.70
HG4A 1006	10,000	94	200	4A1	47.70
HGS					
HGS 1015‡	90	.63	13	S1	$14.60
HGS 1045‡	350	1.4	26	S1	14.60
HGS 1018‡	500	1.6	31	S1	14.60
HGS 1009‡	600	1.9	34	S1	14.60
HGS 1046‡	700	2.2	37	S1	14.60
HGS 1014‡	1000	2.4	44	S1	14.60
HGS 1019	1100/1100	±2.2	47	S3	14.60
HGS1010‡	1900	3.3	61	S4	14.60
HGS 1006‡	2500	3.9	70	S1	14.60
HGS 1005‡	4000	5.5	90	S1	14.60
HGS 1048‡	4000	5.5	90	S4	14.60
HGS 1016‡	7000	6.7	118	S1	14.60
HGS 1017‡	11,000	8.7	148	S1	14.60
HGS 1113*	1000	1.4	45	S1	14.60
HGS 1114*	2500	2.3	70	S1	14.60
HGS 1026*	4000	2.1	90	S1	14.60
HGS 1056*	7000	3.7	118	S1	14.60
HGS 1096*	25,000	3.0	223	S1	14.60
HGS 1004§	600	6.3 Vac	—	S1	14.60
HGS 5009	40	.43	8.9	S1	14.60
HGS 5011‡	350	1.4	26	S1	14.60
HGS 5031‡	600	1.9	34	S4	14.60
HGS 5015‡	1000	2.4	44	S1	14.60
HGS 5003‡	2500	3.9	70	S1	14.60
HGS 5008‡	4000	5.5	90	S5▲	14.60
HGS5014‡	7000	6.7	118	S4	14.60
HGS 5047‡	11,000	8.7	148	S1	14.60
HGS 5016‡	25,000	14.3	224	S1	14.60
HGS 5006*	1000	1.4	45	S1	14.60
HGS 5004*	4000	2.1	90	S1	14.60
HGS 5017§	600	6.3 Vac	—	S1	14.60

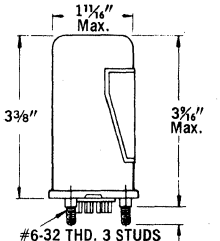
† Double Wound. ‡ Single-Side-Stable. * Bi-Stable. § Chopper.
▲ S5 same as S1 except pin 6 connected to case.



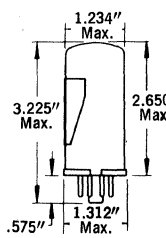
HG



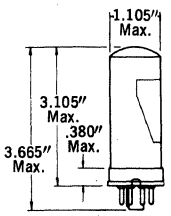
HG2A, HG3A



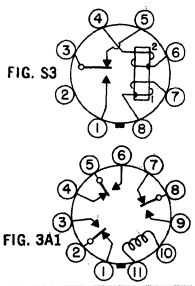
HG4A



HGS



HGP



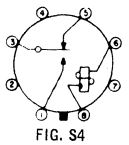


FIG. S4

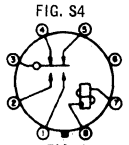


FIG. 1

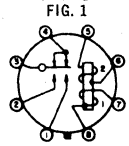


FIG. 2

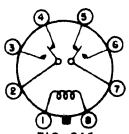


FIG. 2A1

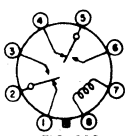


FIG. 2A2

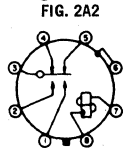


FIG. 4

Stock Part No.	Coil Resistance	Must Operate Voltage (Vdc)	Max. Voltage (Vdc)	Base Figure	List Price
HGP					
HGP 1001‡	90	1.6	16	1	$19.15
HGP 1005‡	1000	6.2	55	1	19.15
HGP-1002‡	4000	13	110	1	19.15
HGP 1008‡	4000	21	110	1	19.15
HGP 1055‡	7000	17	145	1	19.15
HGP 1052‡	11,000	23	180	1	19.15
HGP 1050‡	25,000	36	275	1	19.15
HGP 1006†‡	700/3300	11/21	46/99	1	19.15
HGP 1047*	600	±2.2	43	1	19.15
HGP 1003*	4000	±6.6	110	1	19.15
HGP 1012†	700/3300	4.6/3.7	46/99	3	19.15
HGP 1031†*	7500/7500	±14/14	150/150	3	19.15
HGP 1028§	500	6.3Vac	—	4	19.15
HGP 1009§	4000	18.5Vac	—	4	19.15

† Double Wound. ‡ Single-Side-Stable. * Bi-Stable.
†‡ Single-Side-Stable Double Wound. § Chopper.
†* Double Wound Bi-Stable.

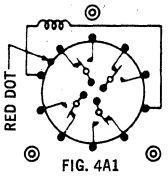


FIG. 4A1

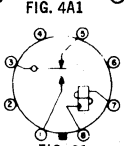
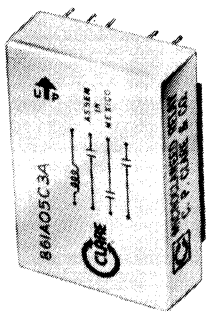


FIG. S1

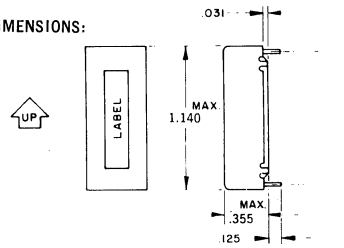
a GENERAL INSTRUMENT company

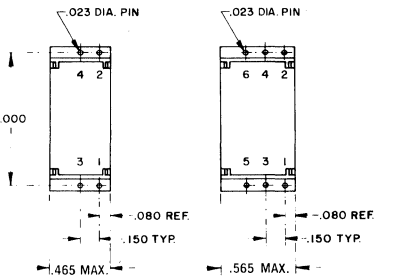
NEW 861 SERIES MERCURY-WETTED REED RELAYS

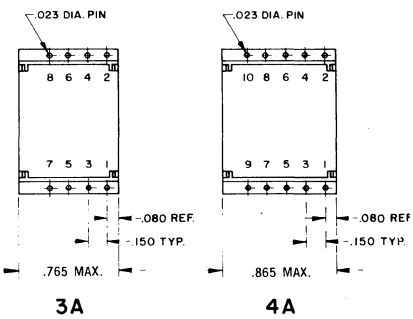


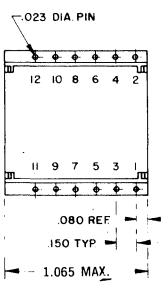
Clare 861 series Mercury-Wetted Microclareed relays are superior when compared to dry reed relays of the same size. The relay has a reliable reed capsule with a no-bounce mercury-wetted armature. You obtain some of the mercury-wetted contact relay advantages at a slight price premium over dry reed relays.

DIMENSIONS:









NOTE: Mount upright within 30° of vertical.

SPECIFICATIONS

CONTACT RATING (Resistive load): Power 35VA, max. Voltage 500Vdc, max. Current .75A, max.

CONTACT RESISTANCE (ON impedance): 50 milliohms, max. initial, total circuit

INSULATION RESISTANCE (OFF impedance): 1000 x 10^6 ohms min. at 100Vdc, +25°C, 50% rel. hum.

BREAKDOWN VOLTAGE: 2000Vac, rms, 60Hz min. across open contacts, 500Vdc all other points

DRAIN TIME: 30 seconds, max.

OPERATING TIME: 3 ms, max. (No bounce on closure)

RELEASE TIME: 3 ms, max. with nominal clamping

TEMPERATURE RANGE (Operating): −38.8°C to +50°C

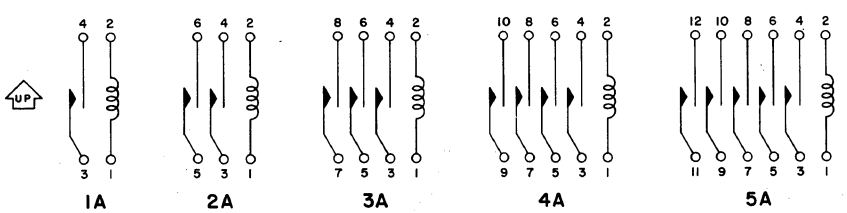
LIFE EXPECTANCY: 20 x 10^6 operations at rated load with proper contact protection

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Must Release (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)
861A05C1A	$5.65	1A	5	3.75	0.15	10	95
861A12C1A	5.65		12	9.0	0.70	18	405
861A2AC1A	6.00		24	18	1.4	36	2210
861A05C2A	7.65	2A	5	3.75	0.15	7.5	55
861A12C2A	7.65		12	9.0	0.70	18	250
861A12C2A	8.00		24	18	1.4	36	1000
861A05C3A	9.65	3A	5	3.75	0.15	7.5	46
861A12C3A	9.65		12	9.0	0.70	18	325
861A24C3A	10.00		24	18	1.4	28	810
861A05C4A	11.65	4A	5	3.75	0.15	7.5	31
861A12C4A	11.65		12	9.0	0.70	18	200
861A24C2A	12.00		24	18	1.4	28	600
861A05C5A	13.65	5A	5	3.75	0.15	7.5	22
861A12C5A	13.65		12	9.0	0.70	18	150
861A24C5A	14.00		24	18	1.4	28	420

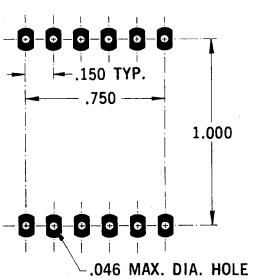
Note: All values at 25°C

Clare 861 series Mercury-Wetted Microclareed relays are superior when compared to dry reed relays of the same size. The relay has a reliable reed capsule with a no-bounce mercury-wetted armature. You obtain some of the mercury-wetted contact relay advantages at a slight price premium over dry reed relays.

SCHEMATICS (Bottom View):



PAD LAYOUT:



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DRY REED RELAYS

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
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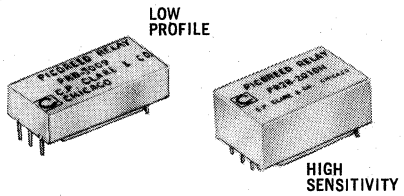
PRB & PRBH SERIES PICOREED®



Clare's micro-miniature PRB and PRBH series Picoreed relays offer signal level to 10VA switching characteristics, power requirements ranging from 48 to 500 milliwatts (dependent on relay configuration) and operate times typically less than 500 microseconds in economical space saving packages. The low profile PRB series permits 0.375″ PCB mounting centers and the high sensitivity PRBH series will mount on 0.5″ PCB centers.

The 5 volt PRB/PRBH relays are fully compatible with the standard 5 volt DTL/TTL logic families and will solve many interface application problems.

Both series have molded epoxy bases with stamped metal covers and mount on 0.70″ x 0.100″ grid patterns. The PRB low profile models are also available in 6 Form A, 1B, 1A1B and 1A latching contact configurations. Electrostatic shielding is available.

SPECIFICATIONS — PRB & PRBH

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 100 volts dc or peak ac, max. Current: .5 ampere, switched, max. 2 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

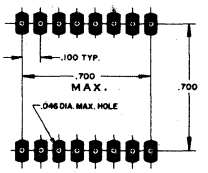
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 5 x 10^6 operations at full rated load

TYPICAL OPERATE TIME: As low as 500 μs including bounce

BREAKDOWN VOLTAGE: 200Vac, rms, 60Hz across open contacts or 275Vdc, max.

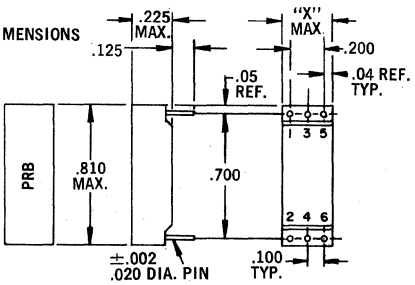
INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

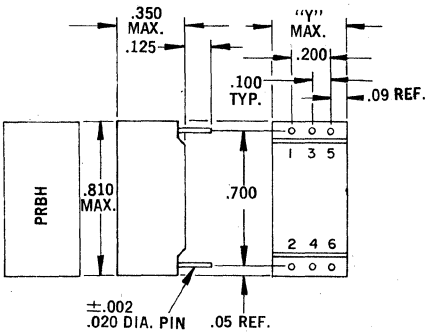
ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 20g's, 10 - 5000Hz. Shock: 100g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.



PCB PAD LAYOUT

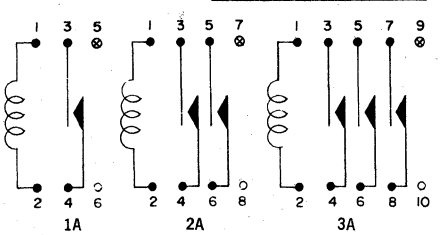
DIMENSIONS

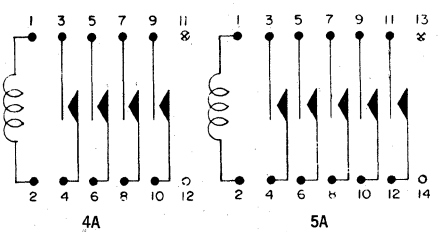




Contact Form	"X"	"Y"
1A	.285	.385
2A	.385	.485
3A	.485	.585
4A	.585	.685
5A	.685	.785

BOTTOM VIEW SCHEMATICS





Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10%)
LOW PROFILE PRB SERIES							
PRB 3510	$3.05	1A	5	3.75	0.5	12	385
PRB 2510	2.75		6	4.5	0.5	12	385
PRB 2513	2.75		12	9	1	24	1200
PRB 2516	3.05		24	18	2	48	5380
PR2B 3007	4.30	2A	5	3.75	0.5	12	135
PR2B 2007	4.00		6	4.5	0.5	12	135
PR2B 2011	4.00		12	9	1	24	740
PR2B 2014	4.30		24	18	2	48	3040
PR3B 3006	5.55	3A	5	3.75	0.5	10	115
PR3B 2006	5.25		6	4.5	0.5	10	115
PR3B 2009	5.25		12	9	1	22	480
PR3B 2013	5.55		24	18	2	46	2250
PR4B 3005	6.80	4A	5	3.75	0.5	10	90
PR4B 2005	6.50		6	4.5	0.5	10	90
PR4B 2008	6.50		12	9	1	22	350
PR4B 2012	6.80		24	18	2	46	1860
PR5B 3005	8.05	5A	5	3.75	0.5	10	105
PR5B 2005	7.75		6	4.5	0.5	10	105
PR5B 2008	7.75		12	9	1	22	420
PR5B 2011	8.05		24	18	2	46	1420
HIGH SENSITIVITY PRBH SERIES							
PRB 3009H	$3.40	1A	5	3.75	0.5	12	535
PRB 2009H	3.00		6	4.5	0.5	12	535
PRB 2013H	3.00		12	9	1	24	2870
PRB 2016H	3.40		24	18	2	48	11,900
PR2B 3007H	4.65	2A	5	3.75	0.5	12	295
PR2B 2007H	4.25		6	4.5	0.5	12	295
PR2B 2010H	4.25		12	9	1	24	1180
PR2B 2013H	4.65		24	18	2	48	3780
PR3B 3006H	5.90	3A	5	3.75	0.5	12	230
PR3B 2006H	5.50		6	4.5	0.5	12	230
PR3B 2009H	5.50		12	9	1	24	875
PR3B 2013H	5.90		24	18	2	48	4700
PR4B 3005H	7.15	4A	5	3.75	0.5	12	155
PR4B 2005H	6.75		6	4.5	0.5	12	155
PR4B 2008H	6.75		12	9	1	24	660
PR4B 2012H	7.15		24	18	2	48	3620
PR5B 3005H	8.40	5A	5	3.75	0.5	12	180
PR5B 2005H	8.00		6	4.5	0.5	12	180
PR5B 2008H	8.00		12	9	1	24	770
PR5B 2011H	8.40		24	18	2	48	3150

DRY REED RELAYS

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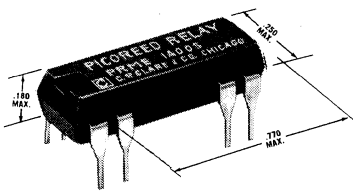
PRME SERIES PICOREED®



Clare's new dual-in-line package PRME Picoreed relay represents a significant addition to the micro-miniature Picoreed relay family packaging. The relays feature 600 microsecond typical response times, signal level to 10VA switching capabilities, total input/output isolation, epoxy molded construction and an IC compatible TO-116 DIP package. Traditional Clare reliability gives 100 x 10^6 operations at signal level loads or 5 x 10^6 operations at the rated load.

The PRME one Form A switching arrangement is compatible with most DTL/TTL drive IC's. The coil draws only 13 milliamperes from standard 5 volt logic supplies. Low contact noise and low thermal emf characteristics make the PRME ideal for electronic process control equipment and low level switching applications.

The 0.180″ height optimizes the industry trend toward high density packaging by allowing PRME mounting on 0.375″ PCB centers compatible with IC components. The PRME adapts to either automatic insertion equipment techniques for direct PCB mounting on 0.30″ x 0.100″ grid patterns or to mounting in standard 14 pin DIP sockets.

SPECIFICATIONS — PRME

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 100 volts dc or peak ac, max. current .5 ampere max, switched. 1.5 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

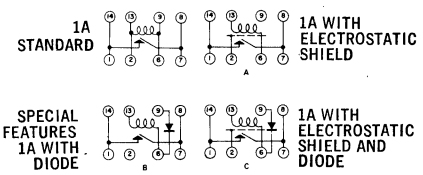
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 5 x 10^6 operations at full rated load

TYPICAL OPERATE TIME: As low as 600 μs including bounce

BREAKDOWN VOLTAGE: 200Vac, rms, 60Hz across open contacts or 275Vdc, max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

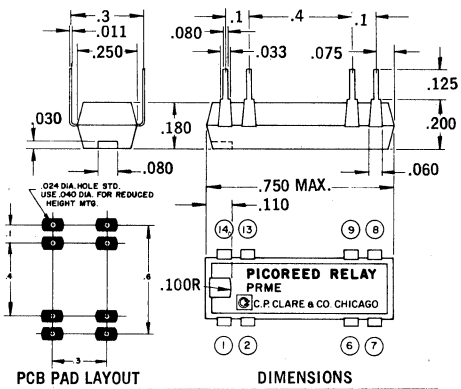
ENVIRONMENTAL (Operating): Vibration: 0.125″ d.a. or 20g's 10-5000Hz. Shock: 100g's, 8 ±1ms, ½ sinewave. Temperature: −40° to +85°C.



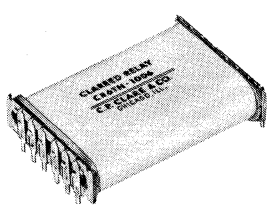
Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Max. Voltage (Vdc)	Coil Resis. (Ohms ±10%)	Power mW	List Price
PRME 1A005	1A	5	3.75	0.9	15	380	65	$3.00
PRME 1A006		6	4.5	0.9	15	380	95	3.00
PRME 1A012		12	9	2	18	530	270	3.00
PRME 1A024		24	18	4	32	2000	290	3.00

Special Features Suffix: Add to the part number	Add to List Price
A: Electrostatic shield between coil and capsule	$ .50
B: Diode between pins 6 and 9; cathode to pin 6	1.00
C: Both electrostatic shield and diode	1.50

Example: The PRME 1A024 with electrostatic shield becomes a PRME 1A024A



CRTN SERIES CLAREED® DRY REED RELAYS



Clare's economical CRTN standard size reed relays offer signal level to 15VA power handling capabilities, total input/output isolation, and low millisecond switching speeds. CRTN relays are direct replacements for our CRT series relays. Like all Clare reed relays, they are immune to false operation and are insensitive to overload transients that affect solid state devices. Clareed relays are rated for millions of reliable, trouble free operations.

Optional CRTN series contact configurations are 3 & 5 Form A, 1B or 2B, 1C or 2C, and 1A latching or 2A latching. Special relays are available with up to twelve contacts. UL recognized versions of our 1 to 12 Form A relays are available as listed in UL File E43775. The relays feature open assembly construction and PCB 2.5″ x .218″ grid mounting centers.

SPECIFICATIONS — CRTN

CONTACT RATING (Resistive Load): Power: 15 volt-amperes, max. Voltage: 250 volts dc or peak ac, max. Current 1 ampere, switched, max. 5 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 70 milliohms max., measured at 100mA, 1000Hz

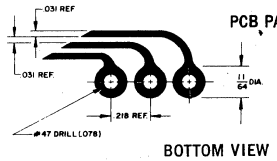
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 20 x 10^6 operations at full rated load

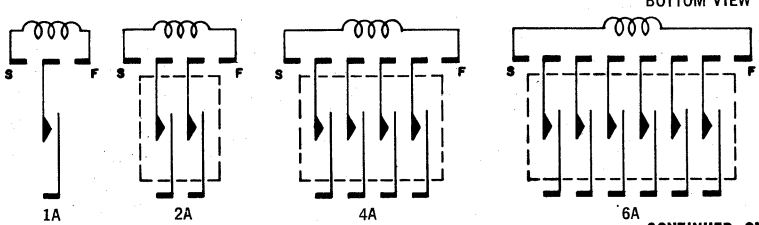
TYPICAL OPERATE TIME: Less than 4.0ms including bounce

BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz across open contacts or 750Vdc, max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 10g's, 10-750Hz. Shock: 30g's, 11 ±1ms, ½ sinewave. Temperature: −65°C to +85°C





CONTINUED ON NEXT PAGE

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DRY REED RELAYS

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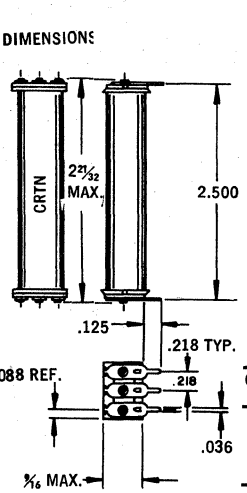
CRTN (Continued)

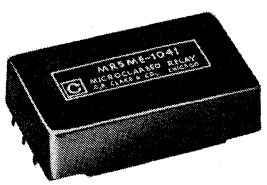
Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10%)	List Price
CRTN 1007	1A	6	4.5	0.6	20	160	$3.50
CRTN 1010		12	9	1.2	35	600	3.50
CRTN 1013		24	18	2.5	75	2500	4.50
CRTN 1016		48	36	4.8	150	9450	6.00
CR2TN 1004	2A	6	4.5	0.5	18	90	4.50
CR2TN 1007		12	9	1.1	35	350	4.50
CR2TN 1010		24	18	2.2	65	1400	5.50
CR2TN 1013		48	36	4.4	130	5400	7.00
CR4TN 1104	4A	6	4.5	0.4	13	35	6.50
CR4TN 1107		12	9	0.8	26	135	6.50
CR4TN 1110		24	18	1.7	53	545	7.50
CR4TN 1113		48	36	3.4	105	2200	9.00
CR6TN 1003	6A	6	4.5	0.4	15	31	8.50
CR6TN 1006		12	9	0.9	30	120	8.50
CR6TN 1009		24	18	1.9	60	510	9.50
CR6TN 1012		48	36	3.8	115	1900	11.00

DIMENSIONS



Contact Form	"X"	"Y"
1A	5/8	.436
2A	27/32	.654
4A	1 5/32	1.090
6A	1 7/64	1.566

MRME TYPE MICROCLAREED®



Clare's MRME Microclareed relays feature signal level to 10VA switching characteristics, and 800 microsecond typical response speeds in a miniature size package. The rugged MRME molded epoxy construction is ideal for critical environmental applications. MRME relays are direct electrical and mechanical replacements for our MRMC series relays.

MRME relays will handle simultaneous signal and power level switching in the same device over a wide band. Total input/output isolation and immunity to false operation by overload transients that affect solid state devices are characteristics of MRME relays.

Optional MRME relays are available in 5 Form A, 1 or 2 Form B, 1A1B or 2A2B, and 1A latching or 2A latching contact configurations. The pins are arranged in a 1.000" x 0.100" staggered offset grid mounting pattern. The MRME relay package readily mounts on 0.5" PCB centers. Electrostatic shielding is available.

SPECIFICATIONS — MRME

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 200 Volts dc or peak a.c. max. Current: 0.75 amperes, switched, max. 2.0 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 10 x 10^6 operations at full rated load

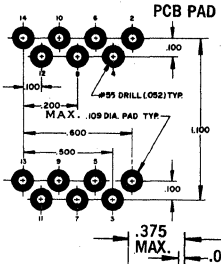
TYPICAL OPERATE TIME: Less than 800μs including bounce

BREAKDOWN VOLTAGE: 250Vac, rms, 60Hz across open contacts or 350Vdc, max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

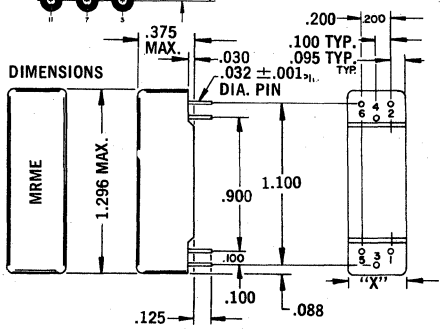
ENVIRONMENTAL (Operating): Vibration: 0.06" d.a. or 10g's, 10 - 2000Hz. Shock: 20g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.

PCB PAD LAYOUT



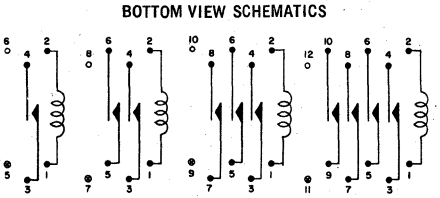
Contact Form	"X"
1A	.390
2A	.490
3A	.590
4A	.690

DIMENSIONS



Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10% @ 25°C)	Price List
MRME 1540	1A	5	3.75	0.15	11	130	$3.50
MRME 1041		6	4.5	0.15	15	220	3.50
MRME 1042		12	9	0.7	29	790	3.50
MRME 1043		24	18	2.5	55	3060	4.05
MR2ME 1540	2A	5	3.75	0.15	10	100	4.85
MR2ME 1041		6	4.5	0.15	13	170	4.85
MR2ME 1042		12	9	0.7	26	635	4.85
MR2ME 1043		24	18	2.5	53	2580	5.40
MR3ME 1540	3A	5	3.75	0.15	9	80	6.20
MR3ME 1041		6	4.5	0.15	12	125	6.20
MR3ME 1042		12	9	0.7	24	510	6.20
MR3ME 1043		24	18	2.5	47	1950	6.75
MR4ME 1540	4A	5	3.75	0.15	8	60	7.55
MR4ME 1041		6	4.5	0.15	11	95	7.55
MR4ME 1042		12	9	0.7	22	410	7.55
MR4ME 1043		24	18	2.5	43	1500	8.10

BOTTOM VIEW SCHEMATICS



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DRY REED RELAYS

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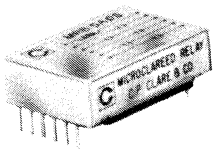
MRB SERIES MICROCLAREED®



Clare's MRB Microreed relays offer versatile signal level to 10VA switching capabilities, total input/output isolation, 800 microsecond typical switching speeds in the miniature sized relay family.

The MRB relays operate with coil power requirements as low as 10 milliwatts. The ultra-reliable operation will exceed 100 x 10^6 operations at signal level loads or 10 x 10^6 operations at the rated load.

Optional MRB relays are available in 3 or 5 Form A, 2 Form B, 3 or 4 Form C, 1A latching or 2A latching and 2A2B contact forms. UL recognized versions in all but Form C are available as listed in UL File E43775. The relays have molded epoxy bases with stamped metal covers and convenient 1.000″ x 0.100″ grid mounting centers for printed circuit board mounting. This low profile package will mount on 0.5″ PCB centers. Electrostatic shielding is available. 1.000″ x 0.150″ grid mounting models are available in 1 to 5 Form A versions. Consult the factory for details.

SPECIFICATIONS — MRB

CONTACT RATING (Resistive Load): Power: 10 volt-amperes, max. Voltage: 200 Volts dc or peak a.c. max. Current: 0.75 amperes, switched, max. 2.0 amperes, carry only, max.

CONTACT RESISTANCE (ON Impedance): Initial: 200 milliohms max., measured at 10mA, 1000Hz

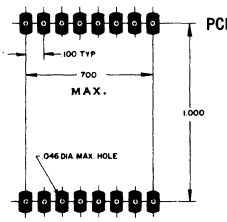
LIFE EXPECTANCY: 100 x 10^6 operations at signal levels. 10 x 10^6 operations at full rated load

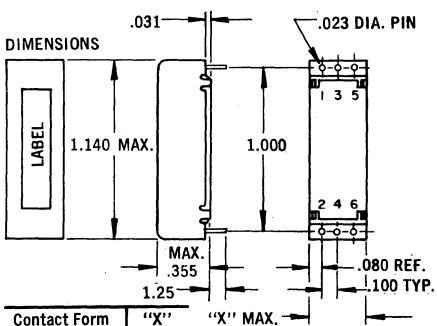
TYPICAL OPERATE TIME: Less than 800μs including bounce

BREAKDOWN VOLTAGE: 250Vac, rms, 60Hz across open contacts or 350Vdc max.

INSULATION RESISTANCE (OFF Impedance): 10^{10} ohms min. at 100Vdc +25°C, 40% rel. hum.

ENVIRONMENTAL (Operating): Vibration: 0.06″ d.a. or 10g's, 10 - 2000Hz. Shock: 20g's, 11 ±1ms, ½ sinewave. Temperature: −40° to +85°C.

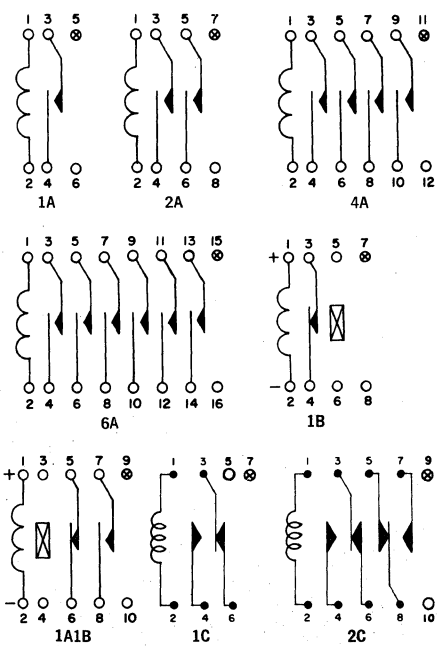




Contact Form	"X"
1A	.365
2A, 1B, 1C	.465
1A1B, 2C	.565
4A	.665
6A	.865

Stock Part Number	List Price	Contact Form	Nominal Voltage (Vdc)	Must Operate Voltage (Vdc)	Must Release Voltage (Vdc)	Maximum Voltage (Vdc)	Coil Resis. (Ohms ±10% @ 25°C)
MRB 1A05	$2.40	1A	5	3.75	0.15	15	225
MRB 1A06	2.40		6	4.5	0.15	18	340
MRB 1A12	2.40		12	9	0.7	36	1400
MRB 1A24	2.70		24	18	1.4	60	4340
MRB 2A05	3.40	2A	5	3.75	0.15	11	105
MRB 2A06	3.40		6	4.5	0.15	14	180
MRB 2A12	3.40		12	9	0.7	26	730
MRB 2A24	3.70		24	18	1.4	48	2500
MRB 4A05	5.40	4A	5	3.75	0.15	9	60
MRB 4A06	5.40		6	4.5	0.15	11	100
MRB 4A12	5.40		12	9	0.7	18	275
MRB 4A24	5.70		24	18	1.4	36	1090
MRB 6A05	7.40	6A	5	3.75	0.15	7	32
MRB 6A06	7.40		6	4.5	0.15	9	50
MRB 6A12	7.40		12	9	0.7	18	210
MRB 6A24	7.70		24	18	1.4	36	900
MRB 1B05	3.40	1B	5	3.75	0.4	7.5	300
MRB 1B06	3.40		6	4.5	0.5	9	450
MRB 1B12	3.40		12	9	1	18	1240
MRB 1B24	3.70		24	18	2	36	5800
MRB 1N05	4.40	1A1B	5	3.75	0.4	7.5	50
MRB 1N06	4.40		6	4.5	0.5	9	82
MRB 1N12	4.40		12	9	1	18	230
MRB 1N24	4.70		24	18	2	36	900
MRB 1C05	5.40	1C	5	3.75	0.4	20	350
MRB 1C06	5.40		6	4.5	0.5	25	560
MRB 1C12	5.40		12	9	1	45	1900
MRB 1C24	5.70		24	18	2	93	7800
MRB 2C05	9.40	2C	5	3.75	0.4	16	220
MRB 2C06	9.40		6	4.5	0.5	21	365
MRB 2C12	9.40		12	9	1	32	880
MRB 2C24	9.70		24	18	2	75	4660

BOTTOM VIEW SCHEMATICS

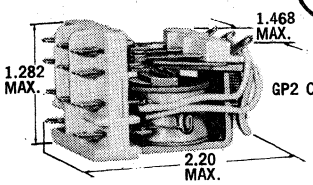


GENERAL PURPOSE RELAYS

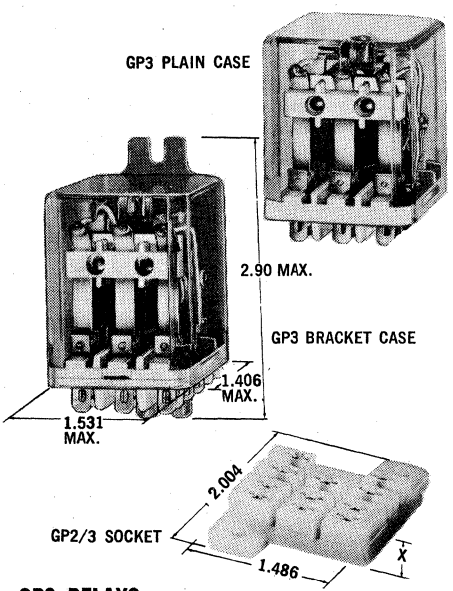
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

a GENERAL INSTRUMENT company

GP2 & GP3



The GP3 (Lexan® dust cover) Relays are UL bulletin 508 recognized (UL File E47012) and CSA listed (File LR26727) as magnetic motor controllers. The rugged AC or DC relays are available in SPDT, DPDT and 3PDT configurations with Gold flashed Silver Cadmium Oxide contacts rated at either 10 amperes at 28Vdc resistive or 120/150Vac, .8 power factor. The GP3 plain case models are available with matching molded nylon sockets for plug-in applications. The GP3 bracket case model is available for direct chassis mounting only. Mechanical life expectancy is 10 million operations, electrical life 100,000 operations minimum at rated load .187" quick connect terminals standard. GP2 models are identical to GP3 models less dust cover.



SPECIFICATIONS — GP2 & GP3

CONTACT RATING: 10 Amperes at 28Vdc resistive or 120/150Vac, .8 power factor. 6 amperes at 240/300Vac, .8 power factor. ⅓ hp at 120Vac, ½ hp at 240Vac

CONTACT RESISTANCE: Initial — 50 milliohms max. at rated current

LIFE EXPECTANCY: Electrical: 100,000 operations minimum at rated load. Mechanical: 10,000,000 operations

OPERATE TIME: Pickup: 15ms typical. Dropout: 11ms typical

BREAKDOWN VOLTAGE: 600Vac, rms, 60Hz minimum between open contacts. 1600Vac, rms, 60Hz all other mutually insulated elements

INSULATION RESISTANCE: 1000 megohms minimum at 500Vdc

	X
GPS 3003	.294"
GPS 3001,2	.542"

ENVIRONMENTAL: Shock: 15g for 11 ±1ms (Non-op.) Vibration: 0.1" d.a. or 10g, 10 to 55Hz (oper.) Temperature Range: −45° to +60°C (AC). −45° to +70°C (DC)

OPTIONS — **List Price Change**

OMIT DUST COVER (GP2 OPEN TYPE)
Relay supplied with #6-32 tapped core, no locating tab. To order, change 3rd character in part number from "3" to "2". Example: GP3R211AA0000 becomes GP2R211AA0000. Deduct $0.15 ea.

BRACKET CASE
To order, change 8th character from "A" to "N". Example: GP3R231AA2000 becomes GP3R231NA2000. No Charge

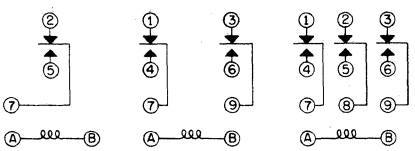
NOTE: Options include neon indicator lamp, external push-to-test button, various mounting modifications for GP2R and GP3R relays, and special contact materials. Contact your local Clare Sales Office for details.

GP3 RELAYS

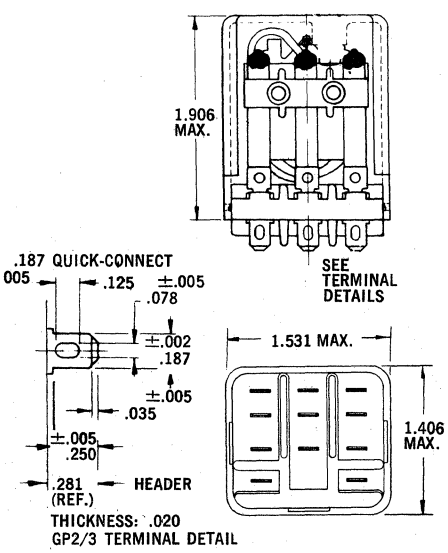
Coil Voltage	Contacts	AC (50/60HZ) Stock Part Number	AC (50/60HZ) List	DC Stock Part Number	DC List
6	SPDT	GP3R211AA0000	$3.40	GP3R211AD0000	$3.30
12	SPDT	GP3R211AA1000	3.40	GP3R211AD1000	3.30
24	SPDT	GP3R211AA2000	3.40	GP3R211AD2000	3.30
48	SPDT	GP3R211AA3000	3.40	GP3R211AD3000	3.30
90	SPDT	———		GP3R211AD4000	3.65
110	SPDT	———		GP3R211AD5000	3.75
120	SPDT	GP3R211AA6000	3.40	———	
6	DPDT	GP3R221AA0000	4.20	GP3R221AD0000	3.75
12	DPDT	GP3R221AA1000	4.20	GP3R221AD1000	3.75
24	DPDT	GP3R221AA2000	4.20	GP3R221AD2000	3.75
48	DPDT	GP3R221AA3000	4.20	GP3R221AD3000	3.75
90	DPDT	———		GP3R221AD4000	4.20
110	DPDT	———		GP3R221AD5000	4.30
120	DPDT	GP3R221AA6000	4.20	———	
6	3PDT	GP3R231AA0000	4.75	GP3R231AD0000	4.30
12	3PDT	GP3R231AA1000	4.75	GP3R231AD1000	4.30
24	3PDT	GP3R231AA2000	4.75	GP3R231AD2000	4.30
48	3PDT	GP3R231AA3000	4.75	GP3R231AD3000	4.30
90	3PDT	———		GP3R231AD4000	4.65
110	3PDT	———		GP3R231AD5000	4.75
120	3PDT	GP3R231AA6000	4.75	———	

GPS3001	Socket, solder terminals	$ .70
GPS3002	Socket, quick-connect terminals	.80
GPS3003	Socket, PCB terminals	.80
GPA3050	Hold down spring clip, box of 50 ea.	$5.00

SCHEMATICS



DIMENSIONS



CLARE GENERAL PURPOSE RELAYS

a GENERAL INSTRUMENT company

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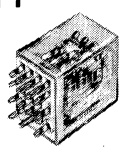
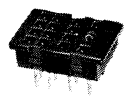
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

GP1





GP1 Relays are miniature 4PDT relays available in both AC and DC models. GP1 Relays with Lexan® dust covers are UL recognized (File E47012) and CSA listed (File LR26727) as magnetic motor controllers. Solder lug terminals are standard. Sockets are available in .375″ or .187″ solder lug or PCB mounting styles. Gold Flashed Fine Silver contacts are standard.

SPECIFICATIONS — GP1

CONTACT RATINGS (Resistive). Gold Flashed Fine Silver: 3A at 120Vac or 28Vdc, $^1/_{10}$ hp at 120Vac. Silver Cadmium Oxide: 5A at 120Vac or 28Vdc, ⅛ hp at 120 or 240Vac at rated load.

CONTACT RESISTANCE (ON Impedance): Initial 50 milliohms

LIFE EXPECTANCY: Electrical: 100,000 operations min. at rated load. Mechanical: 100,000,000 operations.

OPERATE TIME: Pickup: 13ms, max. Dropout: 6ms, max. Nom. voltage, 25°C, unsuppressed

BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz between open contacts. 1500Vac, rms, 60Hz all other mutually insulated elements

INSULATION RESISTANCE (OFF Impedance): 2000 megohms minimum

ENVIRONMENTAL: Shock: 15g, 11 ±1ms, ½ sine-wave. Vibration: 0.06″ d.a. or 10g's 10 to 55Hz. Temperature Range: −45°C to +75°C.

OPTIONS — **Add to List**

OPPOSITE POLARITY RATING — $0.25 each
To order, replace the "R" in the part number with "Q"
Example: GP1R11A0000 becomes GP1Q11A0000

SILVER CADMIUM OXIDE (GOLD FLASHED) CONTACTS — No Charge
To order, change 5th character in part number from '1" to "2". Example: GP1R11A0000 becomes GP1R21A0000.

P.C.B. TERMINALS — No Charge
To order, change 6th character in part number from "1" to "2". Example: GP1R11A0000 becomes GP1R12A0000.

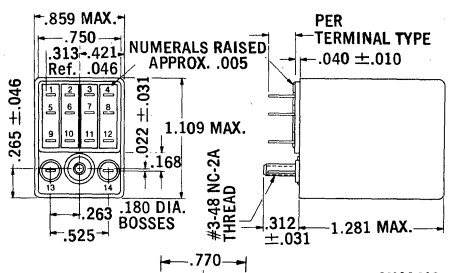
TAPER TAB TERMINALS — No Charge
To order, change 6th character in part number from "1" to "3". Example: GP1R11A0000 becomes GP1R13A0000.

NOTE: Some optional relays may be built to order.

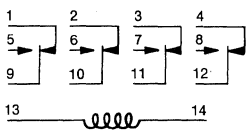
GP1 RELAYS

Coil Voltage	AC (50/60HZ) Stock Part No.	AC (50/60HZ) List	DC Stock Part No.	DC List
6	GP1R11A0000	$4.90	GP1R11D0000	$4.30
12	GP1R11A1000	4.90	GP1R11D1000	4.30
24	GP1R11A2000	4.90	GP1R11D2000	4.30
48	———		GP1R11D3000	4.50
90	———		GP1R11D4000	4.75
110	———		GP1R11D5000	5.00
120	GP1R11A6000	5.30	———	
GPS1001	Socket, .375″ long solder lug w/socket retaining spring			$0.60
GPS1002	Socket, .187″ long solder lug w/socket retaining spring			0.60
GPS1003	Socket, P.C.B. mounting			0.60
GPS1005	Socket, P.C.B. Mounting less ground lug			0.60

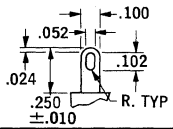
DIMENSIONS



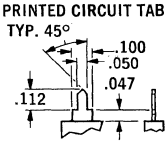
SCHEMATIC



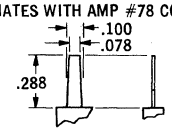
PIERCED SOLDER LUG

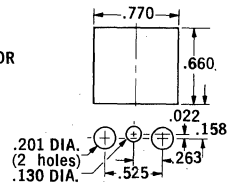


PRINTED CIRCUIT TAB
TYP. 45°

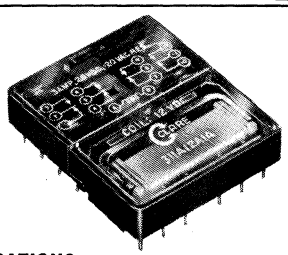


TAPER TAB
MATES WITH AMP #78 CONNECTOR





CHASSIS CUTOUT



NEW 311 SERIES

Clare's new 311 series General Purpose relays offer 3 ampere switching in a low profile package that allows 0.5″ pcb mounting centers. The relay is 0.350″ high and occupies 0.7 c.i. volume. The 0.100″ grid mounting pattern is standard.

The enclosure features a Lexan dust cover and a molded base that protects the relay during wave soldering and subsequent partial immersion cleaning operations. All 311 series relays are designed to meet U. L. Bulletin 508 requirements.

SPECIFICATIONS

CONTACT ARRANGEMENT: 4 Form C

INSULATION RESISTANCE (OFF impedance): 50,000 megohms minimum at 500Vdc, +25°C, 50% relative humidity

CONTACT RESISTANCE (ON impedance): 100 milliohms initial

TYPICAL OPERATE TIME: Operate 15 ms max. including bounce. Release 15 ms max., including bounce

CONTACT RATING (Fine Silver Contacts): 3.0A at 28Vdc, res., 500 x 10^3 operations. 3.0A at 120Vac, res., 200 x 10^3 operations. 3.0A at 120Vac, .8 power factor. 100 x 10^3 operations.

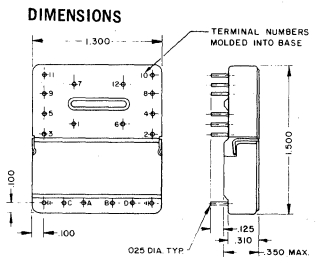
BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz min. between open contacts. 1250Vac, rms, 60Hz min. between all other mutually insulated elements

ENVIRONMENTAL: Temp. range (operating) −40°C to +65°C

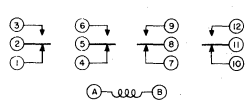
Stock Part Number	Contact Form	Nominal Voltage (Vdc)	Must Operate (Vdc)	Maximum Voltage (Vdc)	Coil Resistance (Ohms, ±10%)
311A11A1A	4C	6	4.5	6.6	25
311A12A1A	4C	12	9	13.2	100
311A13A1A	4C	15	11	17	175
311A14A1A	4C	24	18	27	435
311A15A1A	4C	48	36	56	1800
311A16A1A	4C	90	67	99	5600
311A17A1A	4C	110	82	128	9700

All values at 25°C

DIMENSIONS



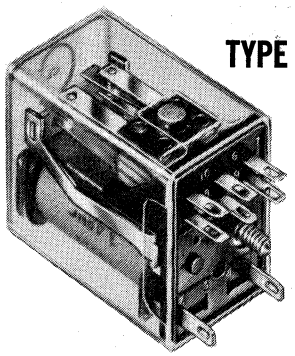
SCHEMATICS



"VP" SERIES GENERAL PURPOSE RELAYS

a GENERAL INSTRUMENT company

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)



TYPE VP

Clare/Varley VP relays have 2, 4 or 6 Form C contact arrangements and Silver contacts rated 2A at 120Vac or 30Vdc resistive. Standard coil voltages are 12, 24, 48 & 120Vdc. The VP is enclosed in an amber Lexan polycarbonate dust cover to prevent contamination. The relays provide an economical and space saving way of solving complex switching problems. Typical applications include telecommunications, business machines, process controls and digital instruments. Sockets available for wired assembly and PCB mounting.

VP

Stock Part No. Part Number	List Price	Nominal Voltage (Vdc)	Contact Form	Must Operate (Vdc)	Maximum Voltage (Vdc)	Coil Resistance In ohms +10%, 25°C
VP2CAB12	$3.15	12	2C	5.0	19	185
VP4CAB12	3.55	12	4C	8.0	19	185
VP6CAB90 OHM	4.55	12	6C	9.0	17.2	90
VP2CAB26	3.15	24	2C	11	37	700
VP4CAB26	3.55	24	4C	16	37	700
VP6CAB430 OHM	4.55	24	6C	18	32	430
VP2CAB47	3.15	48	2C	21	70	2500
VP4CAB47	3.55	48	4C	31	70	2500
VP6CAB1550 OHM	4.55	48	6C	36	56	1550
VP2CAB120	4.40	120	2C	58	166	15000
VP4CAB120	4.90	120	4C	86	166	15000
VP6CAB9000 OHM	5.55	120	6C	86	150	9000

VP2-111PC	$ .55	RP20464G1, PCB socket w/retaining clip
VP2-111W	.55	RP15223G2, Solder lug socket w/retaining clip
VP4-111PC	.70	RP20464G2, PCB socket w/retaining clip
VP4-111W	.70	RP15223G1, Solder lug socket w/retaining clip
VP6-111PC	.95	RP20464G3, PCB socket w/retaining clip
VP6-111W	.95	RP15223G6, Solder lug socket w/retaining clip

SPECIFICATIONS — VP

CONTACT ARRANGEMENTS: 2, 4 and 6 Form C

CONTACT RATINGS (Resistive Load): 2A at 28Vdc or 120Vac

CONTACT RESISTANCE (ON Impedance): 50 milliohms maximum initially

COIL DATA: 2.2W max. dissipation at 25°C

LIFE EXPECTANCY: 100 million operations mechanical — 100,000 operations minimum electrical at rated load

TYPICAL OPERATE TIME: 15ms maximum operate, 8ms maximum dropout at nominal voltage. 25°C, unsuppressed, dc coil

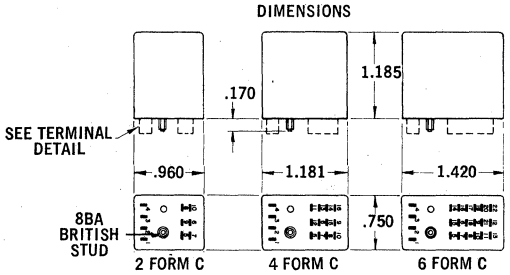
BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz between open contacts, 1000Vac, rms, 60Hz between all other mutually insulated elements

INSULATION RESISTANCE (OFF Impedance): 1000 megohms minimum at 25°C, 50% relative humidity

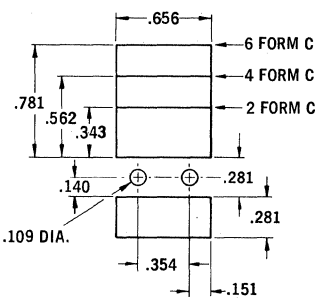
ENVIRONMENTAL (Operating): Temperature range of −55° to +65°C

PHYSICAL: Dust cover — Amber Lexan® polycarbonate; Base material — Black glass filled nylon; Pileup insulation — Grade MP155 pirtoid; Terminals — Pierced solder lug; Weight — 1.3 oz. maximum; Marking — Part number, coil resistance, Clare/Varley name

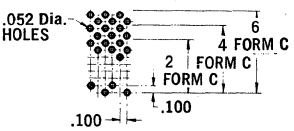
DIMENSIONS



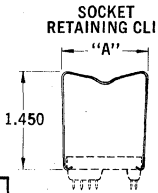
RELAY & SOCKET PANEL CUTOUT



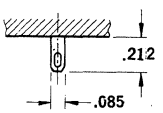
PCB PAD LAYOUT



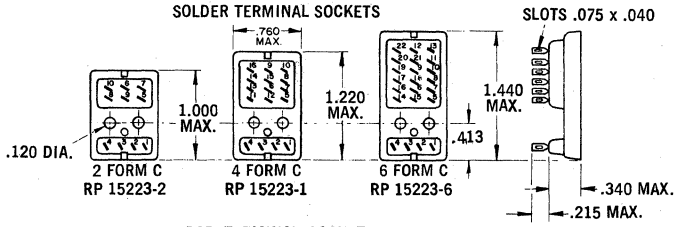
SOCKET RETAINING CLIP



RELAY TERMINAL DETAIL

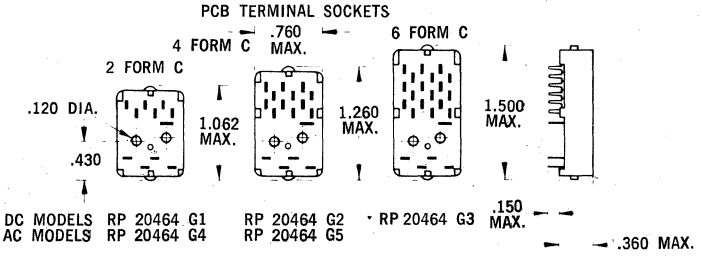


SOLDER TERMINAL SOCKETS

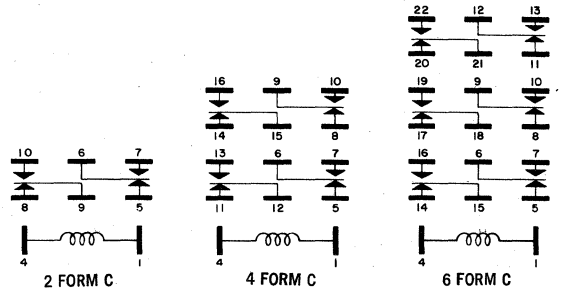


RELAY	"A"
2C	1.030
4C	1.250
6C	1.480

PCB TERMINAL SOCKETS



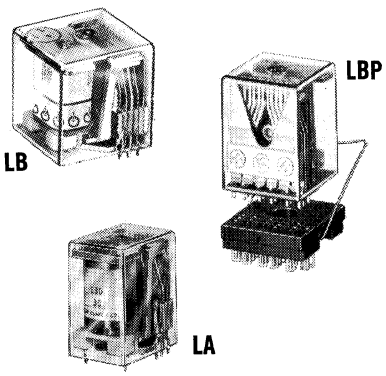
SCHEMATIC DIAGRAMS



CLARE® a GENERAL INSTRUMENT company
3101 Pratt Blvd., Chicago, Illinois 60645
(312) 262-7700 Cable Address: CLARELAY, CHICAGO

TELEPHONE TYPE RELAYS

LA/LB SERIES



Designed for the user who must have high quality at a reasonable price. The LA relays have 4PDT contacts and the LB/LBP relays have 6PDT contacts. These miniature relays have extraordinary switching capacity and versatility for their size. Contacts rated 2 amps at 28Vdc. LA/LB Series is for direct P.C.B. mounting; and the LBP Series is for direct plug into socket mounting. These relays are ideal components for military, industrial and commercial applications.

SPECIFICATIONS — LA/LB SERIES

CONTACT RATING (Resistive Load): 2A at 28Vdc

CONTACT MATERIAL: Palladium, with Gold overlay on bifurcated make and break springs

CONTACT RESISTANCE (ON Impedance): 100 milliohms max. initial

LIFE EXPECTANCY: 100,000 operations at rated load min. 100,000,000 operations mechanical life min.

OPERATE TIME: 10-25ms typical

RELEASE TIME: 5ms max.

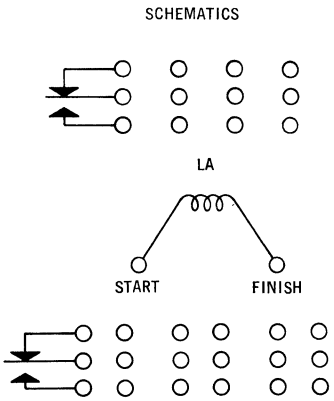
BREAKDOWN VOLTAGE: 500Vac, rms, 60Hz between all mutually insulated points

INSULATION RESISTANCE (OFF Impedance): 500K Megohms min. at 25°C, 50% rel. hum.

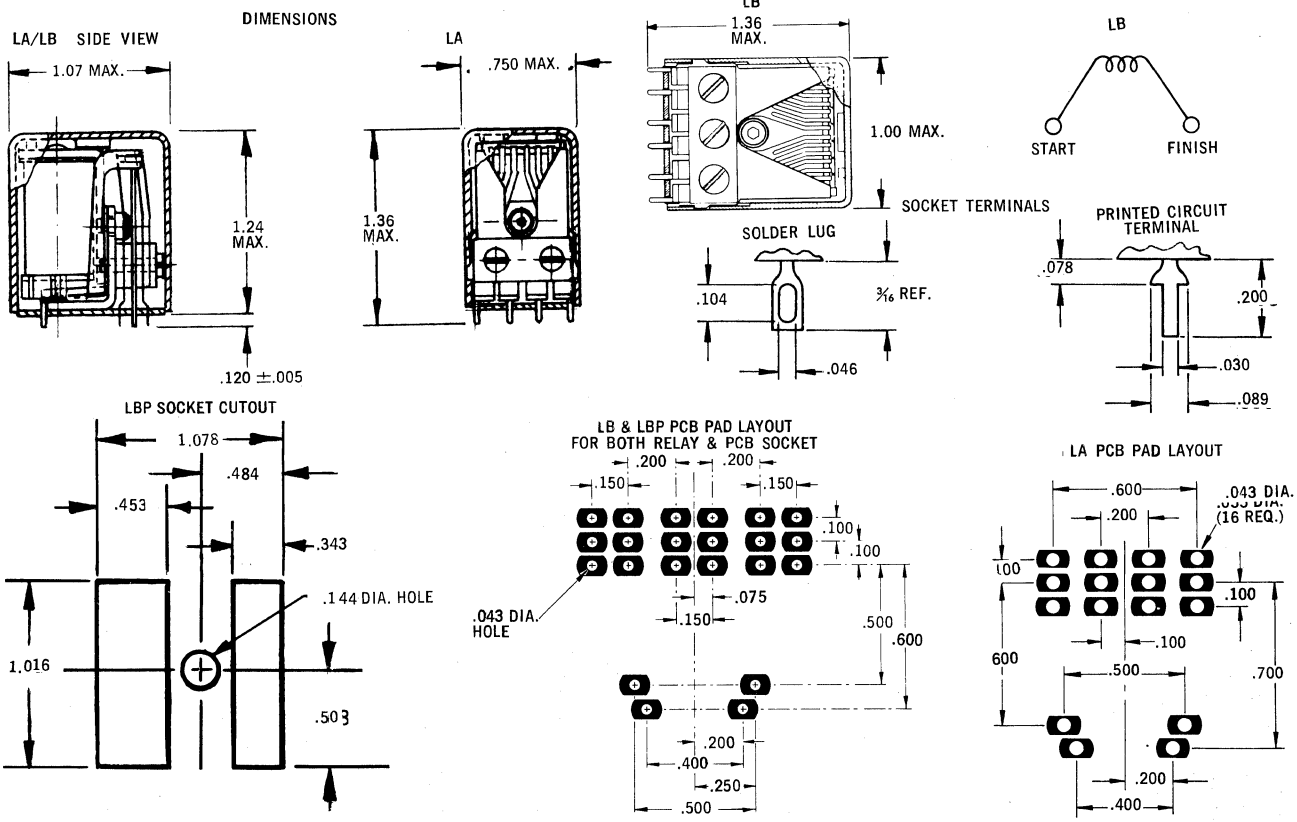
ENVIRONMENTAL (Operating, 10 μs max. contact chatter): Vibration: 5-2000Hz, 10g's. Shock: 15g's, 11ms, ½ sinewave

Stock Part Number	Volts (dc)	Coil Resistance	Contact Form	List Price
LB0060A00, LBP0060A00	6	35	6 Form C	$5.95
LB0060B00, LBP0060B00	12	130	6 Form C	5.95
LB0060H00, LBP0060H00	12	200	6 Form C	5.95
LB0060C00, LBP0060C00	12	330	6 Form C	5.95
LB0060D00, LBP0060D00	24	590	6 Form C	5.95
LB0060K00, LPB0060K00	24	915	6 Form C	5.95
LB0060J00, LBP0060J00	24	1150	6 Form C	5.95
LB0060N00, LBP0060N00	48	2100	6 Form C	5.95
LB0060M00, LBP0060M00	48	3000	6 Form C	5.95
RP 15450G5 Socket, Solder lug for LBP w/Cover Clip				1.35
RP 15450G6 Socket, PCB for LBP w/Cover Clip				1.35
LA0040A00	6	35	4 Form C	5.35
LA0040B00	12	130	4 Form C	5.35
LA0040D00	24	590	4 Form C	5.35
LA0400K00	24	915	4 Form C	5.35
LA0400N00	48	2100	4 Form C	5.35
LA0400M00	48	3000	4 Form C	5.35

SCHEMATICS



DIMENSIONS

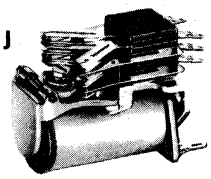


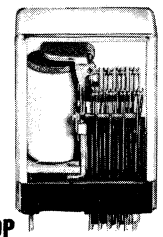
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

CLARE® a GENERAL INSTRUMENT company
3101 Pratt Blvd., Chicago, Illinois 60645
(312) 262-7700 Cable Address: CLARELAY, CHICAGO

TELEPHONE TYPE RELAYS

J & JDP SERIES


J


JDP

J & JDP relays are compact telephone type relays for applications ranging from simple switching in alarm circuits to complex computer functions. Contact combinations of 4, 6 & 8 pole double throw are rated 4A at 120Vac, 60Hz or 30Vdc resistive. Mechanical life exceeds 70 x 10^6 operations.

Type J relays are open type construction for direct chassis mounting. Series JDP relays are furnished with a relay, a socket with solder lug terminals and a dust cover enclosure.

SPECIFICATIONS — J & JDP

CONTACT RATING (Resistive Load): 4A at 120Vac, 60Hz or 30Vdc

CONTACT MATERIAL: Twin Palladium (bifurcated make-and-break springs)

CONTACT RESISTANCE: 100 milliohms max. initial

LIFE EXPECTANCY: 1 x 10^6 operations min. at rated load, mechanical life 70 x 10^6 operations

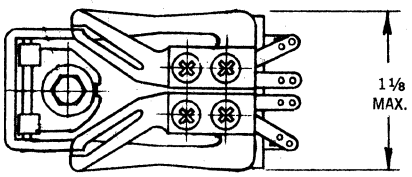
OPERATE TIME: 10-40ms typical

RELEASE TIME (Coil unsuppressed): 1-10ms typical

BREAKDOWN VOLTAGE: 1000Vac, 60Hz

Stock Part Number	Volts (dc)	Coil Resistance	Contact Form	Figure	List Price
J SERIES					
J124C24	12	80	4PDT	A	$7.35
J126C24	12	50	6PDT	A	8.55
J128C24	12	50	8PDT	A	9.90
J244C24	24	500	4PDT	A	7.55
J246C24	24	300	6PDT	A	8.80
J248C24	24	200	8PDT	A	10.10
J484C24	48	1300	4PDT	A	7.90
J486C24	48	1000	6PDT	A	9.15
J488C24	48	800	8PDT	A	10.50
J1104C24	110	6500	4PDT	A	8.30
J1106C24	110	5000	6PDT	A	9.55
J1108C24	110	3600	8PDT	A	10.90
JDP SERIES					
JDP124C24	12	80	4PDT	B1	$8.05
JDP126C24	12	50	6PDT	B2	9.60
JDP128C24	12	50	8PDT	B2	10.95
JDP244C24	24	500	4PDT	B1	8.25
JDP246C24	24	300	6PDT	B2	9.80
JDP248C24	24	200	8PDT	B2	11.15
JDP484C24	48	1300	4PDT	B1	8.65
JDP486C24	48	1000	6PDT	B2	10.15
JDP488C24	48	800	8PDT	B2	11.50
JDP1104C24	110	6500	4PDT	B1	9.05
JDP1106C24	110	5000	6PDT	B2	10.60
JDP1108C24	110	3600	8PDT	B2	11.90

DIMENSIONS "J"



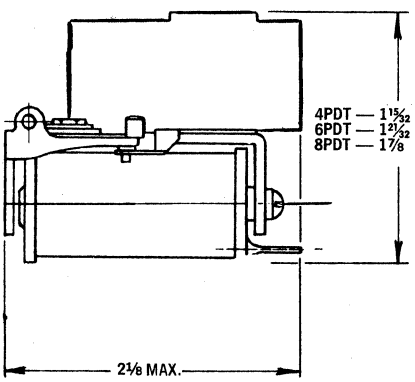
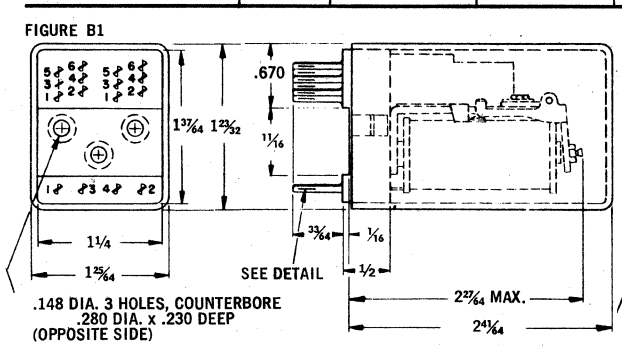
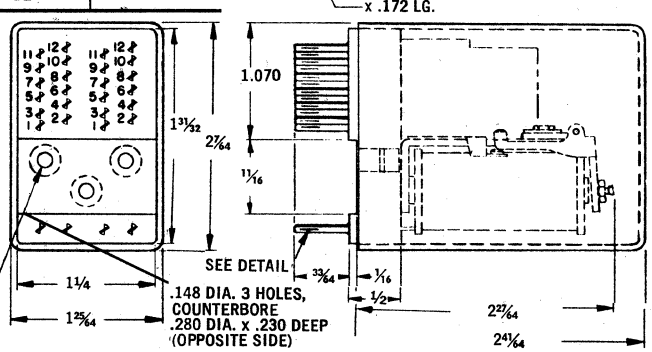


FIGURE A

FIGURE B2

FIGURE B1





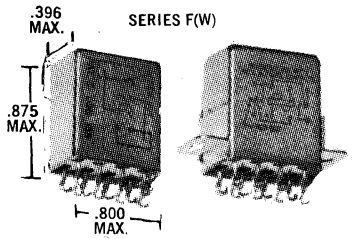
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

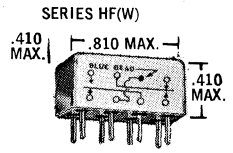
a GENERAL INSTRUMENT company

CRYSTAL CAN RELAYS

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

TYPE F(W) & HF(W)





Clare provides full and half-size crystal can relays of unusual versatility, capable of reliable long life operation under adverse environments. The relays are available in both solder seal versions (F & HF) and welded seal models (FW & HFW). These relays are ideal for use in industrial application as well as military and aerospace. Relays employ a rigid frame to maintain permanent alignment of all elements. Contact arrangements are 2 form C. These relays are manufactured to meet Mil-R-5757/10 and 5757/9.

SPECIFICATIONS — F(W) & HF(W)

CONTACT RATING (Resistive Load): 2A at 28Vdc

CONTACT RESISTANCE (ON Impedance): 50 milliohms max. at 6Vdc, 100mA

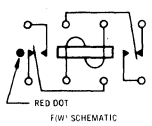
LIFE EXPECTANCY: F & FW: 250,000 operations at rated load. HF & HFW: 100,000 operations at rated load

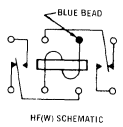
OPERATE TIME: F & FW: 5ms max. HF & HFW: 4ms max.

BREAKDOWN VOLTAGE: 1000Vac, rms, 60Hz between all terminals and case

INSULATION RESISTANCE (OFF Impedance): 1000 Megohms min.

ENVIRONMENTAL: Vibration: 5 - 2000 Hz, 0.125″ d.a. or 30g peak (HF & HFW). 10 - 3000Hz, 0.125″ d.a. or 30g peak (F & FW). Shock: 65g peak, 11 ±1ms Temperature range: −65° to +125°C

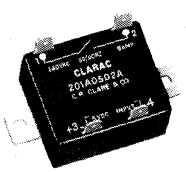


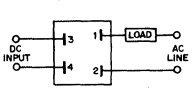


Stock Part No.		List Price	Nom. Volt. (dc)	Coil Res. (Ohms)	Contacts		Terminal Type	Enclosure Variations
Welded Header	Soldered Header				Arrangement	Rating (Amps)		
FW	**F**							
FW1111G00	RP7631G12	$9.80	26.5	675	DPDT	2	S. H.	Side Plate Mtg.
FW1105G00	RP7632G1	9.80	26.5	675	DPDT	2	S. H.	Std. Ear Brkts.
FW1102G00	RP7633G4	9.80	26.5	675	DPDT	2	S. H.	Stud Mtg. Top
FW1104G00	RP7640G1	9.80	26.5	675	DPDT	2	S. H.	Stud Mtg. Side
FW1301G00	RP7641G2	9.80	26.5	675	DPDT	2	3″ Leads	Plain Case
FW1201G00	RP7641G8	9.80	26.5	675	DPDT	2	3/16″ plug in	Plain Case
FW1207G00	RP9809G1	9.80	26.5	675	DPDT	2	3/16″ plug in	Std. Ear Brkts.
*FW1106G02	RP9817G1	9.80	26.5	675	DPDT	2	S. H.	Std. Ear Brkts.
HFW	**HF**							
HFW1201D00	HF1201D00	$11.10	26.5	1250	DPDT	2	3/16″ plug in	Plain Case
†HFW1201K01	HF1201K01	11.10	26.5	700	DPDT	2	3/16″ plug in	Plain Case

QPL Numbers * Mil-R-5757E/10-141 † Mil-R-5757E/9-003

CLARAC™ AC POWER RELAYS





WIRING DIAGRAM

The Clarac relay is an ultra-reliable hybrid relay featuring a reed input and a triac solid state output. The relays are very sensitive and operate with less than 200mW power inputs. Rugged construction, low cost and long life make the Clarac an excellent choice for tough circuit applications such as switching solenoids, ac motors, lamps and other industrial loads.

The units maximum ratings are 4, 8, 10 or 15A at 240Vac, 50/60Hz when mounted on a 8″ x 8″ x 1/8″ aluminum heat sink for optimum operation. The relays must be derated when used without heat sink (free air) or at elevated temperatures (consult Clare Data Sheet 222 for surge current capabilities and additional details). The relays have dust and explosion proof nylon covers, quick-connect terminals and an average shipping weight of 2 oz.

SPECIFICATIONS

LOAD RATING: 4, 8, 10 or 15A at 240Vac, 50/60Hz (400V max. peak)

ELECTRICAL ISOLATION: Greater than 10^{10} ohms input/output isolation

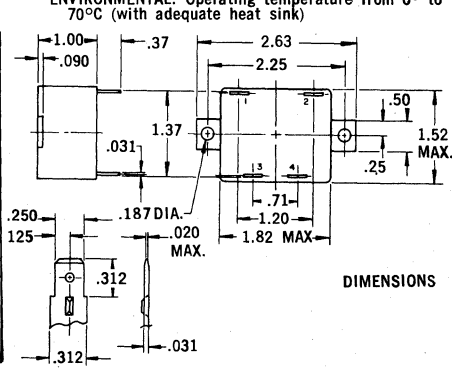
LIFE EXPECTANCY: 100 x 10^6 operations min. with random switching during the cycle

TYPICAL OPERATE TIME: Turn On: 1ms max. Turn Off: At 1st zero amplitude current point of the sinewave after coil de-energization

BREAKDOWN VOLTAGE: 1000Vac, 60Hz min. between all mutually insulated terminals and the mounting plate

ENVIRONMENTAL: Operating temperature from 0° to 70°C (with adequate heat sink)

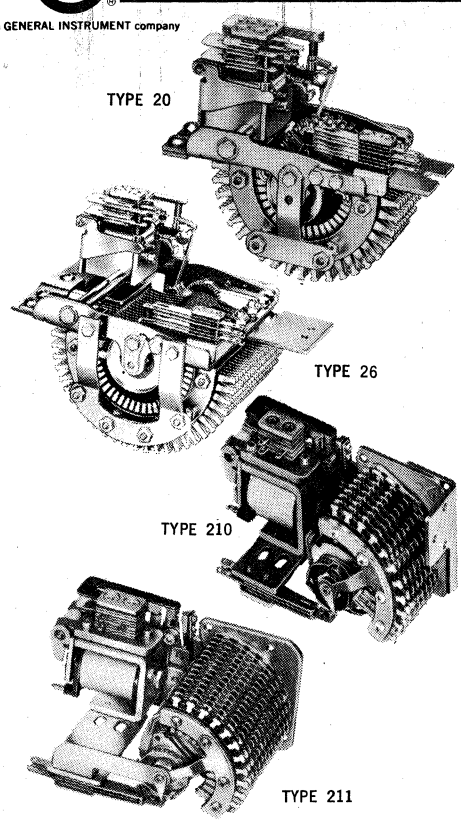
Stock New Part Number	(Reference Only) Old Part No.	Nom. Coil Input Voltage (Vdc)	Must Operate Voltage (Vdc)	Coil Res. (Ohms)	Max. Load Current with heat sink	Load Current (Free air, 25°C)	List Price
201A06B2A	NR1D404AAD2000	6	3.75	218	4	2.5	$11.15
201A06D2A	NR1D407AAD2000	6	3.75	218	8	3.5	11.75
201A06E2A	NR1D410AAD2000	6	3.75	218	10	5.0	12.55
201A06F2A	NR1D415AAD2000	6	3.75	218	15	5.0	14.40
201A12B2A	NR1D404AAD4000	12	9.0	790	4	2.5	11.15
201A12D2A	NR1D407AAD4000	12	9.0	790	8	3.5	11.75
201A12E2A	NR1D410AAD4000	12	9.0	790	10	5.0	12.55
201A12F2A	NR1D415AAD4000	12	9.0	790	15	5.0	14.40
201A24B2A	NR1D404AAD5000	24	18.0	3060	4	2.5	11.15
201A24D2A	NR1D407AAD5000	24	18.0	3060	8	3.5	11.75
201A24E2A	NR1D410AAD5000	24	18.0	3060	10	5.0	12.55
201A24F2A	NR1D415AAD5000	24	18.0	3060	15	5.0	14.40



DIMENSIONS

CLARE®
a GENERAL INSTRUMENT company
3101 Pratt Blvd., Chicago, Illinois 60645
(312) 262-7700 Cable Address: CLARELAY, CHICAGO

STEPPING SWITCHES



Clare stepping switches offer an economical alternative to solid state switching. Multiplexing, counting and sequencing problems are easily solved by providing the most working capacity in the smallest space. Clare stepping switches allow you to select, interrupt or change connections in a succession of circuits in response to current pulses.

Type 210 offers 3, 6 & 12 levels of 10 points with a life expectancy of 100 million steps at 12 levels. Contacts are rated 0.1A at 115Vac or 30Vdc resistive with a 3A carry rating. Operate time is approx. 20ms at 25°C and release time is 10ms. Solder lug terminals are standard.

Type 211 has the same electrical characteristics as the type 210 but in 3, 6, & 12 levels of 11 points.

Type 20 offers 4 & 8 levels of 20 points with a life expectancy of 180 million steps at 8 levels. Contacts are rated 0.1A at 115Vac or 30Vdc resistive with a 3A carry rating. Operate time is approx. 20ms at 25°C and release time is approx. 10ms at 25°C. Solder lug terminals are standard.

Type 26 has the same electrical characteristics as the type 20 but is offered in 4 & 8 levels of 26 points or 6 levels of 52 points.

ALL SWITCHES LISTED HAVE 1 BRIDGING LEVEL WITH THE REMAINING LEVELS BEING NON-BRIDGING. 2C OFF-NORMAL AND 2C INTERRUPTER CONTACTS ARE STANDARD.

SPECIFICATIONS

CONTACT RATINGS (Resistive Load): 0.1A at 115Vac or 30Vdc switched, 3A carry only; max.

CONTACT RESISTANCE (ON Impedance): 0.15 ohm typical

LIFE EXPECTANCY: (See description)

TYPICAL OPERATE TIME: Approximately 20ms at 25°C, release time approx. 10ms

BREAKDOWN VOLTAGE: 1000Vac, 60Hz across open contacts

INSULATION RESISTANCE (OFF Impedance): 10^{11} ohms at 500Vdc between levels

ENVIRONMENTAL: Vibration: 0.06″ d.a., 10 - 55Hz. Shock: 30g's, 11 ±1ms. Temperature: 0°C to +85°C

Stock Part No.	Nom. Volt. (dc)	Coil Resistance (ohms)	Levels	Points	Dimensions H	Dimensions W	Dimensions D	List Price
210-2403A	24	24	3	10	2¾	4⅝	1¹⁹⁄₆₄	$25.25
210-2406A	24	24	6	10	2¾	4⅝	1¹³⁄₁₆	28.85
210-2412A	24	20	12	10	2¾	4⅝	2¹³⁄₁₆	46.90
210-4803A	48	100	3	10	2¾	4⅝	1¹⁹⁄₆₄	25.25
210-4806A	48	100	6	10	2¾	4⅝	1¹³⁄₁₆	28.85
210-4812A	48	70	12	10	2¾	4⅝	2¹³⁄₁₆	46.90
210-11003A	110	600	3	10	2¾	4⅝	1¹⁹⁄₆₄	25.75
210-11006A	110	600	6	10	2¾	4⅝	1¹³⁄₁₆	29.40
210-11012A	110	400	12	10	2¾	4⅝	2¹³⁄₁₆	47.40
211-2403A	24	24	3	11	2¾	4⅝	1¹⁹⁄₆₄	25.25
211-2406A	24	24	6	11	2¾	4⅝	1¹³⁄₁₆	28.85
211-2412A	24	20	12	11	2¾	4⅝	2¹³⁄₁₆	46.90
211-4803A	48	100	3	11	2¾	4⅝	1¹⁹⁄₆₄	25.25
211-4806A	48	100	6	11	2¾	4⅝	1¹³⁄₁₆	28.85
211-4812A	48	70	12	11	2¾	4⅝	2¹³⁄₁₆	46.90
211-11003A	110	600	3	11	2¾	4⅝	1¹⁹⁄₆₄	25.75
211-11006A	110	600	6	11	2¾	4⅝	1¹³⁄₁₆	29.40
211-11012A	110	400	12	11	2¾	4⅝	2¹³⁄₁₆	47.40
20-2404A	24	35	4	20	4⅝	5⅝	2⅛	36.05
20-2408A	24	35	8	20	4⅝	5⅝	2⅛	45.35
20-4804A	48	100	4	20	4⅝	5⅝	2⅛	36.05
20-4808A	48	100	8	20	4⅝	5⅝	2⅛	43.35
20-11004A	110	600	4	20	4⅝	5⅝	2⅛	36.60
20-11008A	110	600	8	20	4⅝	5⅝	2⅛	45.85
26-2404A	24	35	4	26	4⅞	6⁹⁄₁₆	2½	37.60
26-2408A	24	35	8	26	4⅞	6⁹⁄₁₆	2½	46.35
26-4804A	48	100	4	26	4⅞	6⁹⁄₁₆	2½	37.60
26-4808A	48	100	8	26	4⅞	6⁹⁄₁₆	2½	46.35
26-11004A	110	600	4	26	4⅞	6⁹⁄₁₆	2½	38.15
26-11008A	110	600	8	26	4⅞	6⁹⁄₁₆	2½	46.90
26-11026A	110	600	6	52	4⅞	6⁹⁄₁₆	2¾	58.75
RP8047G4	Rectifier Unit							12.90
RP9466	Standard Lubrication Kit							9.00
RP11375	Tool Kit							35.00

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

COMPUTER COMPONENTS INC.
88-06 Van Wyck Expressway, Jamaica, New York 11418 (212) 291-3500

REED RELAYS

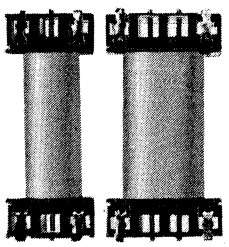
Computer Components Inc. HP Series of dry reed and mercury wetted relays offers the design engineer miniature, low profile, plug-in devices, with magnetically shielded coils.

Fast switching speeds and low power consumption make them applicable to control and instrumentation, low level switching, counting, high speed sampling, computers and associated peripheral equipment.

In addition to the company's standard dry reed and mercury wetted designs, CCI also produces exact replacements for IBM plug-in reed relays. (See Equivalency Chart on back page of catalog for specifications and cross reference part numbers.) Write or phone for catalog.

CONTACT RATING — HP-A SERIES — SINGLE POLE, SINGLE THROW, DRY REED

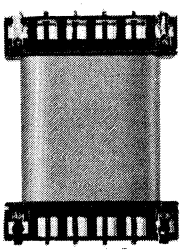
Contact Dash No.	Resistive Load: Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.	Max. Initial Contact Res. (Ohms)	Min. Breakdown Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
1	.5	28	10	10	.100	300	10^{10}	10	Rhodium over Gold	Instrument Grade Low Thermal EMF
2	.5	200	10	12	.200	300	10^{10}	10	Rhodium or Dimet	General Purpose D.C. to 30MHz
3	.5 @ 20V .01 @ 1000V	1000	10	10	.100	1500	10^{10}	10	Rhodium	High Voltage



LOW PROFILE

CONTACT RATING — HP-C SERIES — SINGLE POLE, DOUBLE THROW, DRY REED

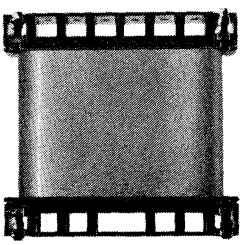
Contact Dash No.	Resistive Load: Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.	Max. Initial Contact Res. (Ohms)	Min. Breakdown Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
1	.25	28	3	3	.150	250	10^9	10	Rhodium over Gold	Instrument Grade
2	.25	150	4	4	.200	200	10^9	10	Rhodium	General Purpose
3	.50	150	6	10	.150	200	10^9	10	Gold Rhodium	General Purpose

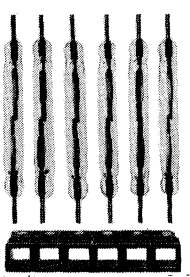


PLUG-IN

CONTACT RATING — MWHP-A SERIES — SINGLE POLE, SINGLE THROW, MERCURY WETTED REED

Contact Dash No.	Resistive Load: Max. Amps D.C.	Max. Volts D.C.	Max. Watts D.C.	V.A. A.C.	Max. Initial Contact Res. (Ohms)	Min. Breakdown Voltage D.C.	Min. I.R. (Ohms)	Life @ Rated Load x 10^6	Contact Material Plating	Suggested Application
1	1.0	100	28	28	.100	1000	10^{10}	100	Mercury Wetted	No Bounce
2	1.0 Derate to .02 @ 500V	500	50	50	.100	1500	10^{10}	50	Mercury Wetted	No Bounce





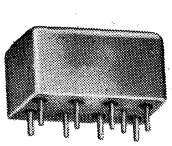
REPLACEABLE SWITCHES

OPERATING PARAMETERS — HP-A, HP-C, MWHP-A SERIES

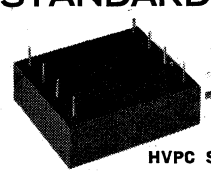
Contact Arrangement†	Nominal Coil Voltage V.D.C.*	Coil Resistance @ 25°C Ohms ±10%	Max. Pick-up Voltage @ 25°C	Min. Release Voltage @ 25°C	Operate Power @ 25°C Milliwatts	Nominal Power @ 25°C Milliwatts	Max. Pick-up Time Milliseconds Contact Form A	Max. Pick-up Time Milliseconds Contact Form B, C, MW	Max. Release Time Milliseconds** Contact Form A	Max. Release Time Milliseconds** Contact Form B, C, MW
1A	6	150	4.5	1.0	140	240	1.0	1.75	0.5	2.0
	12	600	9.0	2.0						
	24	2400	18.0	4.0						
2A	6	110	4.5	1.0	190	330	1.0	1.75	0.5	2.0
2B	12	440	9.0	2.0						
1C	24	1760	18.0	4.0						
4A	6	90	4.5	1.0	230	400	1.5	2.0	0.75	2.5
4B	12	360	9.0	2.0						
2C	24	1440	18.0	4.0						
6A	6	50	4.5	1.0	410	720	1.5	2.5	0.75	2.5
6B	12	200	9.0	2.0						
3C	24	800	18.0	4.0						

NOTES: †Available in mixed arrangements. *Available with 3, 5, 9, 18 and 48 volt coils. **With coil unsuppressed.

STANDARD CATALOG RELAYS

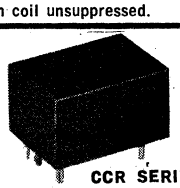


MG SERIES

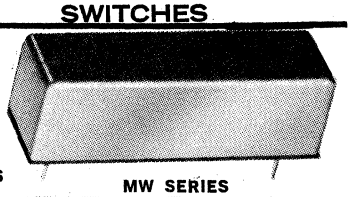


HVPC SERIES

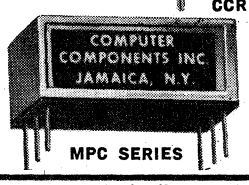
LO SERIES



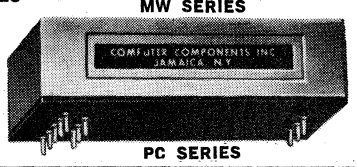
CCR SERIES



MW SERIES



MPC SERIES



PC SERIES

All Relays above are available with the following features:

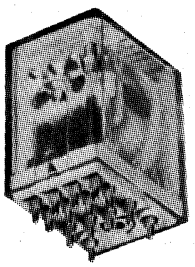
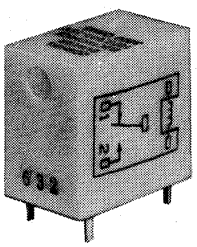
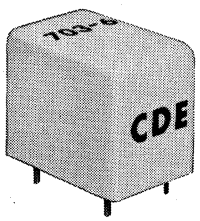
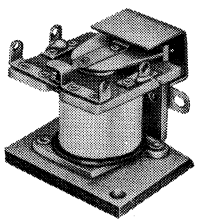
- 6, 12, 24 and 48 VDC coils.
- Magnetic and/or electrostatic shielding.
- Higher insulation resistance.
- Available for +125°C operation (standard temperature −55°C to +85°C).

For detailed information write or phone for our latest catalog.

CDE CORNELL-DUBILIER

Miniature Relays

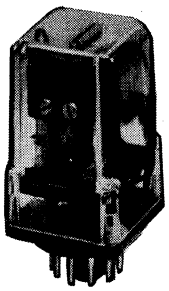
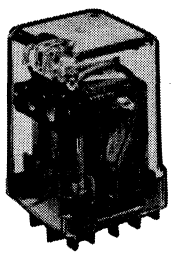
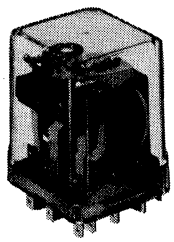
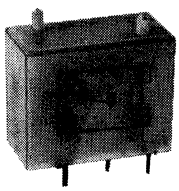
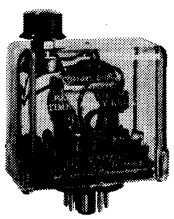
MINIATURE

				
SERIES	**100**	**600**	**700**	**5000**
Contact Rating	Low Level to 5 Amps	Low Level to 5 Amps	Low Level to 3 Amps	2 Amps @ 120 VAC/28 VDC
Contact Configuration	4 PDT	Up to DPDT	SPST or SPDT	SPST or SPDT
Nominal Operating Power	DC 0.9 W AC 1.2 VA	60-360 MW	750 MW	120 MW
Max. Power Input	DC 2.0 W AC 2.0 VA	1 Watt	1 Watt	1 Watt
Min. Operating Power	DC 0.8 W AC 1.1 VA	35-200 MW	450 MW	100 MW
Nominal Operating Time	14 MS	10 MS	10 MS	12 MS
Nominal Release Time	6 MS	8 MS	8 MS	8 MS
Life — Mechanical	Over 30,000,000	Over 50,000,000	Over 10,000,000	Over 10,000,000
Life — Electrical @ Rated Load	100,000 Min.			
Max. Coil Resistance	DC 11,000 Ohms AC 16,200 Ohms	8000 Ohms	2500 Ohms	7000 Ohms
Mountings	Solder Lug/Plug In Taper Tab, PC	Solder Lug/Mtg. Brkt., Stud, PC	PC	Solder Lug Tapped Hole
Approx. Weight	1.5 oz.	1.0 oz.	0.9 oz.	1.5 oz.
Class Number	240.12	240.05	240.08	240.01

For additional Relay engineering literature, write to Relay Manager, Cornell-Dubilier, 150 Avenue L, Newark, New Jersey 07101.

CDE CORNELL-DUBILIER

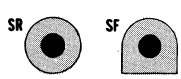
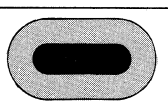
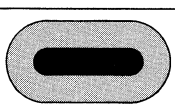
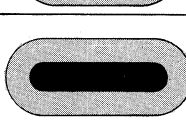
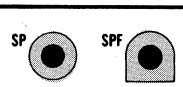
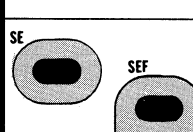
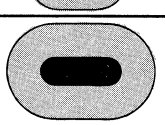
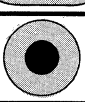
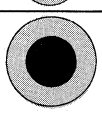
General Purpose, Bi Stable Time Delay Relays

	GENERAL PURPOSE			BI-STABLE	TIME DELAY
					
SERIES	30	20	90	662	TS
Contact Rating	10 Amps @ 120 VAC/28 VDC	10 Amps @ 120 VAC/28 VDC	10 Amps @ 120 VAC/28 VDC	Low Level to 5 Amps	10 Amps @ 120 VAC/28 VDC
Contact Configuration	Up to 3 PDT	Up to 3 PDT	Up to 3 PDT	SPST	DPDT
Nominal Operating Power	DC 1.2 W AC 2.75 VA	DC 1.2 W AC 2.75 VA	DC 1.2 W AC 2.75 VA	360 MW	DC 1.2 W AC 2.75 VA
Max. Power Input	DC 1.5 W AC 3.0 VA	DC 1.5 W AC 3.0 VA	DC 1.5 W AC 3.0 VA	1 Watt	DC 1.5 W AC 3.0 W
Min. Operating Power	DC 0.9 W AC 2.5 VA	DC 0.9 W AC 2.5 VA	DC 0.9 W AC 2.5 VA	250 MW	DC 0.9 W AC 2.5 VA
Nominal Operating Time	15 MS	15 MS	15 MS	10 MS	Adjustable
Nominal Release Time	10 MS	10 MS	10 MS	8 MS	25 MS
Life — Mechanical	Over 20,000,000	Over 20,000,000	Over 20,000,000	250,000	Over 20,000,000
Life — Electrical @ Rated Load	100,000 Min.				
Max. Coil Resistance	10,000 Ohms	10,000 Ohms	10,000 Ohms	8000 Ohms	7000 Ohms
Mountings	Solder Lug/Stud Octal Plug, PC	Solder Lug, Quick Connect, Plug In	Solder Lug, Quick Connect, Plug In	Solder Lug/ Mtg. Brkt., PC	Octal Plug
Approx. Weight	Open 2.3 oz. Closed 3.0 oz.	Open 2.3 oz. Closed 3.0 oz.	Open 2.3 oz. Closed 3.0 oz.	1.2 oz.	6 oz.
Class Number	240.10	240.09	240.11	240.06	240.10

For additional Relay engineering literature, write to Relay Manager, Cornell-Dubilier, 150 Avenue L, Newark, New Jersey 07101.

CDE CORNELL-DUBILIER 150 Avenue L, Newark, N. J. 07101

COTO REED COILS

	END DRAWING (Actual Size)	TYPE	DIMENSIONS Nominal	D.C. VOLTS	RESIS. Ohms Nominal	COIL CURRENT mA	mW Nominal	AMP/TURNS Nominal	REED SWITCHES No. REEDS	REED TYPES	CONTACT FORMS
MINIATURE		U	OD .375 Lg .800 ID .140	6 12 24 32 48	150 625 2500 4000 8600	40 20 9.6 8 5.5	240	125	1 1	1 or 2 3	1A 1C
		UF	Ht .437 Wd .375 Lg .800 ID .140								
		UD	Ht .375 Wd .500 Lg .800 ID .140 x .287	6 12 24 32 48	86 350 1320 2250 5500	69.7 34 18 14.2 8	400	125	3 2 2 2 2 2	1 1 1 1 2 3	3A 2B* 1A & 1B* 1C* 2A 2C
		UT	Ht .350 Wd .710 Lg .725 ID .130 x .500	6 12 24 32 48	85 340 1300 2550 5300	70.5 35.2 18.4 12.5 9	420	105	6 5 5 5 4 4 4	*1 1 1 1 1 2 3	6A 5A 4A & 1B* 3A & 2B* 4B* 4A 4C
MICRO-MINIATURE		UM	OD .300 Lg .400 ID .090	3 6 12 24	55 215 850 3500	55 28 14 7	170	70	1	7	1A
		UMM	OD .290 Lg .435 ID .112	3 6 12 24	55 215 850 3500	55 28 14 7	170	70	1	8 or 9	1A or 1C
		UMD	Ht .200 Wd .315 Lg .450 ID .071x .168	3 6 12 24	40 150 600 2400	75 40 20 10	240	70	1 2 1	8 8 8 & 9	1B* 2A 1A & 1C
STANDARD		SR	OD .500 Lg 2.00 ID .220	6 12 24 32 48	113 450 1650 2840 5890	53 26.5 14.5 11 8.2	330	200	1 1	4 or 5 6	1A 1C
		SF	Ht .500 Wd .500 Lg 2.00 ID .220								
		SD	Ht .500 Wd .720 Lg 2.00 ID .220 x .440	6 12 24 32 48	84 335 1290 2165 5700	66 36 18.5 15 8.5	430	200	1 2 2 2	4 or 5 4, 5, 6 5 & 6 4 & 6	1B* 2A or 2C 1A & 1C 1A & 1C
		SG3	Ht .500 Wd 1.00 Lg 2.00 ID .220 x .660	6 12 24 32 48	52 205 850 1430 3800	86 58.5 28 22 13	700	210	2 3	4 or 5 4, 5, 6	2B* 1B & 1A* 3A or 3C 1A & 2C 2A & 1C
		SH4	Ht .750 Wd 1.375 Lg 2.00 ID .220 x .800	6 12 24 32 48	40 160 650 1090 2500	150 75 37 29.4 19	900	260	4 3	4, 5, 6 4 or 5	4A or 4C 1A & 3C 2A & 2C 3A & 1C 2B & 1A* 1B & 2A*
		SJ5	Ht .750 Wd 1.500 Lg 2.00 ID .220 x 1.020	6 12 24 32 48	33 130 520 830 1950	182 92 46 38 24	1150	280	5 4	4, 5, 6* 4 or 5	5A or 5C 1A & 4C 2A & 3C 3A & 2C 4A & 1C 2B & 2A* 1B & 3A*
		SK6	Ht .750 Wd 1.750 Lg 2.00 ID .220 x 1.220	6 12 24 32 48	25 100 400 680 1575	240 120 60 47 30	1450	310	6 5	4, 5, 6 4 or 5	6A or 6C 1A & 5C 2A & 4C 3A & 3C 4A & 2C 5A & 1C 4B* 2B & 3A* 1B & 4A*
COMPACT		SP	OD .470 Lg 1.450 ID .220	6 12 24 32 48	150 600 2400 4000 9200	40.6 20 10 8 5.2	250	150	1	5 or 6	1A or 1C
		SPF	Ht .500 Wd .470 Lg 1.450 ID .220								
		SE	Ht .625 Wd .812 Lg 1.450 ID .220 x .450	6 12 24 32 48	117 433 1610 2740 7200	51 28 14.9 11.6 6.7	350	160	2 1 2	5 or 6 5 5 & 6	2A or 2C 1B* 1A & 1C
		SEF	Ht .655 Wd .812 Lg 1.450 ID .220 x .450								
		T	Ht .500 Wd .875 Lg .690 ID .136 x .490	6 12 24 32 48	100 400 1600 2800 5800	60 30 15 11.4 8.2	350	125	6 5 4	1 1 2 or 3	6A 5A 4A or 4C
		UH	Ht .875 Wd 1.375 Lg .718 ID .250x .750	6 12 24 32 48	45 180 720 1400 2640	133 67 33 23 18	800	200	Combinations to 23 12	 1 2	 23A 12A or 12C
OTHER		SA	OD .700 Lg 1.187 ID .320	6 12 24 32 48	65 255 965 1810 3660	92 47 25 17.6 13	575	200	Jumbo Reed Swt. Coil		
		S	OD .562 Lg 2.00 ID .220	6 12 24 32 48	105 360 1400 1930 5150	57 33 17 16.5 9.5	400	250	1 1	4 or 5 6	1A 1C
		M	OD .843 Lg 2.00 ID .468	6 12 24 32 48	50 175 820 1400 3120	120 69 29 23 15	700	250	3	4, 5, 6	3A or 3C Drive Coil for High Voltage Reed Switches—Above 10KV (Order with Bore Bushing)
		SPH	OD .470 Lg 1.450 ID .220	6 12 24 32 48	70 260 1070 1690 4000	86 46 23 19 12	575	225	Drive Coil for High Voltage Reed Switches—To 10KV		

COTO REED COILS

*Bias Magnet Required

COTO REED SWITCHES

TYPES	CONTACTS	CONT. FORM w/magnet bias	GLASS DIAMETER	GLASS LENGTH	MOUNTING POSITION	NOM. POWER RATING
1	Dry Form A	Form B	.090 Max	.800 Max	Any	10 Watt
	High Frequency A	—	.090 Max	.800 Max	Any	.3 Watt
2	Dry Form A	Form B	.130 Max	.800 Max	Any	10 Watt
	Hg/Wet A	Form B	.130 Max	.800 Max	Vert to 30°	28 Watt
	Low Thermal A	—	.130 Max	.800 Max	Any	.3 Watt
	High Isolation A	—	.130 Max	.800 Max	Any	10 Watt
3	Dry Form C	—	.130 Max	.800 Max	Any	3 Watt
4	Dry Form A	Form B	.210 Max	1.950 Max	Any	To 450 Watt
	Hg/Wet A	Form B	.210 Max	1.950 Max	Vert to 30°	50 Watt
	High Voltage	Form B	.210 Max	1.950 Max	Any	50 Watt
5	Dry Form A	Form B	.210 Max	1.425 Max	Any	To 100 Watt
6	Dry Form C	—	.218 Max	1.562 Max	Any	To 20 Watt
7	Dry Form A	Form B	.090 Max	.375 Max	Any	.3 Watt
8	Dry Form A	Form B	.070 Max	.470 Max	Any	3 Watt
9	Dry Form C	—	.070 x .110 Max	.435 Max	Any	.1 Watt

Dimensions subject to change without notice.

The above listing of magnetic reed switches does not constitute a complete listing of all switches commercially available to fit Coto Coil reed relay coils. It does indicate the most common types and sizes manufactured by various companies. Coto's sales department will be pleased to assist you in recommending a source for your switch requirements or supplying the complete relay for your application.

SEE PAGE OPPOSITE FOR COMPLETE REED RELAYS

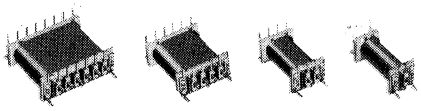
COTO-COIL CO., INC.

57 PAVILION AVE.,
PROVIDENCE, R. I. 02905

Telephone (401) 467-4777

Export Dept.: 13 E. 40th St.,
New York, N. Y. 10016

COTO-COIL MINIATURE REED RELAYS



Series 1000
Dry and Mercury-Wetted

Contact ratings are maximum for resistive loads only and no single parameter should be exceeded.				
TYPE REED	CONTACT (CLOSED) RATING	CONTACT (CLOSED) RES. (OHMS)	CONTACT (OPEN) INS. RES. (OHMS)	CONTACT (OPEN) CAP. (pF)
A-B (DRY)	10W DC/12 VA AC (200V or 500mA)	.10	10^{10} MIN.	.2 NOM.
C (DRY)	3W DC/4 VA AC (50V or 250mA)	.15	10^{9} MIN.	.8 NOM.
A-B (Hg)	28W DC/30VA AC (125V or 1 AMP)	.05	10^{5} MIN.	.3 NOM.

DRY REED TYPES

Contact Form	Nominal Volts	mW	Res. Ohms	PART NO.	D.W.G.	Pin Diagram Bottom View
1A	6	210	170	CR-1001-6	A	
	12		680	-12		
	24		2730	-24		
	32		4800	-32		
	48		10400	-48		
2A	6	340	105	CR-1002-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
3A	6	575	63	CR-1003-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
4A	6	575	63	CR-1004-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
5A	6	1000	36	CR-1005-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
6A	6	1000	36	CR-1006-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
1B *	6	340	105	CR-1021-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
2B *	6	340	105	CR-1022-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
4B *	6	575	63	CR-1024-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
1C * †	6	220	105	CR-1041-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
2C * †	6	360	63	CR-1042-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
3C * †	6	650	36	CR-1043-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
4C * †	6	650	36	CR-1044-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
1A-1B * ‡	6	340	105	CR-1060-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
2A-2B * ‡	6	575	63	CR-1061-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
4A-2B * ‡	6	1000	36	CR-1062-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
1A-1C * †	6	360	63	CR-1070-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
2A-1C * †	6	575	63	CR-1071-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
2A-2C * †	6	650	36	CR-1072-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
Hybrid 1C (1A-1B) * †	6	340	105	CR-1080-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
Hybrid 2C (2A-2B) * †	6	575	63	CR-1081-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		

*These relays contain bias magnets and correct input polarity must be observed. Red terminal indicates (+) coil input.
**These relays carry true Form C switches.
†Positive break before make for Form C switching when joined as pairs.
‡Break before make not guaranteed.

The Coto Series 1000 Miniature PCB Reed Relays offer the most comprehensive choice of switching parameters with pin terminations on the popular grid pattern of 1" x .015". Included are 21 contact combinations of Form A, B and C dry reeds and 11 combinations of Form A and B in mercury wetted types. The latter offer greatly expanded switching capability, and eliminate all contact bounce. Up to 6 poles per relay and 5 standard coil voltages are optional. In addition, special purpose reed switches, windings and terminal pin options, electrostatic and magnetic shielding may be specified.

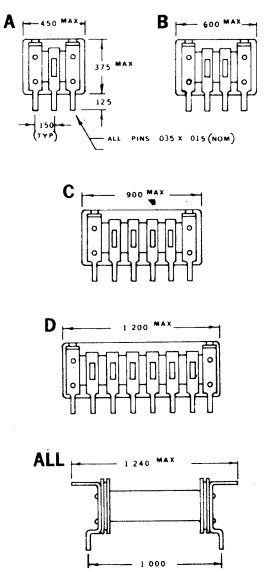
Drive coil windings have been carefully optomized to assure fast contact transfer. This is particularly important in relays carrying several reeds, since the first to close shunts out a disproportionate percent of flux unless adequate overdrive is available. Typical pull-in and drop-out is 1 mil/sec. and .5 mil/sec. respectively, including bounce and coil rise and fall time. Hg wetted reeds are somewhat slower, averaging 2 mil/sec. and 1 mil/sec. Operate times are exclusive of any delay introduced by contact protection devices. Reactive or high inrush loads will require contact protection, as with any type relay if maximum reliability and life are to be realized.

For information on contact protection request Technical Bulletin No. CS-1. For engineering assistance address Sales Engineering Dept. and include full details.

MERCURY-WETTED TYPES (Must be mounted within 35° of vertical)

Contact Form	Nominal Volts	mW	Res. Ohms	PART NO.	D.W.G.	Pin Diagram Bottom View
1A	6	210	170	CR-1101-6	A	
	12		680	-12		
	24		2730	-24		
	32		4800	-32		
	48		10400	-48		
2A	6	340	105	CR-1102-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
3A	6	575	63	CR-1103-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
4A	6	575	63	CR-1104-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		
5A	6	1000	36	CR-1105-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
6A	6	1000	36	CR-1106-6	D	
	12		144	-12		
	24		576	-24		
	32		1030	-32		
	48		2300	-48		
1B *	6	340	105	CR-1121-6	B	
	12		420	-12		
	24		1680	-24		
	32		2950	-32		
	48		6720	-48		
2B *	6	575	63	CR-1122-6	C	
	12		250	-12		
	24		1000	-24		
	32		1760	-32		
	48		4000	-48		

*These relays contain bias magnets and correct input polarity must be observed. Red terminal indicates (+) coil input.



COTO-COIL CO., INC.
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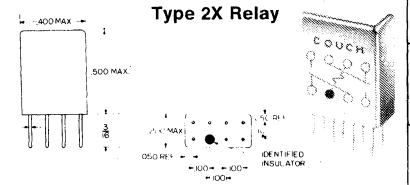
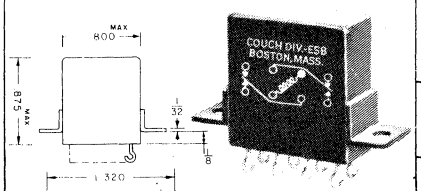
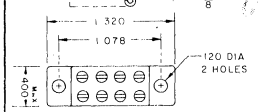
ROTARY RELAYS and MULTIPOLE ROTARY SWITCHES

For Industrial and Military Applications

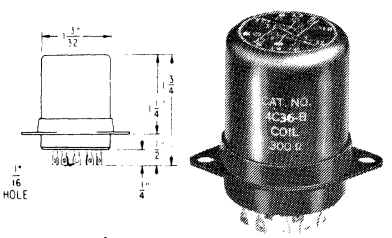
Type 2X Relay



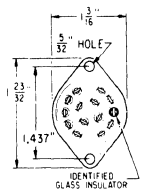




Type 2R Relay



Type 4C36B



One of six standard mounting styles

1/7th SIZE CRYSTAL CAN RELAYS*

Catalog Number	Coil Resistance	Max. Pull-In Current	Min. Drop-Out Current	Max. Pull-In Voltage	Nom. Oper. Voltage
2X10B430-A	100 ohms	32 MA	2.7 MA	3.6 volts	6.6 volts
2X10B460-A	400	16	1.3	7.1	13.2
2X10B490-A	1500	8.0	0.67	13.0	26.5
1X07B435-A	125	24	2.0	3.3	6.6
1X07B465-A	500	12	1.0	6.5	13.2
1X07B495-A	2000	6.0	0.50	13	26.5

Temperature: —65°C to +125°C
Vibration: 30G to 3000 Hz
Shock: 100G for 11 ms
Contact Rating: 1.0 amp, 30 VDC, resistive load
Pull-In Sensitivity: 2X, 100 mw; 1X, 70 mw
Dielectric Strength: 500 VRMS

FULL-SIZE CRYSTAL CAN RELAYS*

One Size – Four Different Sensitivities

2R25A420-B	625	19	1.9	13.0	24-30
2R10A440-B	1500	8.2	.82	13.6	24-47
2R04A460-B	4000	3.2	.32	14.1	24-76
2R02A470-B	6250	2.0	.20	13.8	24-94

Temperature: —65°C to +125°C
Vibration*: 15G-30G to 2000 Hz
Shock*: 50G-100G for 11 ms
Contact Rating*: 1.0-3.0 amps; 30 VDC resistive load
Pull-in Sensitivity: 25 to 250 mw
Dielectric Strength*: 500-1000 VRMS

*Value depends upon pull-in sensitivity.

SUB-MINIATURE ROTARY RELAYS*

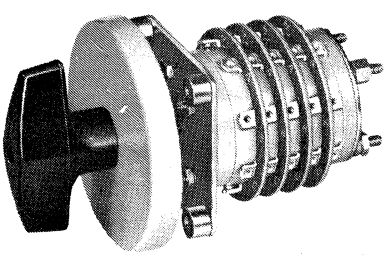
4C36-B	300	41	5.1	13.0	26.5
2B36-B	300	41	5.1	13.0	26.5

Temperature: —65°C to +125°C
Vibration: 30G to 3000 Hz
Shock: 100G for 11 ms
Contact Rating: 4C, 5 amp; 2B, 10 amp
Pull-In Sensitivity: 500 mw
Dielectric Strength: 1000 VAC

***ALL RELAYS AVAILABLE IN A WIDE VARIETY OF TERMINALS, COILS AND MOUNTINGS**

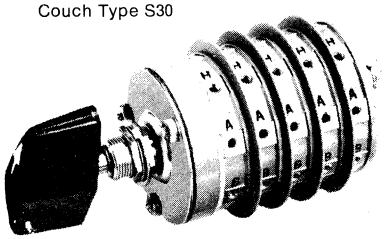
MULTIPOLE ROTARY SWITCHES

STYLE SJR SWITCH
Couch Type S10

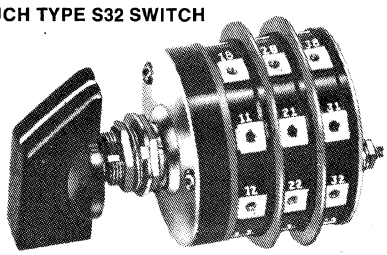


SJR and SJL switches are built in accordance with U.S. Navy drawings and are listed in the Qualified Products List of MIL-S-21604. These switches are extremely reliable under severe environmental conditions. Detailed data sheets give specifications for the many variations available. Write for them.

STYLE SJL SWITCH
Couch Type S30



COUCH TYPE S32 SWITCH



Type S32 is a 15 amp multipole rotary switch offered in a wide variety of circuit sequences for instrument, selector and control applications. A typical application is in voltmeter-ammeter switching circuits for which it can be supplied prewired. It has double-wipe, self-cleaning silver plated contacts enclosed within phenolic sections for high reliability and long life.

Type S32 Specifications

Ratings: 15A – 600V carry
10A – 125 VAC, 60 – 400 Hz
Make and break
Positions: Positive action, 8 positions
Sections: 1 to 12
Poles: 1 to 24
Dielectric: Strength: 2200 VRMS min.
Action: Break-before-make (non-shorting) and Make-before-break (shorting)

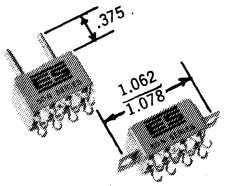
S. H. COUCH DIVISION
ESB INCORPORATED

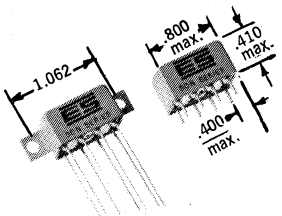
36 RIVER STREET, BOSTON, MASSACHUSETTS 02126
TELEPHONE (617) 298-4147

ELECTRONIC SPECIALTY DIVISION
DATRON SYSTEMS INC. / 18900 N.E. Sandy Blvd. / Portland, Oregon 97220 / (Area Code 503) 665-0121 / TWX 910-469-8782

50N

50N SERIES, HALF SIZE TYPE
2PDT / 250 MW PICK-UP / DRY-CIRCUIT TO 2 AMP LOADS / WELDED SEAL



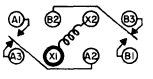


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Voltage +125°C	+25°C	Adjustment Schedule	Prices 1-24	25-49
50N	6.0	40	4.2	3.0	A 250 mw	11.50	10.50
	12.0	150	8.3	6.0			
	26.5	700	18.0	13.0			
	48.0	2500	33.9	24.5			
	110.0	10000	69.3	50.0			

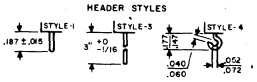
SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 100 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Rating ..... 2.0 Amperes at 28 VDC
Operate Time ..... 4.0 Milliseconds maximum
Release Time ..... 4.0 Milliseconds maximum

These balanced-armature, half-size crystal can hermetically-sealed relays are especially designed for applications demanding fast operating relays with dry-circuit to 2 ampere switching capability. The 50N series is QPL to MIL-R-5757F (M5757/9).



HEADER STYLES



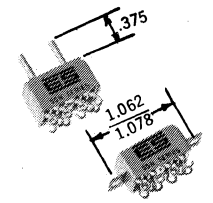
HOW TO ORDER

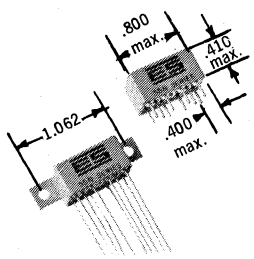
50G B 0 N - 1 - A 700

- 700 — COIL RESISTANCE
- A — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- N — CONTACTS: "N" Resilient Bifurcated Construction.
- 0 — MOUNTING ARRANGEMENTS
  - 0—Plain Shell 1—2 Top Studs 3/8"
  - 2—Flange—4 Hole—Up 1/8"
  - 3—Side Bracket
  - 5—Flange—2 Hole—Up 1/8"
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 50G — SERIES TYPE (2PDT General Purpose)

55N

55N SERIES, HALF SIZE SENSITIVE LATCHING TYPE
2PDT / 90 MW TRANSFER / DRY-CIRCUIT TO 2 AMP LOADS / WELDED SEAL



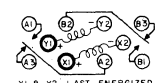


Series	Nominal Voltage	Coil Resistance	Max. Transfer Voltage +125°C	+25°C	Adjustment Schedule	Prices 1-24	25-49
55N	3.0	25	2.1	1.5	A 90 mw	30.00	27.00
	6.0	100	4.2	3.0			
	9.0	300	6.9	5.0			
	12.0	500	9.3	6.7			
	26.5	1800	17.6	12.7			

SPECIFICATIONS

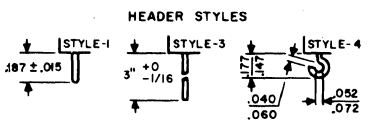
Ambient Temperature ..... −65°C to +125°C
Shock ..... 100 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 2.0 Amperes
Operate and Reset Time ..... 5.0 MSEC maximum

These separate-coil, balanced armature, half-size crystal-can sensitive, hermetically-sealed relays are especially designed for applications demanding fast latching relays with dry-circuit to 2 ampere switching capability. The 55N series is QPL to MIL-R-5757F (M5757/76).



Y1 & Y2 LAST ENERGIZED

HEADER STYLES



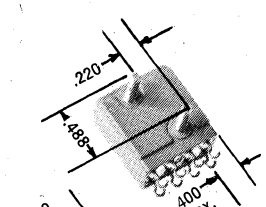
HOW TO ORDER

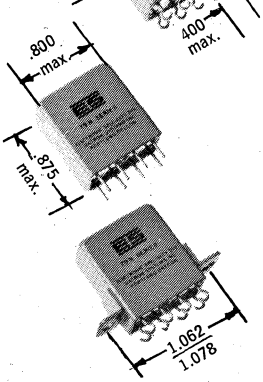
55G B 0 N - 1 - A - 1.8K

- 1.8K — COIL RESISTANCE
- A — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- N — CONTACTS: "N" Resilient Bifurcated Construction.
- 0 — MOUNTING ARRANGEMENTS:
  - 0—Plain Shell 1—2 Top Studs 3/8"
  - 2—Flange—4 Hole—Up 1/8"
  - 3—Side Bracket
  - 5—Flange—2 Hole—Up 1/8"
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 55G — SERIES TYPE (2PDT Latching)

79N

79N SERIES, CRYSTAL CAN TYPE
2PDT / 250 MW PULL-IN / DRY-CIRCUIT TO 3 AMP LOADS / WELDED SEAL



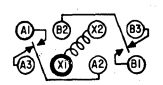


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Voltage +125°C	+25°C	Adjustment Schedule	Prices 1-24	25-49
79N	6.0	35	4.2	3.0	A 250 mw	8.00	7.00
	12.0	140	8.2	5.9			
	26.5	600	17.3	12.9			
	32.0	1000	22.0	15.9			
	48.0	2500	33.9	24.5			
	110.0	10,000	69.3	50.0			

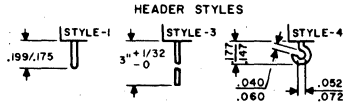
SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 100 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 3.0 Amperes
Operate Time ..... 5.0 Milliseconds maximum
Release Time ..... 5.0 Milliseconds maximum

These balanced-armature, crystal-can, hermetically-sealed relays are especially designed for applications demanding fast operating relays with dry-circuit to 3 ampere switching capability. The 79N series is QPL to MIL-R-5757F (M5757/10).



HEADER STYLES



HOW TO ORDER

79G B 0 N - 1 - A - 600

- 600 — COIL RESISTANCE
- A — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- N — CONTACTS: "N" Resilient Bifurcated Construction
- 0 — MOUNTING ARRANGEMENTS:
  - 0—Plain Shell
  - 3—Side Bracket
  - 4—2 Side Studs 3/8"
  - 5—Flange—Up 1/8"
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 79G — SERIES TYPE (2PDT General Purpose)

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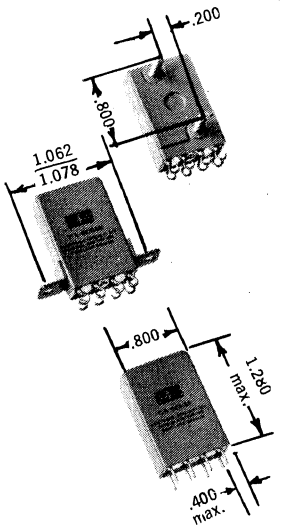
71N 71N SERIES, MICRO-MINIATURE SENSITIVE TYPE

2PDT / 40 MW PULL-IN / DRY-CIRCUIT TO 2 AMP LOADS / WELDED SEAL

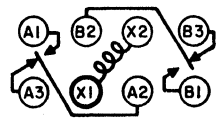


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Current −65°C- +125°C	Min. Drop-Out Current −65°C- +125°C	Adjustment Schedule	Prices 1-24	Prices 25-49
71N	3.6	100	20.0	2.00	A 40 mw	13.50	10.00
	6.0	200	14.2	1.42			
	9.0	500	9.0	0.90			
	12.0	1000	6.3	0.63			
	26.5	5000	2.8	0.28			

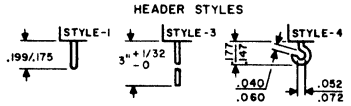
SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 2.0 Amperes
Operate Time ..... 15.0 Milliseconds maximum
Release Time ..... 10.0 Milliseconds maximum

These balanced-armature, micro-miniature, sensitive, hermetically-sealed relays are especially designed for applications requiring low coil power input with dry-circuit to 2 ampere switching capability. Meet and exceed the requirements of MIL-D-5757F (M5757/13).



HEADER STYLES



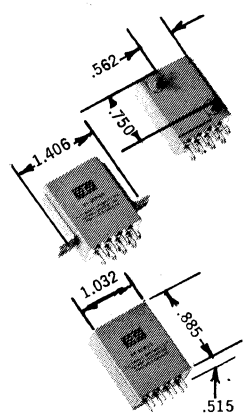
HOW TO ORDER

71G B 0 N - 1 - A 5K

- 5K — COIL RESISTANCE
- A — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- N — CONTACTS: "N" Resilient Construction
- 0 — MOUNTING ARRANGEMENTS: 0—Plain Shell; 3—Side Bracket; 4—2 Side Studs 3/8"; 5—Flange—Up 1/8"
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 71G — SERIES TYPE (2PDT Sensitive)

93* 93 SERIES, MICRO-MINIATURE HIGH CURRENT TYPE

2PDT / 500 MW PULL-IN / 10 AMPERE LOADS



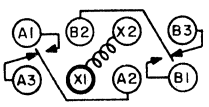
Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Voltage +125°C	Max. Pick-Up Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
93	6.0	16	4.35	3.0	X 500 mw	18.75	16.50
	12.0	65	8.35	5.8			
	26.5	300	18.0	12.5			
	48.0	950	37.0	22.0			
	110.0	5500	75.0	53.0			

SPECIFICATIONS

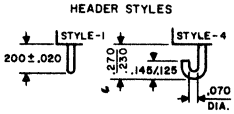
Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's for 11.0 ±1.0 Millisecond
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 10.0 Amperes
Operate Time ..... 7.0 Milliseconds maximum
Release Time ..... 3.0 MSEC. maximum

These balanced-armature microminiature, hermetically-sealed relays are especially designed for applications requiring low coil power input with 10 ampere switching capability. Meet and exceed the requirements of MIL-R-5757F (M5757/23).

*Also available in Latching Series 94.



HEADER STYLES



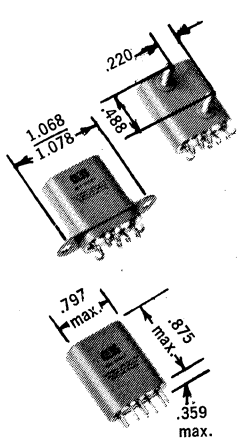
HOW TO ORDER

93G B 0 - 1 - X - 300

- 300 — COIL RESISTANCE
- X — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- 0 — MOUNTING ARRANGEMENTS: 0—Plain Shell; 3—Side Bracket; 4—2 Side Studs 3/8"; 61—Flange—Up 1/4
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 93G — SERIES TYPE (2PDT High Current)

68N 68N SERIES, CRYSTAL CAN TYPE

2PDT / 300 MW PULL-IN / DRY-CIRCUIT TO 2 AMP LOADS

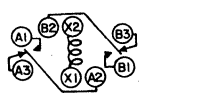


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Voltage +125°C	Max. Pick-Up Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
68N	6.0	35	4.4	3.2	A 300 mw	12.00	10.00
	12.0	140	9.0	6.5			
	26.5	552	18.0	13.0			
	72.0	5000	53.7	38.8			
	110.0	10,000	76.2	55.0			

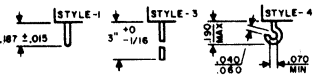
SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's
Contact Life ..... 100,000 operations
Vibration ..... 30 G's maximum
Contact Ratings ..... 3.0 Amperes
Operate Time ..... 5.0 Milliseconds maximum
Release Time ..... 5.0 Milliseconds maximum

These balanced-armature crystal-can, hermetically-sealed relays are especially designed for applications demanding fast operating relays with 2 amperes switching capabilities. Meet and exceed the requirements of MIL-R-5757D.



HEADER STYLES



HOW TO ORDER

68G B 0 N - 1 - A - 552

- 552 — COIL RESISTANCE
- A — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- N — CONTACTS: "N" Resilient Bifurcated Construction
- 0 — MOUNTING ARRANGEMENTS: 0—Plain Shell; 3—Side Bracket; 4—2 Side Studs 3/8"; 5—Flange—Up 1/8"
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 68G — SERIES TYPE (2PDT General Purpose)

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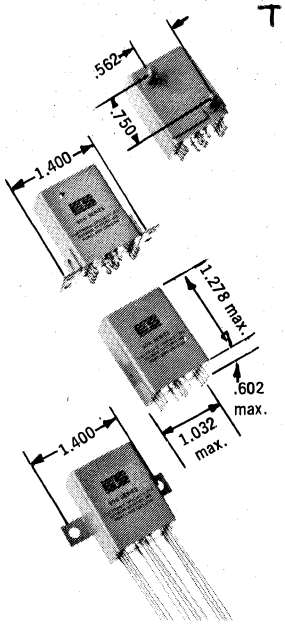
90N 90N SERIES, MICRO-MINIATURE SENSITIVE TYPE

4PDT / 80 MW PULL-IN / DRY-CIRCUIT TO 3 AMP LOADS

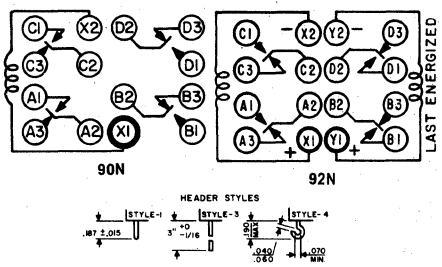


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Current −65°C to +125°C	Min. Drop-Out Current −65°C to +125°C	Adjustment Schedule	Prices 1-24	Prices 25-49
90N	6.0	100	28.3	2.83	A 80 mw	35.00	32.00
	9.0	200	20.0	2.00			
	12.0	500	12.6	1.26			
	26.5	2000	6.3	0.63			
	48.0	8000	3.1	0.31			

SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 3.0 Amperes
Operate Time ..... 20.0 Milliseconds maximum (90N)
Release Time ..... 5.0 Milliseconds maximum (90N)
Operate and Reset Time ..... 9.0 Milliseconds maximum (92N)

These balanced-armature, microminiature, hermetically-sealed relays are especially designed for applications requiring low coil power input with dry-circuit to 3 ampere switching capabilty. Meet and exceed the requirements of MIL-R-5757D.



Series	Nominal Voltage	Coil Resistance	Max. Transfer Voltage +125°C	Max. Transfer Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
92N	3.6	50	2.8	2.0	A 80 mw	45.00	42.00
	6.0	100	3.9	2.8			
	9.0	250	6.2	4.5			
	12.0	500	8.7	6.3			
	26.5	2000	17.5	12.6			

HOW TO ORDER

90H
92H **B** **0** **N** - **1** - **A** - **2K**

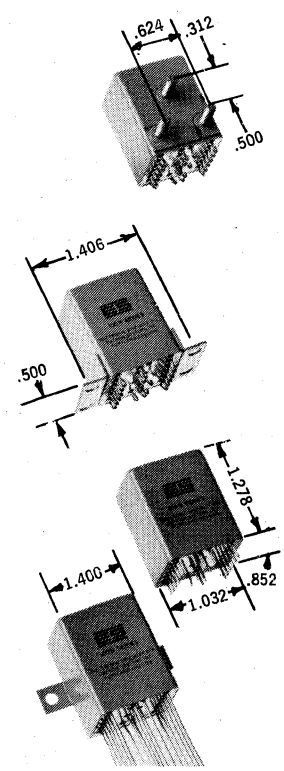
- **2K** — COIL RESISTANCE
- **A** — ADJUSTMENT SCHEDULE
- **1** — HEADER STYLE
- **N** — CONTACTS: "N" Resilient Bifurcated Construction
- **0** — MOUNTING ARRANGEMENTS: 0 — Plain Shell; 3 — Side Bracket; 4 — 2 Side Studs 3/8"; 16 — Flange — Bottom Flush
- **B** — CLASS B TEMPERATURE (−65°C to +125°C)
- **90H / 92H** — SERIES TYPE (4PDT Sensitive Latching)

92N 92N SERIES, MICRO-MINIATURE SENSITIVE LATCHING TYPE

4PDT / 80 MW TRANSFER / DRY-CIRCUIT TO 3 AMP LOADS

100N 100N SERIES, MICRO-MINIATURE SENSITIVE TYPE

6PDT / 150 MW PULL-IN / DRY-CIRCUIT TO 3 AMP LOADS

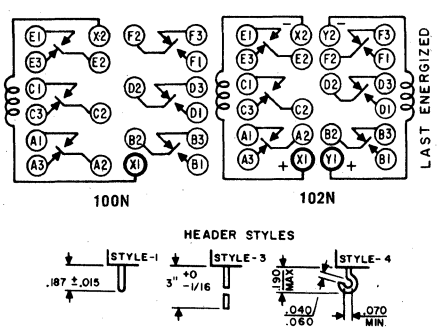


Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Current −65°C- +125°C	Min. Drop-Out Current −65°C to +125°C	Adjustment Schedule	Prices 1-24	Prices 25-49
100N	3.6	20	86.6	8.66	A 150 mw	46.00	37.00
	6.0	50	54.8	5.48			
	9.0	100	38.7	3.87			
	12.0	200	27.4	2.74			
	26.5	1000	12.2	1.22			
	48.0	4000	6.1	0.61			

SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 3.0 Amperes
Operate Time ..... 18.0 Milliseconds maximum above (100N)
Release Time ..... 5.0 Milliseconds maximum (100N)
Operate and Reset Time ..... 8.0 Milliseconds maximum (102N)

These microminiature, hermetically-sealed relays are especially designed for applications requiring low coil power input with dry-circuit to 3 ampere switching capability. Meet and exceed the requirements of MIL-R-5757D.



Series	Nominal Voltage	Coil Resistance	Max. Transfer Voltage +125°C	Max. Transfer Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
102N	3.6	25	2.6	1.9	A 150 mw	54.00	48.00
	6.0	50	3.7	2.7			
	9.0	100	5.4	3.9			
	12.0	250	8.5	6.1			
	26.5	1000	17.0	12.3			
	48.0	4000	33.9	24.5			

HOW TO ORDER

100J
102J **B** **0** **N** - **1** - **A** - **1K**

- **1K** — COIL RESISTANCE
- **A** — ADJUSTMENT SCHEDULE
- **1** — HEADER STYLE
- **N** — CONTACTS: "N" Resilient Bifurcated Construction
- **0** — MOUNTING ARRANGEMENTS: 0 — Plain Shell; 3 — Side Bracket; 17 — 3 Side Studs 3/8"; 16 — Flange — Bottom Flush
- **B** — CLASS B TEMPERATURE (−65°C to +125°C)
- **100J / 102J** — SERIES TYPE (6PDT Sensitive Latching)

102N 102N SERIES, MICRO-MINIATURE SENSITIVE LATCHING TYPE

6PDT / 150 MW TRANSFER / DRY-CIRCUIT TO 3 AMP LOADS

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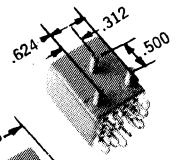
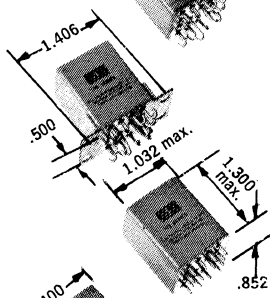
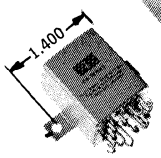
103

103 SERIES, MICRO-MINIATURE HIGH CURRENT TYPE

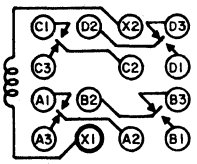
4PDT / 1000 MW PULL-IN / 10 AMP LOADS



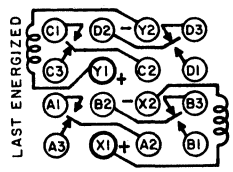




Series	Nominal Voltage	Coil Resistance	Max. Pick-Up Voltage +125°C	Max. Pick-Up Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
103	6.0	8	4.35	3.0	X 1000 mw	37.00	29.00
	12.0	32	8.35	5.8			
	26.5	150	18.0	12.5			
	48.5	475	37.0	22.0			
	110.0	2750	75.0	53.0			



103

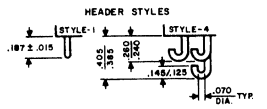


104

SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 50 G's
Contact Life ..... 100,000 operations
Vibration ..... 20 G's maximum
Contact Ratings ..... 10.0 Amperes
Operate Time ..... 8.0 Milliseconds maximum (103)
Release Time ..... 5.0 Milliseconds maximum (103)
Operate and Reset Time ..... 9.0 Milliseconds maximum (104)

These balanced-armature micro-miniature, hermetically-sealed relays are especially designed for applications requiring low coil power input with 10 ampere switching capability. Meet and exceed the requirements of MIL-R-5757D, type designation RY-4XX4B4.



HOW TO ORDER

103H
104H **B 0 - 1 - X - 250**

- 250 — COIL RESISTANCE
- X — ADJUSTMENT SCHEDULE
- 1 — HEADER STYLE
- 0 — MOUNTING ARRANGEMENTS: 0—Plain Shell, 3—Side Bracket, 17—3 Side Studs 3/8", 16—Flange—Bottom Flush
- B — CLASS B TEMPERATURE (−65°C to +125°C)
- 103H / 104H — SERIES TYPE (4PDT High Current Latching)

Series	Nominal Voltage	Coil Resistance	Max. Transfer Voltage +125°C	Max. Transfer Voltage +25°C	Adjustment Schedule	Prices 1-24	Prices 25-49
104	3.0	10	2.4	1.7	A 300 mw	45.00	38.00
	9.0	60	6.0	4.3			
	12.0	125	8.5	6.1			
	26.5	500	17.0	12.3			
	72.0	5000	53.7	38.8			

104

104 SERIES, MICRO-MINIATURE HIGH CURRENT LATCHING TYPE

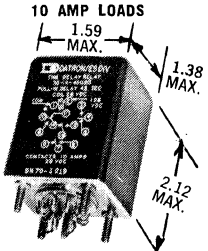
4PDT / 300 MW TRANSFER / 10 AMP LOADS

30

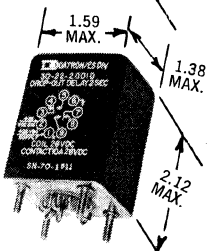
30 SERIES TIME DELAY, 2 AND 10 AMP CONTACT LOADS

1PDT - 4PDT DELAY OPERATE/RELEASE

10 AMP LOADS

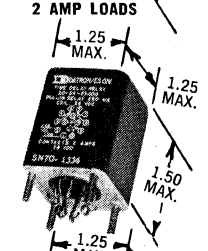


4PDT

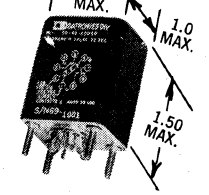


2PDT

2 AMP LOADS



4PDT



2PDT

SPECIFICATIONS

10 AMP LOADS
30-1 Series, Delay on Operate Relay
30-2 Series, Delay on Release Relay

5.5 Ounces Maximum
Black Lacquer
30 G's for 11.0 ±1.0 Milliseconds
50,000 Operations Min., 100,000 Operations Available..
10 G's 5 to 500 Hz
80,000 Ft.
500 VRMS (Coil Circuit to Case), 1000 VRMS (All Other Combinations)
18 to 30 VDC
28 VDC
50 Milliseconds Maximum
2.0 Milliseconds Maximum
−55°C to +125°C
±5% at 25°C, 18 to 30 VDC
±10% Over Entire Range of Rated Voltage and Temperature
0.2 to 180 Seconds, Fixed
Mil - STD - 704

50 Milliseconds Maximum to Repeat Delay within 90% of First Cycle

A. 30-11, 30-12: 100 Milliamperes
B. 30-13, 30-14: 200 Milliamperes
C. 30-21, 30-22: 100 Milliamperes, Supply; 20 Milliamperes, Signal
D. 30-23: 200 Milliamperes, Supply; 30 Milliamperes, Signal

2 AMP LOADS
30-3 Series, Delay on Operate Relay
30-4 Series, Delay on Release Relay

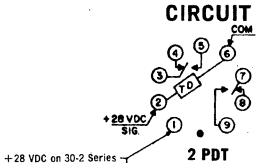
Weight ..... 4.0 Ounces Maximum
Case Finish ..... Black Lacquer
Shock ..... 30 G's for 11.0 ±1.0 Milliseconds
Contact Life ..... 100,000 Operations Minimum
Vibration ..... 10 G's 5 to 500 Hz
Altitude ..... 80,000 Ft.
Dielectric Strength ..... 500 VRMS (Coil Circuit to Case and Open Contacts), 1000 VRMS (All Other Combinations)
Operating Voltage ..... 18 to 30 VDC
Nominal Voltage ..... 28 VDC
Release Time ..... 50 Milliseconds Maximum
Contact Bounce ..... 2.0 Milliseconds Maximum
Operating Temp. Range ..... −55°C to +125°C
Timing Tolerance ..... ±5% at 25°C, 18 to 30 VDC and Temperature
Time Delay Range ..... ±10% Over Entire Range of Rated Voltage
Transient Voltage Protected Per ..... 0.2 to 90 Seconds, Fixed
..... MIL - STD - 704

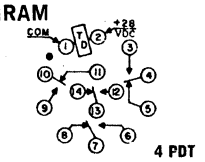
Recycle Time ..... 50 Milliseconds Maximum to Repeat Delay within 90% of First Cycle

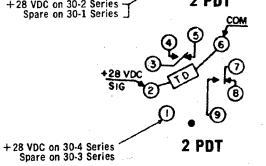
Max. Operating Current at 28 VDC, 25°C

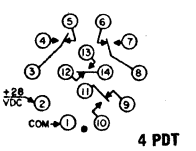
A. 30-31, 30-32: 75 Milliamperes
B. 30-33, 30-34: 100 Milliamperes
C. 30-41, 30-42: 75 Milliamperes, Supply; 5 Milliamperes, Signal
D. 30-43: 100 Milliamperes, Supply; 5 Milliamperes, Signal

CIRCUIT DIAGRAM









HOW TO ORDER

10 AMP LOADS

30 - 12 - 750 1 0

- 0 — SPECIAL REQUIREMENTS: 0 is Standard, 125°C; 9 is −54°C to +105°C; 8 is −54°C to +85°C
- 1 — NUMBER OF ZEROS FOLLOWING (Time Multiplier)
- 750 — OPERATE TIME IN MILLISECONDS
- 12 — NUMBER OF POLES
- 30 — 30-1 DELAY ON OPERATE (10 amp contacts); 30-2 DELAY ON RELEASE (10 amp contacts); 30-3 DELAY ON OPERATE (2 amp contacts); 30-4 DELAY ON RELEASE (2 amp contacts)

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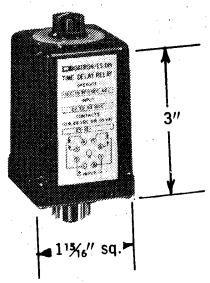
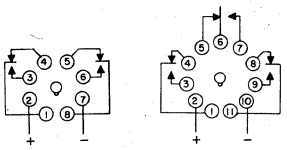
25 SERIES, TIME DELAY

2PDT / 3PDT 10 AMP LOAD

Series	Nominal	Input Voltages and Limits: Minimum	Maximum	Steady State Nom. Current	Prices: 1-9	10-24
25	24 VAC	20 VAC	28 VAC	20 MA	21.50	18.50
	120 VAC	105 VAC	130 VAC	35 MA		
	220 VAC	208 VAC	330 VAC	35 MA		
	24 VDC	20 VDC	32 VDC	20 MA		
	48 VDC	41 VDC	55 VDC	20 MA		





SPECIFICATIONS

Temperature Range ..... Operating −10°C to +55°C
Contact Rating ..... 10.0 Amperes @ 120 VRMS
Repeatability ..... ±2%
Accuracy ..... ±10%
Reset Time ..... 150 Milliseconds
Recycle Time ..... 150 Milliseconds
Polarity Protection ..... Yes
Timing Range ..... Adjustable/Fixed
.5 - 30 seconds 1.0 - 300 seconds

HOW TO ORDER

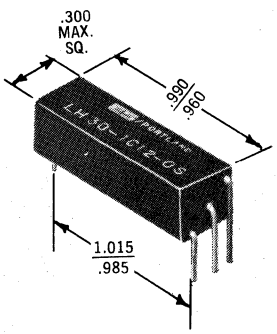
25 · 1 · 2 · 1 · A
- A — FIXED; B — ADJUSTABLE (KNOB)
- 1 — AS SPECIFIED (in seconds); 2 — .5 - 30 SECONDS; 3 — 1.0 - 300 SECONDS
- NUMBER OF POLES: 2 — 2PDT; 3 — 3PDT
- INPUT VOLTAGE: 1 — 24 VAC; 2 — 120 VAC; 3 — 220 VAC; 4 — 24 VDC; 5 — 48 VDC
- SERIES: HYDRID TIME DELAY (DELAY ON OPERATE)

LH SERIES, REED RELAY

SPST N.O. AND SPDT

COIL DATA

Nominal Coil Voltage	Coil Resistance ±10%	Max. Pick-up Voltage @ 25°C	Min. Drop-out Voltage @ 25°C
5	110	4.0	.40
6	145	4.8	.48
12	575	9.6	.96
24	1100	19.0	1.9
48	4700	38.0	3.8



SPECIFICATIONS

Temperature Range ..... −55°C to +85°C
Insulation Resistance ..... 1000 Megohms min. @ 25°C
Vibration ..... 20 G's to 2000 Hz
Shock ..... 30 G's
Capacitance ..... 2 Picofarads typ.
Contact Configuration ..... Form A (SPST N.O.)
Form C (SPDT)

Designed for low-cost switching applications, the LH series reed relay is rugged and reliable. Completely encapsulated and available, with axial leads or Radial leads (for PC mounting), for immediate shipment from stock or local distributor. Custom designs per your specifications are also available upon request.

PRINTED CIRCUIT PATTERN

LH30	LH20	LH10
LH30-1A** -0*	LH20-1A -0*	LH10-1A** -0*
E LH30-1A** -2*	E LH20-1A** -2*	E LH10-1A** -2*
LH30-1C** -0*	LH20-1C** -0*	LH10-C** -0*
E LH30-C** -2*	E LH20-1C** -2*	E LH10-1C** -2*

NOTES:
1. E: Electrostatic shield to be grounded.
2. Electromagnetic shielding is available.
3. *Contact indicator.
4. **Coil voltage indicator.

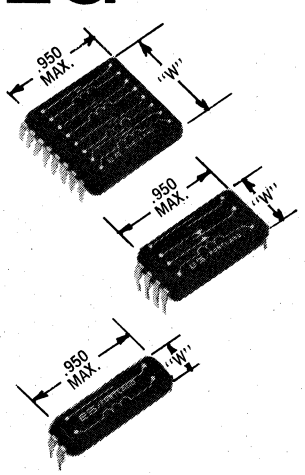
TYPICAL REED CHARACTERISTICS

Reed Capsule Designation	Contact Config.	Max. Initial Contact Rating: Amps	Power	Min. Life Expectancy (Operations x 10⁶): Rated	Low Level	Initial Contact Resistance (milliohms)	Max. Operate Time (microsec)	Max. Release Time (microsec)	Dielectric Strength Cont.-Cont. (Volts)
S	A	.500	10W	10	100	500	450	50	200
S	C	.250	3W	2	50	500	350	250	150
R	A	.500	10W	20	100	100	450	50	200
R	C	.250	3W	5	50	100	350	250	150

HOW TO ORDER

LH30 · 1 A 06 · 0 S 0
- SPECIAL INDICATOR, WHEN APPLICABLE: C — COAX SWITCH; D — DIODE COIL SUPPRESSION; H — HIGH VOLTAGE SWITCH
- REED SWITCH CONTACT MATERIAL: S — STANDARD, (.500 OHM MAX. CONT. RES.); R — SPECIAL, (.150 OHM MAX. CONT. RES.); G — GOLD; M — MERCURY; T — TUNGSTEN
- SHIELD INDICATOR: 0 — NO SHIELD; 1 — ELECTRO-MAGNETIC SHIELD; 2 — ELECTRO-STATIC SHIELD; 3 — ELECTRO-MAGNETIC & STATIC SHIELDS
- NOMINAL VOLTAGE EXPRESSED IN TWO DIGITS: 06 — 6 VDC; 12 — 12 VDC
- CONTACT FORM: A — MAKE; C — BREAK-MAKE
- NUMBER OF REED SWITCHES
- GRID SPACING: 0 — .100" CENTERS, RADIAL; 1 — .150" CENTERS, RADIAL; 2 — .200" CENTERS, RADIAL; 5 — AXIAL
- COIL PIN LOCATION: 1 — DIAGONAL; 2 — SAME SIDE, OPPOSITE ENDS; 3 — SAME END, OPPOSITE SIDES
- BASIC MODEL: LH .300 HIGH BY .990 LONG, REED RELAY WITH SELF LEADS

LG SERIES, REED RELAY



COIL SELECTION TABLE† — COIL DATA

Power (MW sensitivity)*	150	150	150	200	300
Coil Voltage (D.C.)	5	6	12	24	48

†Non-standard coil voltages and degrees of sensitivity may be specified for multiple packages that utilize common or individual coils.
*Less power consumption, through careful design and the winding of fine wire, results in greater efficiency and lower temperature rise.

SPECIFICATIONS

Temperature Range ..... −55°C to +85°C
Insulation Resistance ..... 1000 Megohms min. @ 25°C
Vibration ..... 30 G's to 2000 Hz
Shock ..... 100 G's
Overvoltage 100%

TYPICAL REED CHARACTERISTICS — LG SERIES

Reed Capsule Designation	Contact Config.	Max. Initial Contact Rating: Amps	Power	Min. Life Expectancy (Operations x 10⁶): Rated	Low Level	Initial Contact Resistance (milliohms)	Max. Operate Time (microsec)	Max. Release Time (microsec)	Dielectric Strength Cont.-Cont. (Volts)
S	A	.50	10W	20	100	100	450	50	400
S	C	.25	3W	5	50	150	350	250	250
M	A	1.0	28W	50	500	50	2000	1000	1000

WIDTH AND CONTACT CONFIGURATION

"W"	Common Coils	Individual Coils
.3	1A	1A
.4	2A 1B 1C	1B 1C
.5	3A (1A, 1C)* 2B 2C	2A
.7	4A (2A, 2C)* 5A (2A, 2B)* 3B 3C	3A (1A, 1B)* 2B (1A, 1C)*
.9	6A (3A, 2C)* 4C (1A, 3B)*	4A (1A, 2B)* 3B (1A, 2C)*
1.3	10A (5A, 2B, 1C)* 7B (4A, 2B, 2C)* 7C	6A (1A, 1B, 2C)* 1B

HOW TO ORDER

LG 30 · 2 C 12 · 0 S 0
- SPECIAL INDICATOR, WHEN APPLICABLE: C — COAX SWITCH; D — DIODE COIL SUPPRESSION; H — HIGH VOLTAGE SWITCH; L — LATCHING RELAY
- REED SWITCH CONTACT MATERIAL: S — STANDARD, .500 OHM MAX. CONTACT RES.; R — SPECIAL, .500 OHM MAX. CONTACT RES.; G — GOLD; R — RHODIUM; M — MERCURY; T — TUNGSTEN
- COIL & SHIELD: 1 — COMMON COIL & ELECTRO-MAGNETIC SHIELD; 0 — COMMON COIL, NO SHIELD; 2 — COMMON COIL & ELECTRO-STATIC SHIELD; 3 — COMMON COIL & ELECTRO-MAGNETIC & STATIC SHIELDS; 4 — INDIVIDUAL COILS, NO SHIELD; 5 — INDIVIDUAL COILS & ELECTRO-MAGNETIC SHIELD; 6 — INDIVIDUAL COILS & ELECTRO-STATIC SHIELD; 7 — INDIVIDUAL COILS & ELECTRO-MAGNETIC & STATIC SHIELDS
- NOMINAL VOLTAGE EXPRESSED IN TWO DIGITS: 06 — 6 VDC; 12 — 12 VDC
- CONTACT FORM: A — MAKE; B — BREAK; C — BREAK-MAKE
- NUMBER OF REED SWITCHES
- GRID SPACING: 0 — .100" CENTERS, RADIAL; 1 — .150" CENTERS, RADIAL; 2 — .200" CENTERS, RADIAL; 3 — .300" CENTERS, RADIAL; 4 — .400" CENTERS, RADIAL; 5 — .100" CENTERS, AXIAL; 6 — .150" CENTERS, AXIAL; 7 — .200" CENTERS, AXIAL; 9 — OTHER
- WIDTH OF RELAY IN TENTHS OF INCH
- BASIC MODEL: .285 HIGH BY 1.000 LONG, LEAD FRAME, TRANSFER MOLDED

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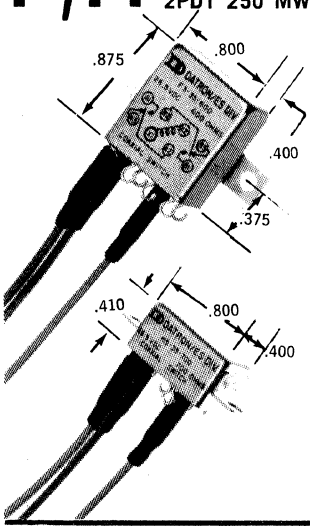
F/H

F SERIES FULL SIZE COAXIAL RELAY
H SERIES HALF SIZE COAXIAL RELAY
2PDT 250 MW PULL-IN (WELDED SEAL)



Coil Resistance DC Ohms +25°C	F SERIES FULL SIZE COAXIAL							
	Rated Operate Voltage		Maximum Pickup Voltage		Maximum Drop-Out Voltage		Minimum Drop-Out Voltage	
	Nom.	Max.	+125°C	+25°C	+125°C	+25°C	+25°C	−65°C
35	6.0	7.9	4.2	3.0	2.1	1.5	0.5	0.3
140	12.0	16.0	8.2	5.9	4.2	3.0	1.0	0.6
600	26.5	32.2	17.3	12.5	8.7	6.3	2.3	1.5

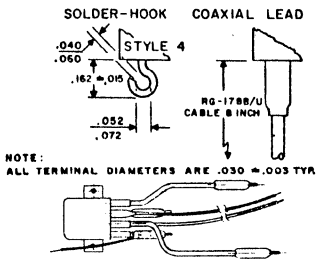
SPECIFICATIONS

Ambient Temperature ..... −65°C to +125°C
Shock ..... 100 G's for 11.0 ±2.0 Milliseconds
Vibration ..... 20 G's max. @ 56-2000 Hz
Contact Life ..... R.F. (depends on VSWR)
Contact Rating ..... R.F. 50 Watts
Frequency Range ..... To 500 MHz
VSWR ..... <1:1.1 typical
Insertion Loss ..... 0.16 DB typical
Crosstalk ..... 50 DB typical
Characteristic Impedance ..... 50 Ohms

H SERIES HALF SIZE COAXIAL

40	6.0	7.9	4.2	3.0	2.5	1.6	0.6	0.35
150	12.0	16.0	8.3	6.0	5.0	3.4	1.2	0.75
700	26.5	32.2	18.0	13.0	11.0	7.2	2.3	1.5

STANDARD TERMINALS



Also available with rigid, formed coaxial cables for direct mounting on PC boards or hi-density packaging

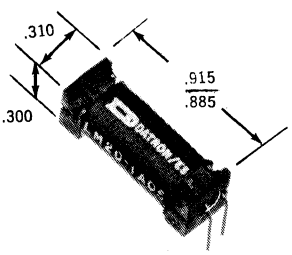
HOW TO ORDER

H 13 - 35 - 700 2

- SPECIAL NUMBER (Includes special Adjustments, cable and connector variations)
- COIL RESISTANCE
- HEADER STYLE — 35 - SPDT: RF, SPDT: Aux. 36 - DPDT: RF
- MOUNTING ARRANGEMENT — Flange 5, 13, Side Bracket, 3
- RELAY SERIES — H - Half Size F - Full Size

LM

LM SERIES REED RELAY
SPST NO

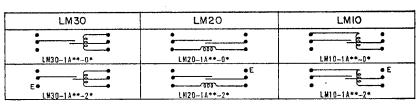


STANDARD COIL DATA

Nominal Coil Voltage	Coil Resistance ±10%	Maximum Pick-up Voltage at 25°C	Minimum Drop-Out Voltage at 25°C
(T²L) 5	3.30	4.0	.40
6	180	4.8	.48
12	750	9.6	.96
24	2300	19.0	1.9

SPECIFICATIONS

Temperature Range ..... −55°C to +85°C
Insulation Resistance ..... 1000 Megohms min. @ 25°C
Vibration ..... 20 G's @ 2000 Hz
Shock ..... 30 G's
Coil Overvoltage 100%
Capacitance ..... 2 Picofarads typical



NOTES:
1. There is no terminal where there is no connection or letter adjacent to a dot (●).
2. E: Electrostatic shield ground terminal.
3. Electromagnetic shielding is available
4. *Contact indicator.
5. **Coil voltage indicator

HOW TO ORDER:

LM 3 0-1 A 06 0 S

- REED SWITCH CONTACT MATERIAL: S–Standard: (.500 OHM Max. Cont. Res.) R–Special (.100 OHMS Max. Const. Res. Form A
- SHIELD INDICATOR: 0–No Shield; 1–Electro-Magnetic Shield; 2–Electro-Static Shield; 3–Electro-Magnetic & Static Shields
- NOMINAL VOLTAGE EXPRESSED IN TWO DIGITS: 05–6 VDC; 12–12 VDC
- CONTACT FORM: A–Make (SPST NO.)
- NUMBER OF REED SWITCHES
- GRID SPACING: 0–.100 Inch Centers, Radial; 1–.150 Inch Centers, Radial; 2–.200 Inch Centers, Radial; 5–Axial
- COIL PIN LOCATION: 1–Diagonal 2–Same Side, Opposite Ends 3–Same End, Opposite Sides

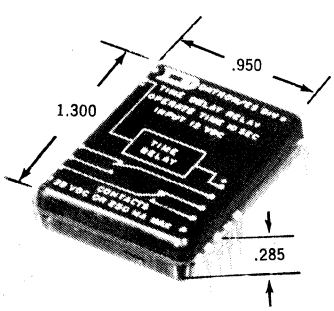
BASIC MODEL: LM .300 High By .915 Long, Reed Relay with Self Leads

TYPICAL REED CHARACTERISTICS

Reed Capsule Designation	Contact Config.	Initial Contact Rating Max.		Minimum Life Expectancy (operations x 10⁶)			Initial Contact Resistance (milliohms)	Max. Contact Bounce (microsec.)	Max. Operate Time (microsec)	Max. Release Time (microsec)	Dielectric Strength Cont.-Cont. (volts)
		Amps	Power	Rated	Intermed.	Low Level					
S	A	.500	10W	10	30	100	500	350	450	50	350
R	A	.500	10W	20	50	100	100	350	450	50	400

LT

SERIES TIME DELAY RELAY
MULTIPOLE TIME DELAY



TYPICAL SWITCHING CHARACTERISTIC

Contact Config.	Initial Contact Rating Max.		Minimum Life Expectancy (Operation x 10⁶)			Initial Contact Resistance (milliohms)	Operate Time Including Bounce (millisec)	Dielectric Strength Cont.-Cont. (volts)	Maximum Switching Voltage (VDC)
	Amps	Power	Rated	Intermed.	Low Level				
SPST NO.	.500	10W	20	50	100	100	1.0	400	200
SPST NC.	.500	10W	20	50	100	100	1.0	400	200
SPDT DPDT	.250	3W	5	10	50	150	NO.1.0 NC.1.5	250	28

SPECIFICATIONS

Temperature Range ..... 0°C to +60°C
Reset Time ..... 60 M.S.
Recycle Time ..... 60 M.S.
Timing Range ..... Fixed delay .1 to 120 sec.
Repeatability ..... ±2%
Accuracy Over Voltage and Temperature Range ..... ±10%

HOW TO ORDER

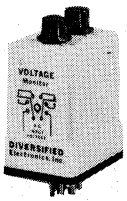
LT - 1 - 05 - F (*)

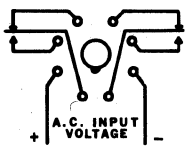
- SPECIAL REQUIREMENTS (Assign Number)
- F - Fixed Time Delay; R - Remote Time Delay; Minimum delay 100 Milliseconds
- NOMINAL COIL VOLTAGE — 05 - 5 VDC; 06 - 6 VDC; 12 - 12 VDC; 24 - 24 VDC; 48 - 48 VDC
- CONTACT CONFIGURATION — 1 - 2PDT; 2 - 1PDT; 3 - 2PST NO; 4 - 1PST NO; 5 - 1PST NC
- SERIES TYPE — Time Delay

1. VOLTAGE MONITORS

VOLTAGE BAND MONITOR/RELAY • VB SERIES

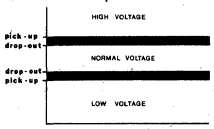
The **VB SERIES** offers protection to equipment which is required to operate between two voltage limits. The solid state monitor determines pre-selected under or over voltage conditions and de-energizes an internal 10A DPDT relay if these limits are exceeded. The **VB SERIES** is equipped with a time delay to accommodate start-up transients. Both A.C. and D.C units are available.





(D.C. POLARITY INDICATED)

RESPONSE TIME: Pickup: 30m. sec. Drop-out: 0.5 sec.
TEMPERATURE: Operating: 0°C to +55°C
Storage: −45°C to+85°C
RATED OUTPUT: DPDT Relay
10A @ 24VDC or 120VAC — 5A @ 240VAC Resistive
POWER REQUIRED: 3 Watts (Approx.)
ENCLOSURE: A. 1.75 x 2.38 x 2.88 H. Drop-out time to 2.5 sec. in "A" enclosure, to 5.0 sec. in "F" enclosure available on request.



AC KNOB ADJUSTABLE:

Catalog No.	Nominal Voltage	Lo-Limit Pick-up	Hi-Limit Pick-up	Hyst. Voltage
VBA- 24-AKA	24VAC	19-24	24-29	2
VBA-120-AKA	120VAC	90-120	120-150	5
VBA-208-AKA	208VAC	185-208	208-240	8
VBA-240-AKA	240VAC	200-240	240-270	10

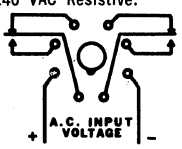
DC KNOB ADJUSTABLE:

VBA- 12-DKA	12VDC	10-12	12-15	1
VBA- 24-DKA	24VDC	19-24	24-29	1
VBA- 28-DKA	28VDC	22-28	28-34	1
VBA- 48-DKA	48VDC	38-48	48-58	2
VBA-110-DKA	110VDC	85-110	110-135	5
VBA-240-DKF	240VDC	200-240	240-270	10
VBA-305-DKF	305VDC	250-305	305-360	10

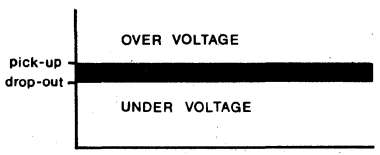
OVER VOLT-UNDER VOLT MONITOR/RELAY • UO SERIES

The **UO SERIES** consists of a solid state voltage detector that senses a voltage greater than a pre-set "pick-up" voltage and causes an internal DPDT relay to operate. When the voltage drops to the pre-set level, the output relay will de-energize. A hysteresis is set into each unit to allow a differential between pick-up and drop-out. **UO SERIES,** adjustable, close differential relays also available. Both A.C. and D.C. units available.

RESPONSE TIME: Pickup: 30m. sec. Drop-out: 0.5 sec.
TEMPERATURE: Operating: 0° to +55°C
Storage: −45C° to +85°C
RATED OUTPUT: DPDT Relay
10A @ 24VDC or 120VAC — 5A @ 240 VAC Resistive.
POWER REQUIRED: 3 Watts (Approx.)
ENCLOSURE: A. 1.75 x 2.38 x 2.88 H. Drop-out time to 2.5 sec. in "A" enclosure, to 5.0 sec. in "F" enclosure available on request.



(D.C. POLARITY INDICATED)



AC KNOB ADJUSTABLE:

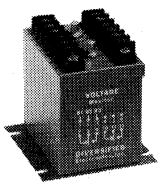
Catalog No.	Drop-out Voltage	Pull-in Voltage	Hyst. Voltage
UOA- 24-AKA	19- 27VAC	21- 29VAC	2
UOA-120-AKA	97-130VAC	102-135VAC	5
UOA-208-AKA	177-222VAC	185-230VAC	8
UOA-240-AKA	205-250VAC	215-260VAC	10
UOA-440-AKF	370-462VAC	388-480VAC	18

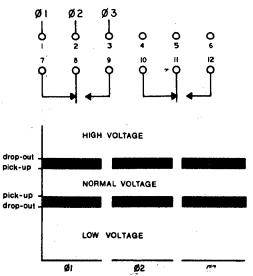
DC KNOB ADJUSTABLE:

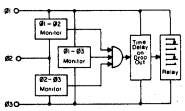
UOA- 12-DKA	9- 14VDC	10- 15VDC	1
UOA- 24-DKA	19- 27VDC	21- 29VDC	2
UOA- 48-DKA	38- 53VDC	40- 55VDC	2
UOA-110-DKA	92-125VDC	97-130VDC	5
UOA-240-DKF	205-250VDC	215-260VDC	10
UOA-305-DKF	260-335VDC	272-347VDC	12

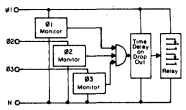
3 PHASE VOLTAGE BAND MONITOR/RELAY • PB SERIES

The **PB SERIES** offers protection to three phase equipment which is required to operate between two voltage limits. The three phases are monitored for a preselected under or over limit. An internal control relay is de-energized when the voltage goes outside of these limits. This device provides both under and over voltage monitoring of each phase of a Delta or Y system in one package. The monitors are equipped with a drop out time delay to accommodate start-up transients. With normal operating voltages on all phases, an internal relay will be energized. If the voltage on any phase goes above or below the drop-out limit, the signal to the time delay will be removed. If this out-of-limit condition exists on any phase, for a period longer than the release time or the time delay, the output relay will de-energize. **PB SERIES** is offered in A.C. only.









AC KNOB ADJUSTABLE: ALL VOLTS ϕ TO ϕ

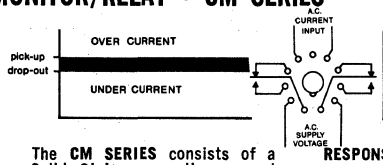
Catalog No.	Low-Limit	Hi-Limit	Hyst. Voltage
PBA-120-AKF-D	90-120	120-150	5
PBA-208-AKF-D	185-208	208-240	8
PBA-240-AKF-D	200-240	240-270	8
PBA-208-AKF-Y	185-208	208-240	8

RESPONSE TIME: Pickup: 30m. sec. Drop-out: 0.5 sec.
TEMPERATURE: Operating: 0°C to +55°C
Storage: −45°C to+85°C
RATED OUTPUT: DPDT Relay
10A @ 24VDC or 120VAC — 5A @ 240VAC Resistive
POWER REQUIRED: 3 Watts (Approx.)
ENCLOSURE: F. 3.6 x 2.56 x 3.1 H.

UPA SERIES 3-PHASE UNDER VOLTAGE MONITOR
Also available for under A.C. voltage protection. Write for detailed specifications.

2. CURRENT MONITORS

CURRENT MONITOR/RELAY • CM SERIES



The **CM SERIES** consists of a Solid State, magnetic, current detector which senses a current level. When the monitored current exceeds the trip point setting for a period greater than the response time, an internal 10 amp. DPDT relay will operate. A current decrease of at least 5% of trip point is required for relay to de-energize. The monitors are equipped with appropriate time delays to accommodate start-up transients and short-time line variations.

AC KNOB ADJUSTABLE:

Catalog No.	Supply Voltage	Trip Point (Amps)
CMA-120-AKA- 1	120VAC	0.2- 1.0
CMA-120-AKA- 5	120VAC	1.0- 5.0
CMA-120-AKA-10	120VAC	5.0-10.0

Also available for 240AC supply voltage.

RESPONSE TIME: Operate: 1 sec. Release: 30m. sec.
CURRENT DIFFERENTIAL: 5% of Trip Point
TRIP POINT (FIXED): ±10% of setting
TEMPERATURE: Operating: 0°C to +55°C
Storage: −45°C to+85°C
RATED OUTPUT: DPDT Relay — Resistive
10A @ 28VDC or 120VAC — 5A @ 240VAC
SUPPLY POWER (AUXILIARY): 3 Watts (Approx.)
ENCLOSURE: A. 1.75 x 2.38 x 2.88 H.

CURRENT TRANSFORMER • CT SERIES

The **CT SERIES** designed to be used with the CM Series monitors, when AC currents above 10 amps. are to be detected. This torroidal transformer is used to extend the range of the 5 amp. current monitor. The transformer slips over a conductor and is provided with a secondary lead length of 24 in.

CT SERIES — CURRENT TRANSFORMER

Catalog No.	Current Ratio	Accuracy	Capacity	Max. Dia. of Primary
CT 50/5	50/5	6.0%	2V.A.	1"
CT 100/5	100/5	3.0%	2V.A.	1"

Also available in 25, 500, 1000 and 2500 amps.

Contact us for special requirements or modifications to these units. Write for Catalog Number 100 for more detail and application notes.

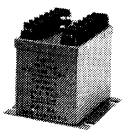
DIVERSIFIED Electronics, Inc. 47712
EVANSVILLE, INDIANA Box 6231
Phones (812) 424-2288 & 424-5596

3. PHASE MONITORS

PHASE SEQUENCE, PHASE LOSS & UNDER VOLTAGE MONITOR/RELAY • SL SERIES - 3φ

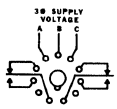
The **SL SERIES** is designed for use in applications where motor rotation or connection to the power line is critical, or where loss of one or more phases will cause damage to electrical equipment. If the Phase Sequence is correct and full line voltage is present on all three phases, the internal control relay will de-energize.

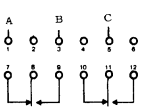
ENCLOSURE A

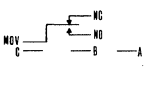


ENCLOSURE F

ENCLOSURE G







RESPONSE TIME: Pickup: 30m. sec. Drop-out: 0.5 sec.

TEMPERATURE: Operating: 0°C to +55°C
Storage: −45°C to +85°C

RATED OUTPUT: DPDT Relay
10A @ 24VDC or 120VAC—5A @ 240VAC Resistive

POWER REQUIRED: 3 Watts (Approx.)

ENCLOSURE: A, F, G. Drop-out time to 2.5 sec. in "A" enclosure, to 5.0 sec. in "F" enclosure.

ENCLOSURE "G" is a new, lower cost, design for applications where the relay does not require as much dust and humidity protection.

DIMENSIONS
Excluding Flanges, Knobs and Connectors.

A. 1.75 x 2.38 x 2.88 H.

F. 3.6 x 2.56 x 3.1 H.

G. 2.3 square chassis with mounting flange 2.3 high including relay.

AC FIXED:

Catalog No.	3φ Supply Voltage	Drop-Out % of Nominal Voltage One Phase Low	Drop-Out % of Nominal Voltage All Phases Low
SLA-208-AFA-A	208	83%	90%
SLA-220-AFA-A	220	83%	90%
SLA-240-AFA-A	240	83%	90%
SLA-440-AFF-A	440	83%	90%
SLA-480-AFF-A	480	83%	90%
SLA-208-AFG-A	208	83%	90%
SLA-220-AFG-A	220	83%	90%
SLA-240-AFG-A	240	83%	90%

AC KNOB ADJUSTABLE:

SLA-230-AKA-A	208-240	160-240
SLA-230-AKF-A	208-240	160-240
SLA-440-AKF-A	430-480	355-480

Available in 50, 60 and 400 Hz. Specify frequency when ordering.

4. SOLID STATE TIME DELAY RELAYS (Same Enclosure Style As "A" Above)

TDB SERIES • INTERVAL ON OPERATE

If voltage is removed before time-out, timer will reset.

KNOB ADJUSTABLE —Fig. 1

Catalog No.	Input Voltage	Delay Time (Sec)
TDB- 24-DKA-010	24VDC	.1 to 10
TDB- 24-AKA-010	24VAC	.1 to 10
TDB-120-AKA-010	120VAC	.1 to 10
TDB-120-AKA-200	120VAC	2 to 200

FIXED — Fig. 1

TDB- 24-DFA-010	24VDC	10
TDB- 24-AFA-010	24VAC	10
TDB-120-AFA-010	120VAC	10

EXT. RES. ADJUSTABLE — Fig. 2

Catalog No.	Input Voltage	Delay Time (Sec)	Ext. Res. Max. Time
TDB- 24-DRA-010	24VDC	.1 to 10	1 Meg
TDB- 24-ARA-010	24VAC	.1 to 10	1 Meg
TDB-120-ARA-010	120VAC	.1 to 10	1 Meg
TDB-120-ARA-200	120VAC	2 to 200	2 Meg

TDC SERIES • DELAY ON OPERATE

If voltage is removed before time-out, timer will reset and relay contacts will not pick-up.

KNOB ADJUSTABLE — Fig. 1

Catalog No.	Input Voltage	Delay Time (Sec)
TDC- 24-DKA-010	24VDC	.1 to 10
TDC- 24-AKA-010	24VAC	.1 to 10
TDC-120-AKA-010	120VAC	.1 to 10
TDC-120-AKA-200	120VAC	2 to 200

FIXED — Fig. 1

TDC- 24-DFA-010	24VDC	10
TDC- 24-AFA-010	24VAC	10
TDC-120-AFA-010	120VAC	10

EXT. RES. ADJUSTABLE — Fig. 1

Catalog No.	Input Voltage	Delay Time (Sec)	Ext. Res. Max. Time
TDC- 24-DRA-010	24VDC	.1 to 10	1 Meg
TDC- 24-ARA-010	24VAC	.1 to 10	1 Meg
TDC-120-ARA-010	120VAC	.1 to 10	1 Meg
TDC-120-ARA-200	120VAC	2 to 200	2 Meg

TDD SERIES • DELAY ON RELEASE

If control switch is re-closed before time-out, timer will reset.

KNOB ADJUSTABLE — Fig. 3

Catalog No.	Input Voltage	Delay Time (Sec)
TDD- 24-DKA-010	24VDC	.1 to 10
TDD- 24-AKA-010	24VAC	.1 to 10
TDD-120-AKA-010	120VAC	.1 to 10
TDD-120-AKA-200	120VAC	2 to 200

FIXED — Fig. 3

TDD- 24-DFA-010	24VDC	10
TDD- 24-AFA-010	24VAC	10
TDD-120-AFA-010	120VAC	10

EXT. RES. ADJUSTABLE — Fig. 4

Catalog No.	Input Voltage	Delay Time (Sec)	Ext. Res. Max. Time
TDD- 24-DRA-010	24VDC	.1 to 10	1 Meg
TDD- 24-ARA-010	24VAC	.1 to 10	1 Meg
TDD-120-ARA-010	120VAC	.1 to 10	1 Meg
TDD-120-ARA-200	120VAC	2 to 200	2 Meg

TDE SERIES • SINGLE SHOT

Timer resets automatically at end of delay period.

KNOB ADJUSTABLE — Fig. 3

Catalog No.	Input Voltage	Delay Time (Sec)
TDE- 24-DKA-010	24VDC	.1 to 10
TDE- 24-AKA-010	24VAC	.1 to 10
TDE-120-AKA-010	120VAC	.1 to 10
TDE-120-AKA-200	120VAC	2 to 200

FIXED — Fig. 3

TDE- 24-OFA-010	24VDC	10
TDE- 24-AFA-010	24VAC	10
TDE-120-AFA-010	120VAC	10

EXT. RES. ADJUSTABLE — Fig. 4

Catalog No.	Input Voltage	Delay Time (Sec)	Ext. Res. Max. Time
TDE- 24-DRA-010	24VDC	.1 to 10	1 Meg
TDE- 24-ARA-010	24VAC	.1 to 10	1 Meg
TDE-120-ARA-010	120VAC	.1 to 10	1 Meg
TDE-120-ARA-200	120VAC	2 to 200	2 Meg

D.C. POLARITY INDICATED

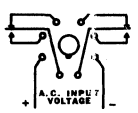


Fig. 1.

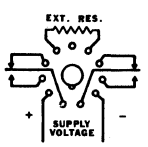


Fig. 2.

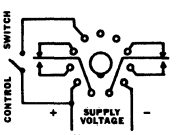


Fig. 3.

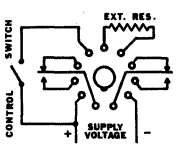


Fig. 4.

5. NEW PRODUCTS (Inquire About Our Other Products Briefly Described Below)

A. MOTOR MONITOR. Monitors several motors in a multiple motor installation. Will remove all motors from the line when a single phasing or low voltage condition occurs. When proper conditions are restored, all motors re-start in sequence. (Time delay between each motor start.)

B. CRANK CYCLE TIMER. Used to crank engines of stand-by M-G sets when primary power is lost and then restored.

C. ANTI-SHORT CYCLE TIMER. Prevents damage to air conditioning compressors by not allowing them to re-start for 5 minutes if there is a momentary power or thermostat interruption.

D. SOLID STATE CURRENT OVERLOADS. Features faster response than thermal overload approach. Used to detect an over current or under current conditions.

E. RELAY SOCKETS. Are now available in stock to accommodate all applicable products herein.

DIVERSIFIED Electronics, Inc. | 47712
EVANSVILLE, INDIANA | Box 6231

Contact us for special requirements or modifications to these units. Write for Catalog Number 100 for more detail and application notes.

Phones (812) 424-2288 & 424-5596

Douglas Randall

REEDRELAYS

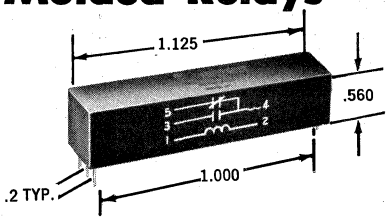
DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

Kidde

Miniature Molded Relays

Series MM (Dry Reed)

Series HgM (Mercury Wet)



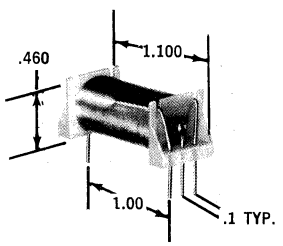
1.125" L x .560" H: Terminals on 1.0" x .2" centers.
Terminals can be located to meet other spacing.
CONTACT ARRANGEMENTS: 1A to 6A, 1B to 4B, 1A1B, 2A2B, 1C, 2C, 1A Latching, 2A Latching.

Series	Form	Max. Resistive Load
MM	A or B	10W, .5A or 250VDC
	C	3W, .25A or 28VDC
HgM	A or B	28W, 1.0A or 28VDC

Miniature Open Relays

Series MG (Dry Reed)

Series HgMG (Mercury Wet)



1.100" L x .460" H: Terminals on 1.000" x 0.1" centers.
CONTACT ARRANGEMENTS: 1A to 3A, 1B to 2B, 1A1B, 1A1C, 1C to 2C, 1A Latching, 2A Latching.

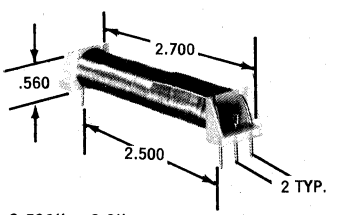
Series	Form	Max. Resistive Load
MG	A or B	10W, .5A or 250VDC
	C	3W, .25A or 28VDC
HgMG	A or B	28W, 1.0A or 28VDC

Standard Open Relays

Series SG (Dry Reed)

Series HgG (Mercury Wet)

Series HPG (High Power)



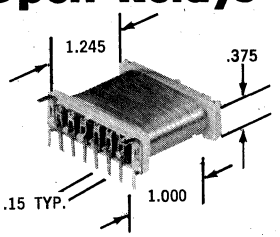
2.700" L x .560" H: Terminals on 2.500" x 0.2" centers.
CONTACT ARRANGEMENTS: 1A, 2A, 1B, 1C, 2C, 1A Latching, 2A Latching.

Series	Form	Max. Resistive Load
SG	A or B	15W, 1.0A or 250VDC
	C	10W, .5A or 250VDC
HgG	A or B	50W, 3.0A or 250VDC
HPG-1	A or B	110VA, 1.0A or 110VAC
	C	20W, 1.0A or 500VDC
HPG-2	A or B	600VA, 3.0A or 208VAC

Low Profile Open Relays

Series LP (Dry Reed)

Series HgLP (Mercury Wet)



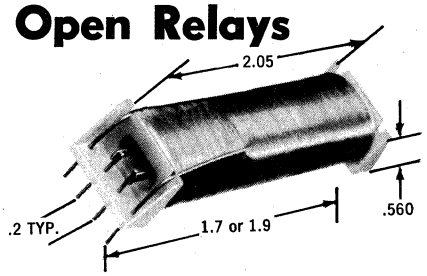
1.245" L x .375" W: Terminals on 1.000" x .150" centers.
CONTACT ARRANGEMENTS: 1A to 6A, 1B to 4B, 1C to 3C, 1A1B, 2A2B, 1A1C, 2A2C.

Series	Form	Max. Resistive Load
LP	A or B	10W, .5A or 250VDC
	C	3W, .25A or 28VDC
HgLP	A or B	28W, 1.0A or 28VDC

Compact Open Relays

Series CG (Dry Reed)

Series HPCG (High Power)



2.050" L x .560" H: Terminals on 1.9" or 1.7" x .2" centers.
CONTACT ARRANGEMENTS: 1A, 2A, 1B, 1C, 1A Latching, 1C Latching.

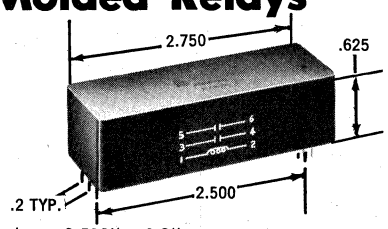
Series	Form	Max. Resistive Load
CG	A or B	15W, 1.0A or 250VDC
	C	10W, .5A or 250VDC
HPCG-1	A or B	110VA, 1.0A or 110VAC
	C	20W, 1.0A or 500VDC
HPCG-2	A or B	600VA, 3.0A or 208VAC

Standard Molded Relays

Series SM (Dry Reed)

Series Hg (Mercury Wet)

Series HP (High Power)



2.750" L x .625" H: Terminals on 2.500" x 0.2" centers.
Terminals can be located to meet other spacing.
CONTACT ARRANGEMENTS: 1A to 4A, 1B to 4B, 1C to 3C, 1A1B, 2A2B, 1A Latching, 1C Latching.

Series	Form	Max. Resistive Load
SM	A or B	15W, 1.0A or 250VDC
	C	10W, .5A or 250VDC
Hg	A or B	50W, 3.0A or 250VDC
HP-1	A or B	110VA, 1.0A or 110VAC
	C	20W, 1.0A or 500VDC
HP-2	A or B	600VA, 3.0A or 208VAC

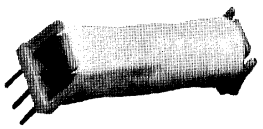
Douglas Randall

REED RELAYS

DIVISION OF WALTER KIDDE & COMPANY, INC. • 6 PAWCATUCK AVE., PAWCATUCK, CONN. 02891 • (203) 599-1750

Kidde

Low Profile — Series XMG



SIZE: 1.1 L x .350 H x .350 W.
CONTACTS: 1A, 1C, 1A, Hg. Wet.
RATING: 1A — 10 W, .5 A, 250 VDC.
1C — 3 W, .25 A, 100 VDC.
1A Hg. — 28 W, 1 A, 28 VDC.

Verti-Reed — Series VR

FOR LIMITED AREA: .16 sq. in.; .9 H x .4 Sq.
CONTACTS: 1A, 2A, 1B, 1C, 1A latch.
RATING: A & B — 10 W, .5 A, 250 VDC.
C — 3 W, .25 A, 100 VDC.

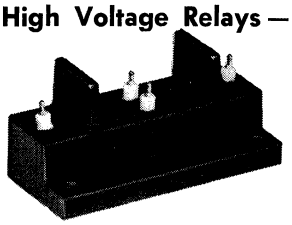
Snap-In — Series SI

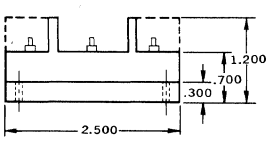
Plugs into BERG-PAC 45590 clips. Replaces IBM. Removable switch.
CONTACTS: 1A, 1A Hg. Wet.
RATING: 1A — 10 W, .5 A, 250 VDC.
1A Hg. — 28 W, 1 A, 280 VDC.

Tubular — Series MT

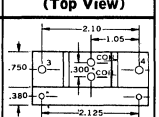
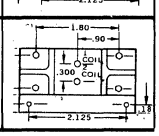
Axial Leads or Prebent
AREA: 15/16 L x 3/8 O.D.
CONTACTS: 1A, 1C, 1A Hg.
RATING: 1A — 10 W, .5A, 250 VDC.
1C — 3 W, .25 A, 100 VDC.
1A Hg. — 28 W, 1 A, 28 VDC.

High Voltage Relays — Series HV





COIL DATA

Contact Arrangement	Nominal Voltage	Part Number	DCR Ohms ±10%	Terminal Layout (Top View)
1A	6	6 HV1A	25	
	12	12 HV1A	100	
	24	24 HV1A	400	
2A	6	6 HV2A	20	
	12	12 HV2A	80	
	24	24 HV2A	320	

CONTACT DATA

Series	Maximum Resistive Rating			Breakdown Voltage (min.)	Initial Resistance
35	3,500 VDC	3.0 A	50 W	5,000 VDC	.100 Ohms
75	7,500 VDC	3.0 A	50 W	10,000 VDC	.100 Ohms
100	10,000 VDC	3.0 A	50 W	12,500 VDC	.100 Ohms

OPTION:

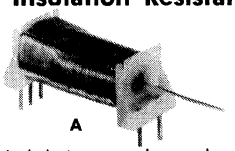
Relays also available in Form B up to 7500 VDC.

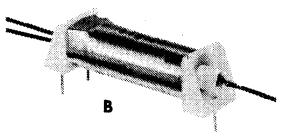
Note: To order, specify as follows: 6 HV1A 35 is a 6 HV1A relay with 3,500 VDC switch.

Special Designs

Douglas Randall has developed a wide variety of custom relays to meet special requirements. A few designs are shown below to illustrate this capability. Special molding techniques have been perfected which make it possible to manufacture any size, shape or terminal arrangement with very low tooling cost. Rapid engineering and prototype service is available for special applications.

High Insulation Resistance Relays





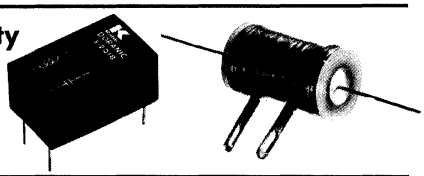
Two typical designs are shown above:
A — A miniature reed relay with a floating lead to maintain high IR.
B — This is a relay using Form A and Form B switches timed to provide a Form C (break before make) function with flying leads to maintain 10^{13} ohms. Up to 5 Form A contacts.

High Temperature Relays

Use of Class H insulation throughout and design of the coil to provide good contact pressure over a wide temperature range make this relay suitable for 180°C operation.

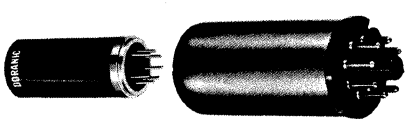
High Sensitivity Relays

The relays shown will operate at 10 MW coil power.

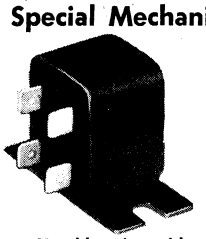


Plug-in Relays

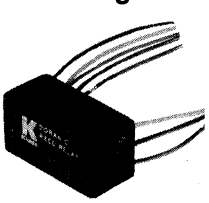
Reed relays are easily adapted to standard style headers for socket mounting.



Special Mechanical Arrangements



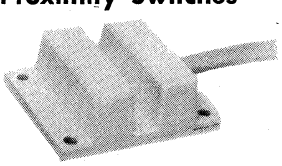
Metal housing with spade terminals.



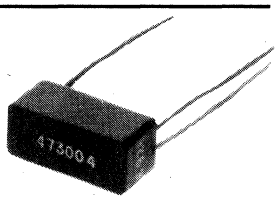
Lead wire termination.

Vertical mounting for mercury wgt.

Proximity Switches

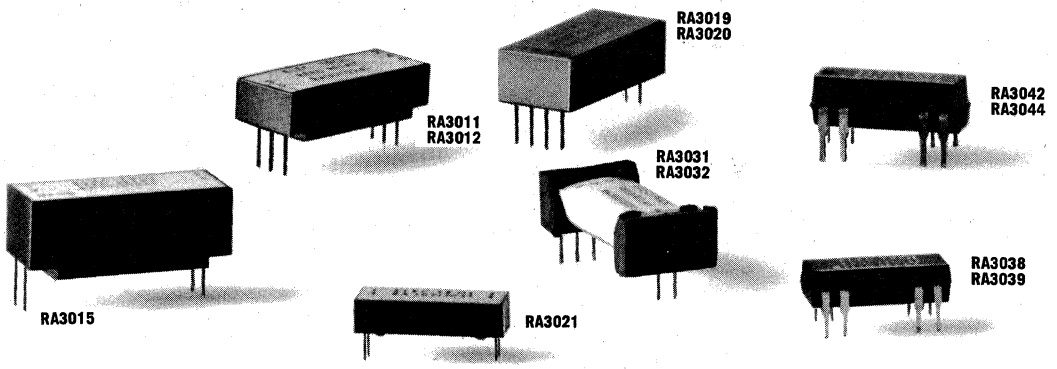


This is a vane operated switch and magnet assembly in an aluminum housing. Switches rated from dry circuit to 100 watts are available.



Epoxy molded switch and magnet assemblies are available in many sizes, contact ratings and terminal arrangements.

ELEC-TROL REED RELAYS



ORDERING INFORMATION

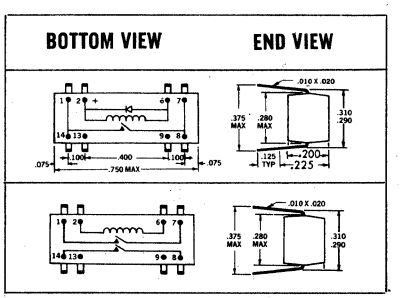
To order any ELEC-TROL reed relay, a ten digit part number can be developed to describe the desired relay from the model number and the numbers shown in the shaded columns on the data sheets.

The relay part number is developed as shown at right:

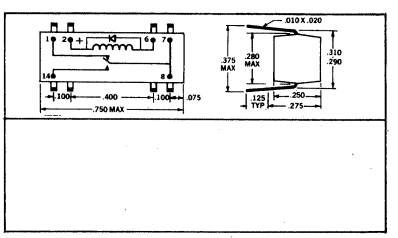
RAXXXX X XX X
Model Number
Number of Poles
Operating Volts
Contact Rating Symbol Number

ELEC-TROL reed relays supply the answer to advanced switching problems providing fast switching time, compact size, high reliability, long life, low power operation at low cost. Simplicity of design, coupled with 100% inspection and attention devoted to minute details of production enable ELEC-TROL to supply reed relays of superior performance. To be sure that reed switches used in ELEC-TROL reed relays are of the finest quality and provide the highest contact reliability, a stringent test program is applied to each production lot of reed contacts prior to their incorporation in relays. The lot of reed contacts is accepted on the basis of a successful life test performed on a sample taken from the lot. Each reed contact is then 100% tested for contact resistance and sensitivity. ELEC-TROL, INC. has complete design, production and testing facilities for fabrication of reed relays in a new modern plant located in Saugus, California near Los Angeles. Total application services are available to assist in optimum and economical application of these devices in your system.

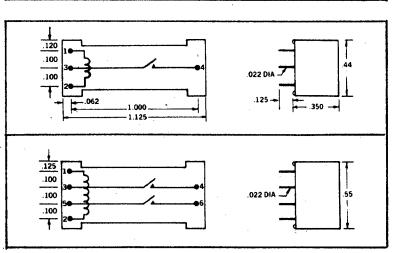
Model	No. Poles	Nom. Volts	Coil Res. (Ω)	Max. P.U. Volts	Min. D.O. Volts	Contact Rating Symbol No.	1	2
RA3038, 1 or 2 pole (w/o diode) RA3039, 1 pole only (w/diode) DIP FORM A DRY REED Encapsulated	1	05	500	3.8	1.0	Watts	10	cont. sym. 1 with 10^6 opr. run-in
		06	500	4.0	1.0	Max. Amps	0.5	
		12	500	8.0	2.0	Max. Volts	50	
		24	1400	16.0	4.0	Life X 10^6	0.1	
	2	05	200	3.8	1.0	Cont. Res. (Ω)	0.3	
		06	200	4.0	1.0	Min. Bkdn. V.	200	
		12	385	8.0	2.0	IR @ 20°C	10^{10}	
		24	1200	16.0	4.0			



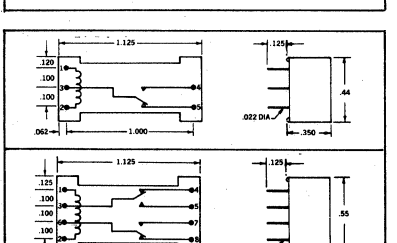
RA3042 (w/o diode) RA3044 (w/diode) DIP FORM C DRY REED Encapsulated	1	05	200	4.0	0.5	Watts	3	cont. sym. 1 with 10^6 opr. run-in
		06	80	4.0	0.5	Max. Amps	0.25	
		12	500	8.0	1.0	Max. Volts	28	
		24	2000	16.0	2.0	Life X 10^6	5	
						Cont. Res. (Ω)	0.3	
						Min. Bkdn. V.	200	
						IR @ 20°C	10^9	



RA3031 OPEN LINE FORM A DRY REED UP TO 4 POLES Open	1	05	500	3.8	0.5	Watts	10	cont. sym. 1 with 10^6 opr. run-in
		06	125	4.0	0.5	Max. Amps	0.5	
		12	500	8.0	1.0	Max. Volts	250	
		24	2000	16.0	2.0	Life X 10^6	10	
	2	05	200	3.8	0.5	Cont. Res. (Ω)	0.2	
		06	110	4.0	0.5	Min. Bkdn. V.	350	
		12	440	8.0	1.0	IR @ 20°C	10^{12}	
		24	1750	16.0	2.0			



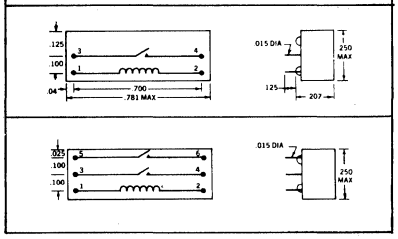
RA3032 OPEN LINE FORM C DRY REED UP TO 3 POLES Open	1	05	500	3.8	0.5	Watts	3	cont. sym. 1 with 10^6 opr. run-in
		06	125	4.0	0.5	Max. Amps	0.25	
		12	500	8.0	1.0	Max. Volts	28	
		24	2000	16.0	2.0	Life X 10^6	5	
	2	05	200	3.8	0.5	Cont. Res. (Ω)	0.2	
		06	80	4.0	0.5	Min. Bkdn. V.	200	
		12	310	8.0	1.0	IR @ 20°C	10^9	
		24	1250	16.0	2.0			

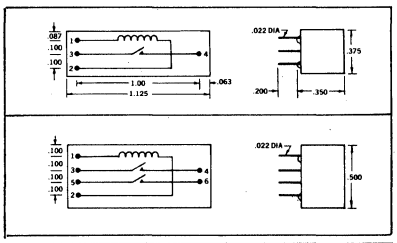


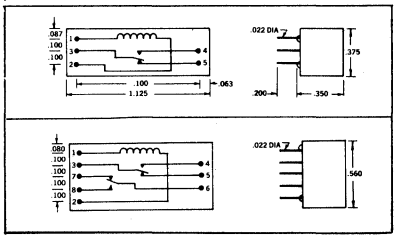
ELEC-TROL REED RELAYS

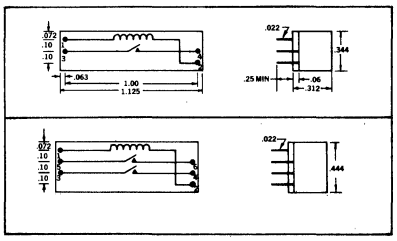
Model	No. Poles	Nom. Volts	Coil Res. (Ω)	Max. P.U. Volts	Min. D.O. Volts	Contact Rating Symbol No.	1	2
RA3021 PICO FORM A DRY REED	1	05	500	4.0	1.0	Watts	10	cont. sym. 1 with 10^6 opr. run-in
		06	95	4.0	1.0	Max. Amps	0.5	
		12	385	8.0	2.0	Max. Volts	100	
		24	1200	16.0	4.0	Life X 10^6	10	
	2	05	200	4.0	1.0	Cont. Res. (Ω)	0.2	
		06	95	4.0	1.0	Min. Bkdn. V.	200	
		12	385	8.0	2.0	IR @ 20°C	10^{10}	
Encapsulated		24	1200	16.0	4.0			
RA3019 ECONOLINE FORM A DRY REED	1	05	500	4.0	0.5		1	2
		06	125	3.8	0.5	Watts	10	cont. sym. 1 with 10^6 opr. run-in
		12	500	7.5	1.0	Max. Amps	0.5	
		24	2000	15.0	2.0	Max. Volts	250	
	2	05	250	3.8	0.5	Life X 10^6	10	
UP TO 6 POLES		06	110	3.8	0.5	Cont. Res. (Ω)	0.2	
		12	440	7.5	1.0	Min. Bkdn. V.	350	
Enclosed		24	1750	15.0	2.0	IR @ 20°C	10^{12}	
RA3020 ECONOLINE FORM C DRY REED	1	05	500	4.0	0.5		1	2
		06	125	3.8	0.5	Watts	3	cont. sym. 1 with 10^6 opr. run-in
		12	500	7.5	1.0	Max. Amps	0.25	
		24	2000	15.0	2.0	Max. Volts	28	
	2	05	250	4.0	0.5	Life X 10^6	5	
UP TO 4 POLES		06	80	3.8	0.5	Cont. Res. (Ω)	0.2	
		12	310	7.5	1.0	Min. Bkdn. V.	200	
Enclosed		24	1250	15.0	2.0	IR @ 20°C	10^9	
RA3011 MINIATURE FORM A DRY REED	1	06	125	3.5	0.5		1	2
		12	500	7.0	1.0	Watts	10	cont. sym. 1 with 10^6 opr. run-in
		24	2000	14.0	2.0	Max. Amps	0.5	
						Max. Volts	250	
	2	06	110	3.5	0.5	Life X 10^6	10	
UP TO 6 POLES		12	440	7.0	1.0	Cont. Res (Ω)	0.2	
		24	1750	14.0	2.0	Min. Bkdn. V.	350	
Encapsulated						IR @ 20°C	10^{12}	
RA3012 MINIATURE FORM C DRY REED	1	06	125	3.5	0.5		1	2
		12	500	7.0	1.0	Watts	3	cont. sym. 1 with 10^6 opr. run-in
		24	2000	14.0	2.0	Max. Amps	0.25	
						Max. Volts	28	
	2	06	80	3.5	0.5	Life X 10^6	5	
UP TO 4 POLES		12	310	7.0	1.0	Cont. Res (Ω)	0.2	
		24	1250	14.0	2.0	Min. Bkdn. V.	200	
Encapsulated						IR @ 20°C	10^9	
RA3015 MINIATURE FORM A MERCURY WETTED	1	06	95	4.0	0.5		1	2
		12	375	8.0	1.0	Watts	28	cont. sym. 1 with 10^6 opr. run-in
		24	1500	16.0	2.0	Max. Amps	1.0	
						Max. Volts	100	
	2	06	60	4.0	0.5	Life X 10^6	100	
UP TO 6 POLES		12	250	8.0	1.0	Cont. Res. (Ω)	0.10	
		24	1000	16.0	2.0	Min. Bkdn. V.	1000	
Encapsulated						IR @ 20°C	10^8	

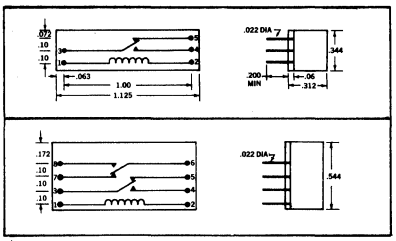
BOTTOM VIEW END VIEW

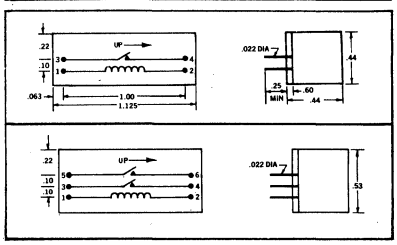












ENVIRONMENTAL RATINGS

Relay Type	Temperature	Vibration	Shock	Orientation
MINIATURE DRY REED	−55°C to +85°C	20G to 2000 Hz	50G	any position
STANDARD DRY REED	−55°C to +85°C	10G to 500 Hz	50G	any position
MINIATURE AND STANDARD MERCURY WETTED	−30°C to +85°C	not applicable	not applicable	±30° max. from vertical

NOTES
1. For complete detail information see ELEC-TROL Catalog No. 101.
2. Electromagnetic and electrostatic shielding available on special order.
3. Coil res., max. P.U. Volts, minimum D.O. Volts @ 20°C.

ELEC-TROL, INC.
26477 N. GOLDEN VALLEY RD.
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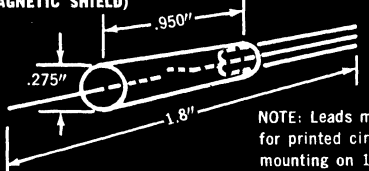
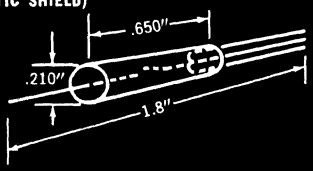
HIGH VOLTAGE REED RELAYS
NICKEL PLATE STEEL JACKET
(MAGNETIC SHIELD)



ULTRA MICRO REED RELAYS
NICKEL PLATE STEEL JACKET
(MAGNETIC SHIELD)



NOTE: Leads may be bent for printed circuit board mounting on 1" centers.

CONTACT RATINGS — FORM A (SPST)

Voltage (Max. Switching)	1000 VDC	Voltage (Max. Switching)	250 VDC
Current (Max. Switching)	750 MA	Current (Max. Switching)	.5 Amp
Power (Max. Switching)	15 Watts	Power (Max. Switching)	10 Watts
Current (Max. Carry)	2 Amps	Current (Max. Gating)	1 Amp
Capacitance (Typical)	.2 PF	Capacitance (Typical)	.2 PF
Contact Resistance (Typical)	.100 Ohms	Contact Resistance (Typical)	.100 Ohms
Insulation Resistance	10^{12} Ohms	Insulation Resistance	10^{12} Ohms
Operate Time (Typical)	½ ms	Operate Time (Typical)	½ ms
Release Time (Typical)	¾ ms	Release Time (Typical)	¾ ms
Life (Low Load)	100 Million	Life (Low Load)	100 Million
Life (¼ Load)	50 Million	Life (¼ Load)	50 Million
Life (½ Load)	25 Million	Life (½ Load)	25 Million
Life (¾ Load)	10 Million	Life (¾ Load)	10 Million
Life (Full Load)	1 Million	Life (Full Load)	1 Million

COIL RATINGS — FORM A (SPST)

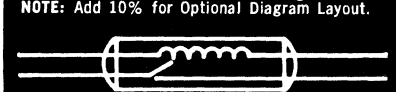
COIL VOLTAGE	PULL-IN VOLTAGE	P/N	COIL RES.	COIL VOLTAGE	PULL-IN VOLTAGE	P/N	COIL RES.
1	.75	1A1A-HV 1A1AH-HV	3 Ohms 10		.75	1A1 1A1H	3 Ohms 10
3	2.25	1A3A-HV 1A3AH-HV	30 100	3	2.25	1A3 1A3H	30 100
5	3.75	1A5A-HV 1A5AH-HV	100 400	5	3.75	1A5 1A5H	100 400
6	4.5	1A6A-HV 1A6AH-HV	125 400	6	4.5	1A6 1A6H	125 400
10	7.5	1A10A-HV 1A10AH-HV	400 1000	10	7.5	1A10 1A10H	400 1000
12	9.0	1A12A-HV 1A12AH-HV	500 1000	12	9.0	1A12 1A12H	500 1000
15	12.0	1A15A-HV 1A15AH-HV	750 1500	15	12.0	1A15 1A15H	750 1500
24	18.0	1A24A-HV 1A24AH-HV	1000 2000	24	18.0	1A24 1A24H	1000 2000

O.E.M. PRICE LIST (ALL VOLTAGES) FORM A

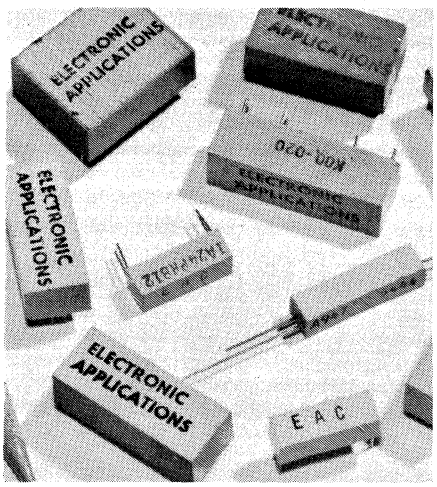
QUANTITY	1A* A-HV	1A* AH-HV	QUANTITY	1A*	1A*H
1-24	4.36	4.75	1-24	2.88	3.17
25-49	3.92	4.27	25-49	2.59	2.85
50-99	3.49	3.80	50-99	2.30	2.53
100-499	3.05	3.32	100-499	2.02	2.22
500-999	2.62	2.86	500-999	1.73	1.90
1000-2499	2.18	2.38	1000-2499	1.44	1.59
2500-4999	1.96	2.14	2500-4999	1.30	1.43
5000-9999	1.74	1.90	5000-9999	1.15	1.27
10000-24999	1.64	1.79	10000-24999	1.01	1.11
25000-49999	1.58	1.73	25000-4999	.86	.95
50000-99999	1.53	1.67	50000-99999	.81	.89
100000-UP	1.42	1.55	100000-UP	.70	.77

*Voltage
NOTE: Add 10¢ for Plastic Insulating Sleeve.
NOTE: Add 10% for Optional Diagram Layout.

TERMS: 1% — 10/N — 30 Days F.O.B. So. El Monte



NOTE: Add Y to P/N (Example 1A5A$^{Y}_{\Delta}$H)



VOLTAGES
1, 3, 5, 6, 10, 12, 15, 24, 48
FORM A, B, C
UP TO 6 POLES

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LOW COST COMMERCIAL REED RELAYS
NICKEL PLATED, STEEL JACKET MAGNETIC SHIELD

CONTACT RATINGS

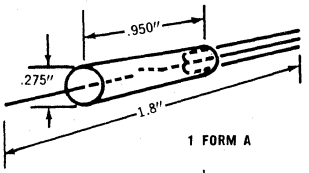
	FORM A	FORM C		FORM A	FORM C
Voltage (Max. Switching)	250 VDC	200 VDC	Operate Time (Typical)	½ ms	½ ms
Current (Max. Switching)	1 Amp	500 ma	Release Time (Typical)	¾ ms	¼ ms
Power (Max. Switching)	20 Watts	10 Watts	Life (Low Load)	100 Million	50 Million
Current (Max. Carry)	2 Amps	1 Amp	Life (¼ Load)	50 Million	25 Million
Capacitance (Typical)	.2 PF	.8 PF	Life (½ Load)	25 Million	10 Million
Contact Resistance (Typical)	.100 Ohms	.100 Ohms	Life (¾ Load)	10 Million	4 Million
Insulation Resistance (Typical)	10^{12} Ohms	10^{12} Ohms	Life (Full Load)	1 Million	1 Million

COIL VOLTAGE	PULL-IN VOLTAGE	1 FORM A (SPST) P/N	1 FORM A (SPST) OHMS COIL RES.	1 FORM C (SPDT) P/N	1 FORM C (SPDT) OHMS COIL RES.	2 FORM A (2PST) P/N	2 FORM A (2PST) OHMS COIL RES.	2 FORM C (2PDT) P/N	2 FORM C (2PDT) OHMS COIL RES.	3 FORM A (SPST) P/N	3 FORM A (SPST) OHMS COIL RES.
1	.75	1A1A	3	1C1A	3	2A1A	2	2C1A	2	3A1A	1.5
		1A1AH	10	1C1AH	10	2A1AH	7.5	2C1AH	7.5	3A1AH	5
		1A1AHH	30	1C1AHH	30	2A1AHH	20	2C1AHH	20	3A1AHH	15
3	2.25	1A3A	30	1C3A	30	3A3A	20	2C3A	20	3A3A	15
		1A3AH	100	1C3AH	100	2A3AH	75	2C3AH	75	3A3AH	50
		1A3AHH	250	1C3AHH	250	2A3AHH	175	2C3AHH	175	3A3AHH	125
5	3.75	1A5A	100	1C5A	100	2A5A	75	2C5A	75	3A5A	50
		1A5AH	400	1C5AH	200	2A5AH	300	2C5AH	150	3A5AH	200
		1A5AHH	700	1C5AHH	400	2A5AHH	500	2C5AHH	300	3A5AHH	350
6	4.5	1A6A	125	1C6A	125	2A6A	100	2C6A	100	3A6A	75
		1A6AH	400	1C6AH	250	2A6AH	300	2C6AH	175	3A6AH	200
		1A6AHH	1000	1C6AHH	500	2A6AHH	750	2C6AHH	375	3A6AHH	500
10	7.5	1A10A	400	1C10A	100	2A10A	300	2C10A	300	3A10A	200
		1A10AH	1000	1C10AH	1000	2A10AH	750	2C10AH	750	3A10AH	500
		1A10AHH	2000	1C10AHH	1600	2A10AHH	1500	2C10AHH	1200	3A10AHH	1000
12	9	1A12A	500	1C12A	500	2A12A	375	2C12A	375	3A12A	250
		1A12AH	1000	1C12AH	1000	2A12AH	750	2C12AH	750	3A12AH	500
		1A12AHH	2000	1C12AHH	2000	2A12AHH	1500	2C12AHH	1500	3A12AHH	1000
15	12	1A15A	750	1C15A	750	2A15A	600	2C15A	600	3A15A	375
		1A15AH	1500	1C15AH	1500	2A15AH	1200	2C15AH	1200	3A15AH	750
		1A15AHH	3000	1C15AHH	3000	2A15AHH	2000	2C15AHH	2000	3A15AHH	1500
24	18	1A24A	1000	1C24A	1000	2A24A	750	2C24A	750	3A24A	500
		1A24AH	2000	1C24AH	2000	2A24AH	1500	2C24AH	1500	3A24AH	1000
		1A24AHH	4000	1C24AHH	4000	2A24AHH	3000	2C24AHH	3000	3A24AHH	2000

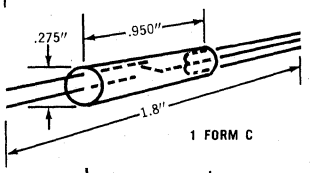
O.E.M. PRICE LIST (ALL VOLTAGES)

QUANTITY	1 FORM A (SPST) 1A* A	1A* AH	1A* AHH	1 FORM C (SPDT) 1C* A	1C* AH	1C* AHH	2 FORM A (2PST) 2A* A	2A* AH	2A* AHH	2 FORM C (2PDT) 2C* A	2C* AH	2C* AHH	3 FORM A 3A* A	3A* AH	3A* AHH
1-24	1.60	1.76	1.92	3.96	4.36	4.75	2.72	2.99	3.26	7.13	7.84	8.56	4.08	4.49	4.90
25-49	1.44	1.58	1.73	3.56	3.92	4.27	2.45	2.69	2.93	6.42	7.06	7.70	3.67	4.04	4.41
50-99	1.28	1.41	1.54	3.17	3.49	3.80	2.18	2.39	2.61	5.70	6.27	6.85	3.26	3.59	3.92
100-499	1.12	1.23	1.34	2.77	3.05	3.32	1.90	2.09	2.28	4.99	5.49	5.99	2.36	3.14	3.43
500-999	.96	1.06	1.15	2.38	2.62	2.86	1.63	1.79	1.96	4.28	4.70	5.14	2.45	2.69	2.94
1000-2499	.80	.88	.96	1.98	2.18	2.38	1.36	1.49	1.63	3.57	3.92	4.28	2.04	2.25	2.45
2500-4999	.72	.79	.86	1.78	1.96	2.14	1.22	1.35	1.47	3.21	3.53	3.85	1.34	2.02	2.21
5000-9999	.64	.70	.77	1.58	1.74	1.90	1.09	1.20	1.30	2.85	3.14	3.42	1.63	1.80	1.96
10000-24999	.56	.62	.67	1.49	1.64	1.79	.95	1.05	1.14	2.50	2.74	2.99	1.43	1.57	1.72
25000-49999	.48	.53	.58	1.44	1.58	1.73	.82	.90	.98	2.14	2.35	2.57	1.22	1.35	1.47
50000-99999	.45	.50	.54	1.39	1.53	1.67	.76	.84	.91	1.99	2.20	2.40	1.14	1.26	1.37
100000-UP	.39	.43	.47	1.29	1.42	1.55	.68	.75	.82	1.73	1.96	2.14	1.02	1.12	1.23

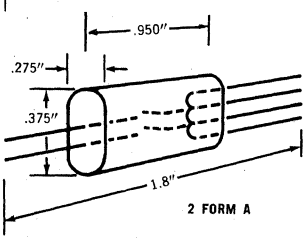
*Voltage



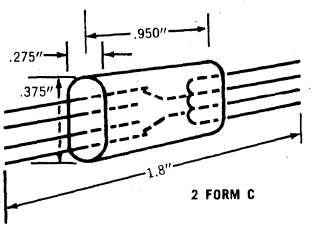
1 FORM A



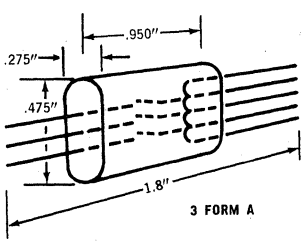
1 FORM C



2 FORM A



2 FORM C



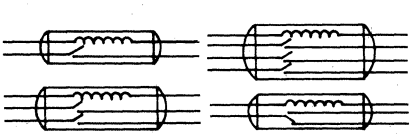
3 FORM A

NOTE:
Leads may be bent for printed circuit board mounting on 1″ centers.

NOTE:
Add 10¢ for Plastic Insulating Sleeve.

NOTE:
Add 10% for Optional Diagram Layout.

TERMS:
1%—10/N—30 Days F.O.B. So. El Monte



NOTE:
Add Y to P/N (Example 1A5A$^{Y}_{\wedge}$H)

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NICKEL PLATED, STEEL JACKET MAGNETIC SHIELD

CONTACT RATINGS

	FORM A (SPST)		FORM A (SPST)
Voltage (Max. Switching)	250 VDC	Operate Time (Typical)	½ ms
Current (Max. Switching)	1½ Amp	Release Time (Typical)	¾ ms
Power (Max. Switching)	30 Watts	Life (Low Load)	100 Million
Current (Max. Carry)	2 Amps	Life (¼ Load)	50 Million
Capacitance (Typical)	.2 PF	Life (½ Load)	25 Million
Contact Resistance (Typical)	.100 Ohms	Life (¾ Load)	10 Million
Insulation Resistance	10^{12} Ohms	Life (Full Load)	1 Million

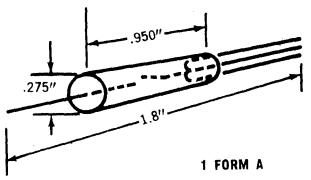
COIL RATINGS

COIL VOLTAGE	PULL-IN VOLTAGE	1 FORM A (SPST) P/N	1 FORM A (SPST) OHMS COIL RES.	2 FORM A (2PST) P/N	2 FORM A (2PST) OHMS COIL RES.	3 FORM A (3PST) P/N	3 FORM A (3PST) OHMS COIL RES.
1	.75	1A1A-X	3	2A1A-X	2	3A1A-X	1.5
		1A1AH-X	10	2A1AH-X	7.5	3A1AH-X	5
		1A1AHH-X	30	2A1AHH-X	20	3A1AHH-X	15
3	2.25	1A3A-X	30	2A3A-X	20	3A3A-X	15
		1A3AH-X	100	2A3AH-X	75	3A3AH-X	50
		1A3AHH-X	250	2A3AHH-X	175	3A3AHH-X	125
5	3.75	1A5A-X	100	2A5A-X	75	3A5A-X	50
		1A5AH-X	400	2A5AH-X	300	3A5AH-X	200
		1A5AHH-X	700	2A5AHH-X	500	3A5AHH-X	350
6	4.5	1A6A-X	125	2A6A-X	100	3A6A-X	75
		1A6AH-X	400	2A6AH-X	300	3A6AH-X	200
		1A6AHH-X	1000	2A6AHH-X	750	3A6AHH-X	500
10	7.5	1A10A-X	400	2A10A-X	300	3A10A-X	200
		1A10AH-X	1000	2A10AH-X	750	3A10AH-X	500
		1A10AHH-X	2000	2A10AHH-X	1500	3A10AHH-X	1000
12	9	1A12A-X	500	2A12A-X	375	3A12A-X	250
		1A12AH-X	1000	2A12AH-X	750	3A12AH-X	500
		1A12AHH-X	2000	2A12AHH-X	1500	3A12AHH-X	1000
15	12	1A15A-X	750	2A15A-X	600	3A15A-X	375
		1A15AH-X	1500	2A15AH-X	1200	3A15AH-X	750
		1A15AHH-X	3000	2A15AHH-X	2000	3A15AHH-X	1500
24	18	1A25A-X	1000	2A24A-X	750	3A24A-X	500
		1A24AH-X	2000	2A24AH-X	1500	3A24AH-X	1000
		1A24AHH-X	4000	2A24AHH-X	3000	3A24AHH-X	2000

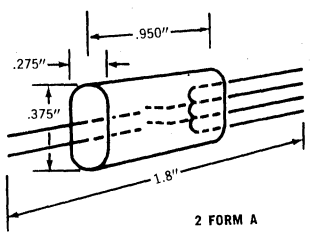
OEM PRICE LIST — (ALL VOLTAGES)

QUANTITY	1 FORM A (SPST) 1A* A-X	1A* AH-X	1A* AHH-X	2 FORM A (2PST) 2A* A-X	2A* AH-X	2A* AHH-X	3 FORM A (3PST) 3A* A-X	3A* AH-X	3A* AHH-X
1-24	2.40	2.64	2.88	3.99	4.39	4.79	5.99	6.59	7.19
25-49	2.16	2.38	2.59	3.59	3.95	4.31	5.39	5.93	6.47
50-99	1.92	2.11	2.30	3.19	3.51	3.83	4.79	5.27	5.75
100-499	1.58	1.85	2.02	2.79	3.07	3.35	4.19	4.61	5.03
500-999	1.44	1.58	1.73	2.39	2.63	2.87	3.59	3.95	4.31
1000-2499	1.20	1.32	1.44	1.99	2.20	2.40	2.99	3.29	3.59
2500-4999	1.08	1.19	1.30	1.79	1.98	2.16	2.69	2.97	3.24
5000-9999	.96	1.06	1.15	1.59	1.76	1.92	2.39	2.64	2.88
10000-24999	.84	.92	1.01	1.39	1.54	1.68	2.09	2.31	2.52
25000-49999	.72	.79	.86	1.19	1.32	1.44	1.79	1.98	2.16
50000-99999	.67	.74	.81	1.12	1.23	1.34	1.68	1.85	2.01
100000-UP	.59	.66	.72	.99	1.09	1.19	1.49	1.65	1.79

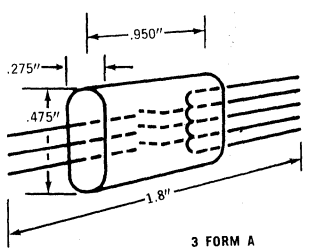
*Voltage



1 FORM A

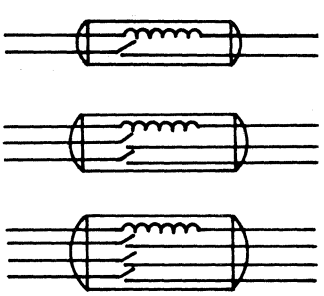


2 FORM A



3 FORM A

NOTE:
Leads may be bent for printed circuit board mounting on 1" centers.



NOTE:
Add 10¢ for Plastic Insulating Sleeve.
NOTE:
Add 10% for Optional Diagram Layout.
TERMS:
1%—10/N—30 Days F.O.B. So. El Monte

NOTE:
Add Y to P/N (Example 1A5A$^{Y}_{\wedge}$H)

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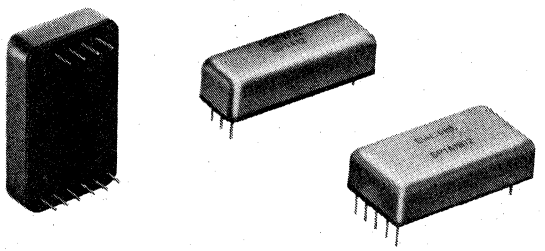
• .15" x 1.35" GRID • DRY REED

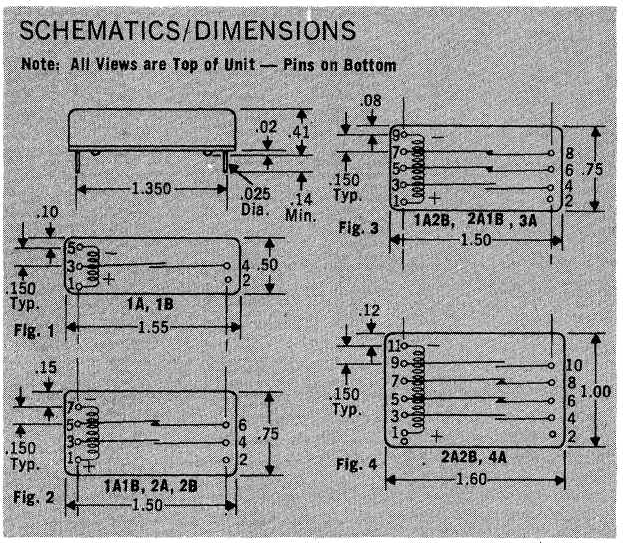
MAGNETICALLY SHIELDED



These ruggedly reliable general purpose reed relays are designed for "workhorse" applications. Capable of handling 10 watts at ½ amp, they are widely used in industrial systems such as machine tool controls. Metal cases provide excellent magnetic shielding. Available in a wide variety of contact configuration. Stress free encapsulation is ensured by careful engineering and manufacturing.

SCHEMATICS/DIMENSIONS

Note: All Views are Top of Unit — Pins on Bottom



OPTIONS

For Electrostatic Shield, Add Suffix S (connected to Pin #2)

Contact Arrangement	Schematics/ Dimensions Fig.	Table of Coil Resistance Values @ 20°C Coil Voltages 5V Ohms	6V Ohms	12V Ohms	24V Ohms	Price 100 Qty. Any Voltage
1A	1	290	290	1080	4100	$2.35
1B	1	465	465	1900	4100	2.80
2A	2	145	145	650	2600	3.04
2B	2	95	95	400	1480	3.50
*1A1B	2	95	95	400	1480	3.50
1A2B	3	75	75	280	1170	4.30
2A1B	3	75	75	280	1170	4.30
3A	3	115	115	490	1800	3.48
4A	4	80	80	300	1250	4.05
2A2B	4	49	49	300	830	5.10
Max. Pull-in Voltage @ 20°C	—	4.0	4.8	9.6	19.2	—
Min. Drop-out Voltage @ 20°C	—	.8	.9	1.8	3.6	—

Prices subject to change without notice.
*Form C action.

ORDERING INFORMATION

To order, specify Series Number, Contact Arrangement, Coil Voltage and optional electrostatic shields if required.

GP	1A	05	S
General Purpose	Contact Arrangement	Coil Voltage	With Electrostatic Shielding

GENERAL SPECIFICATIONS

Operate Time:

Form A In the order of 1.0 ms including bounce.
Form B In the order of .1 ms.

Release Time:

Form A In the order of .1 ms.
Form B In the order of 1.0 ms including bounce.

Insulation Resistance:

Typically greater than 1 x 10^{12} ohms.

Life Expectancy:

100 x 10^6 operations at low level:
10 x 10^6 at rated load.

Operate Temperature: 0°C to +65°C.

Storage Temperature: −55°C to +85°C.

CONTACT RATING

Form A, B

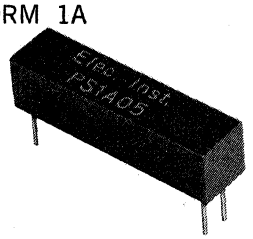
½ amp. max., 200 volts max. with 10 watt power limitation. Initial contact resistance .100 ohms max. Breakdown voltage 300 volts.

PICO SERIES

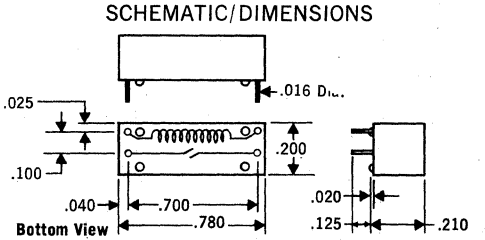
ULTRA-MINIATURE REED RELAYS

Micro-sized reed relays specifically designed for ultra high speed switching systems and requiring minimum coil power. Extremely small in physical size for high density circuit packaging. Use to interface solid state circuits in instrument, in computer and telemetry applications.

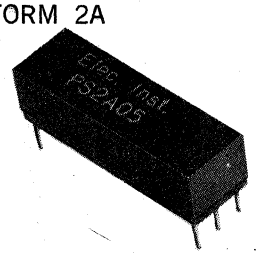
FORM 1A



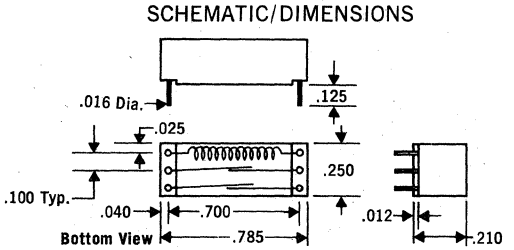
SCHEMATIC/DIMENSIONS



FORM 2A



SCHEMATIC/DIMENSIONS

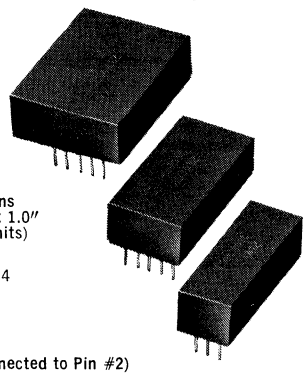


ELECTRONIC INSTRUMENT & SPECIALTY CORP.

Mini-Inch Reed Relays

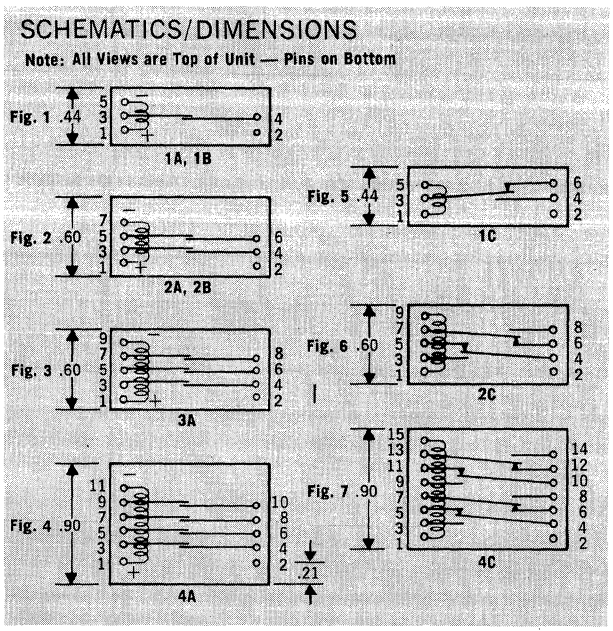
- .10" x 1.00" GRID
- DRY REED
- MERCURY WETTED

Magnetically shielded, and stress free encapsulated, the Mini-inch series has both dry reed and mercury wetted contacts available. More compact than the general purpose relay, and with a .10" pin grid, these relays have wide acceptance for PC board mounting.

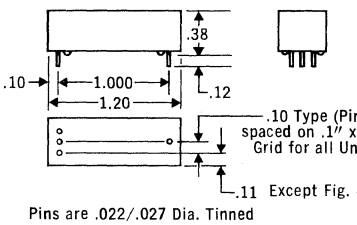


SCHEMATICS/DIMENSIONS

Note: All Views are Top of Unit — Pins on Bottom



Dimensions Typical of all Units



Pins are .022/.027 Dia. Tinned

OPTIONS

For Electrostatic Shield, add Suffix S (connected to Pin #2)

Switch Type	Contact Arrangement	Schematics/ Dimensions Fig.	Table of Coil Resistance Values @ 20°C Coil Voltages 5V Ohms	6V Ohms	12V Ohms	24V Ohms	Price 100 Qty. Any Voltage
Dry Reed	1A	1	100	125	500	2000	$2.09
	2A	2	85	110	440	1750	3.04
	3A	3	65	85	340	1350	3.78
	4A	4	45	60	250	1000	4.52
	1B	1	100	125	500	2000	2.80
	2B	2	85	110	440	1750	3.50
	1C	5	100	125	500	2000	4.25
	2C	6	60	80	310	1250	7.10
	4C	7	22	30	125	500	12.72
Mercury* Wetted	1A	1	70	95	375	1500	4.18
	2A	2	45	60	250	1000	6.40
	4A	4	18	25	100	400	11.40
Max. Pull-in Voltage @ 20°C	—	—	4.0	4.8	9.6	19.2	—
Min. Drop-out Voltage @ 20°C	—	—	.8	.9	1.8	3.6	—

Prices subject to change without notice.

*Must be mounted vertically. Coil pins at bottom.

ORDERING INFORMATION

To order specify Series Number (MS), Contact Arrangement, Coil Voltage, Mercury Wetted Contacts if required (Suffix M), and electrostatic shielding if required (Suffix S).

MS	1A	05	M	S
Series	Contact Arrangement	Coil Voltage	Mercury Wetted	Electrostatic Shielding

FORM 1A PICO SERIES

Contacts: Dry Reed normally open

Contact Rating:
¼ amp max., 100 volts max., within 10 watt power limitation. Initial contact resistance .150 ohm max.

Operate Time: In the order of 0.3 millisecond

Release Time: In the order of 0.1 millisecond

Insulation Resistance:
Typically greater than 1 x 10^{11} ohms

		All Values @ 20°C			
Cat. No.	Volts	Coil Resist. ±10%	Pull-in Max. Volts	D.O. Min. Volts	Price 100 Qty.
PS1A05	5	390	4.0	.8	$2.24
PS1A06	6	390	4.8	.9	2.24
PS1A12	12	1125	9.6	1.8	2.49
PS1A24	24	3800	19.2	3.6	2.97

Prices subject to change without notice.

FORM 2A PICO SERIES

Contacts: Dry Reed normally open

Contact Rating:
100 ma max., 28 volts max., within 3 watt power limitation. Initial contact resistance .200 ohm max.

Operate Time: In the order of 0.2 millisecond

Release Time: In the order of 0.1 millisecond

Insulation Resistance:
Typically greater than 1 x 10^{11} ohms

		All Values @ 20°C			
Cat. No.	Volts	Coil Resist. ±10%	Pull-in Max. Volts	D.O. Min. Volts	Price 100 Qty.
PS2A05	5	200	4.0	.8	$3.04
PS2A06	6	200	4.8	.9	3.04
PS2A12	12	400	9.6	1.8	3.16
PS2A24	24	1200	19.2	3.6	3.21

Prices subject to change without notice.

GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time (excluding bounce)
Dry Reed, Form A	.3 ms	.1 ms
Dry Reed, Form B	.1 ms	.3 ms
Dry Reed, Form C	.5 ms	.1 ms
Mercury Wetted, Form A	2.0 ms	2.0 ms

Insulation Resistance:
1 x 10^{12} ohms typical, except Form C (1 x 10^{10})

Life Expectancy:
100 x 10^6 operations at low level
10 x 10^6 at rated load, Mercury Wetted 10 X higher

Operate Temperature: 0°C to +65°C

Storage Temperature: −55°C to +85°C

CONTACT RATING

Dry Reed, Form A, B:
½ amp. max., 200 volts max. with 10 watts power limitation. Initial contact resistance .1 ohm max. Breakdown voltage 300 volts.

Dry Reed, Form C:
¼ amp. max., 28 volts max. with 3 watts power limitation. Initial contact resistance .15 ohm max. Breakdown voltage 250 volts min.

Mercury Wetted Form A:
1 amp max., 100 volts max. with 28 watts power limitation. Initial contact resistance .05 ohm max. Breakdown voltage 1000 volts min.

*Consult factory or local representative for performance details.

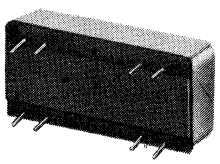
42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

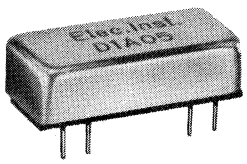
ELECTRONIC INSTRUMENT & SPECIALTY CORP.

DIP Reed Relays

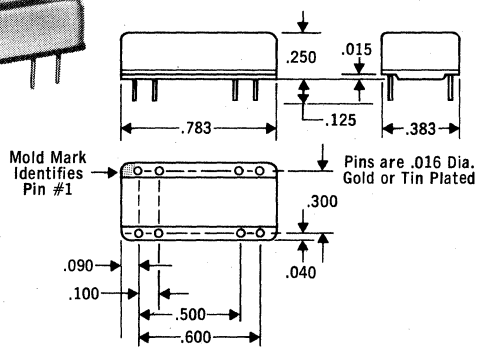
- **DRY REED**
- **MERCURY WETTED**
- **MAGNETICALLY SHIELDED**

Featuring high performance in a compact, low profile package, these DIP reed relays can be driven directly from TTL and DTL circuits. Magnetic shielding is standard with this line. Careful engineering and manufacturing ensures stress free encapsulation.

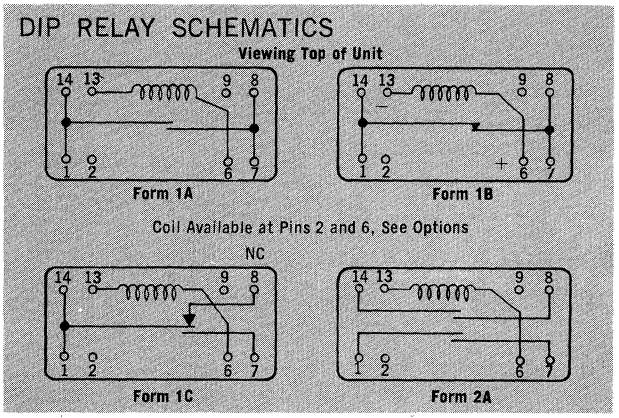




DIMENSIONS



DIP RELAY SCHEMATICS



GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time (excluding bounce)
Dry Reed, Form A	.3 ms	.1 ms
Dry Reed, Form B	.1 ms	.3 ms
Dry Reed, Form C	.5 ms	.1 ms
Mercury Wetted Form A	2.0 ms	2.0 ms

Insulation Resistance: Typically greater than 1 x 10^{12} ohms except Form C (1 x 10^{10})

Life Expectancy: 100 x 10^6 operations at low level; 10 x 10^6 at rated load, mercury wetted 10 times higher

CONTACT RATING

Dry Reed, Form 1A, 2A, 1B: ¼ amp max., 100 volts max., within 10 watt power limitation. Initial contact resistance .150 ohm max.

Dry Reed, Form 1C: ¼ amp max., 28 volts max., within 3 watt power limitation. Initial contact resistance .150 ohm max.

Mercury Wetted, Form 1A: 1 amp max., 100 volts max., within 28 watt power limitation. Initial contact resistance .050 ohm max.

*Consult factory or local representative for performance details.

OPTIONS

Coil Pins @ 2 & 6 — Add Suffix C

For Electrostatic Shield, Add Suffix S (connected to Pin #9)

For Diode Across Coil, Add Suffix D (Pin #13 Negative, Pin #6 Positive)

All Values @ 20°C

Cat. No.	Contact Arrangement	Volts	Coil Resistance ±10%	Max. Pull-in Volts	Min. Drop out Volts	Price 100 Qty.
DRY REED CONTACTS						
D1A05	1A	5	500	4.0	.8	$2.09
D1B05	1B	5	500	4.0	.8	2.94
D1C05	1C	5	200	4.0	.8	4.55
D1A06	1A	6	500	4.8	.9	2.09
D1B06	1B	6	500	4.8	.9	2.94
D1C06	1C	6	200	4.8	.9	4.55
D1A12	1A	12	1000	9.6	1.8	2.24
D1B12	1B	12	1000	9.6	1.8	3.09
D1C12	1C	12	750	9.6	1.8	4.86
D1A24	1A	24	4000	19.2	3.6	2.67
D1B24	1B	24	4000	19.2	3.6	3.51
D1C24	1C	24	3000	19.2	3.6	5.80
D2A05	2A	5	200	4.0	.8	3.04
D2A06	2A	6	200	4.8	.9	3.04
D2A12	2A	12	800	9.6	1.8	3.19
D2A24	2A	24	3000	19.2	3.6	3.61
MERCURY WETTED CONTACTS						
*MD1A05	1A	5	80	4.0	.8	4.18
*MD1A06	1A	6	100	4.8	.9	4.18
*MD1A12	1A	12	400	9.6	1.8	4.33
*MD1A24	1A	24	1600	19.2	3.6	4.51

*NOTE: Must be mounted vertically, Pins 1 & 14 at top.

Prices subject to change without notice.

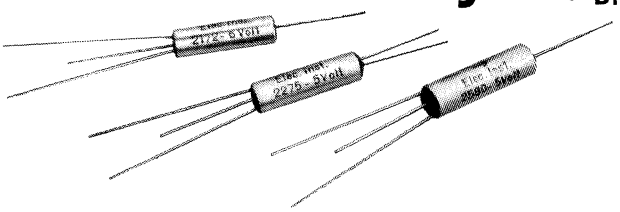
Terms: 1% 10 Days / Net 30 F.O.B. Factory

42 PLEASANT STREET / STONEHAM, MASSACHUSETTS 02180 / TELEPHONE (617) 438-5300

ELECTRONIC INSTRUMENT & SPECIALTY CORP.

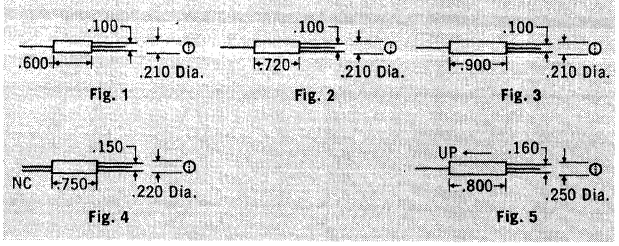
Axial Reed Relays

- MICROMINIATURE
- DRY REED
- MERCURY WETTED
- MAGNETICALLY SHIELDED



These **tiny** axial reed relays, available in dry reed or mercury wetted configurations, are fast to operate, take up a minimum of space, yet can carry a big load. Ideal for applications where low contact resistance, fast operation and long life in a midget packet are required.

SCHEMATICS/DIMENSIONS



GENERAL SPECIFICATIONS

Speed, Typical*	Operate Time (excluding bounce)	Release Time
Dry Reed, Form 1A	.2 to .5 ms	.1 ms
Dry Reed, Form 1C (N.O.)	.4 ms	.1 ms
Mercury Wetted, Form 1A	2 ms	2 ms

Insulation Resistance: Typically greater than 1×10^{12} ohms except Form C (1×10^{10})

Life Expectancy: 100 x 10^6 operations at low level; 10 x 10^6 at rated load, Mercury Wetted 10 X higher

Operate Temperature: 0°C to +65°C

Storage Temperature: −55°C to +85°C

*Consult factory for performance details.

OPTIONS

For Electrostatic Shield, add Suffix S

Cat. No.	2160S			2160R				2172*				2190				2275				2580**			
Dimensions	Fig. 1			Fig. 1				Fig. 2				Fig. 3				Fig. 4				Fig. 5			
Contact Type	DRY REED																			Mercury Wetted			
Contact Arrangement	1A			1A				1A				1A				1C				1A			
Nominal Voltage	5	6	12	5	6	12	24	5	6	12	24	5	6	12	24	5	6	12	24	5	6	12	24
Coil Resist., Ohms	750	1000	3800	375	500	2100	4800	400	630	2800	5500	400	630	2800	5500	240	325	1200	5000	105	105	400	1700
Contact Ratings																							
Current, Max.	10 ma			10 ma				¼ amp.				½ amp.				¼ amp.				1 amp.			
Voltage, Max.	28 volts			28 volts				100 volts				200 volts				28 volts				28 volts			
Power, Max.	.3 watts			.3 watts				10 watts				10 watts				3 watts				28 watts			
Initial Contact Resistance Max.	.200 ohms			.200 ohms				.150 ohms				.100 ohms				.150 ohms				.050 ohms			
Price 100 Qty., $	3.83	3.83	4.40	3.33	3.33	3.83	4.99	3.33	3.33	3.83	4.99	3.33	3.33	3.83	4.99	5.16	5.16	5.67	6.70	4.04	4.04	4.54	5.57
Pull-in Voltage Max. @ 20°C	80% of nominal voltage																						
Drop-out Voltage Min. @ 20°C	15% of nominal voltage																						

*Available RF switch (low resistive loss to 100 MHz).
**Available in dry reed contacts for 1000 VDC or 2000 VDC breakdown.
Prices subject to change without notice.

ORDERING INFORMATION

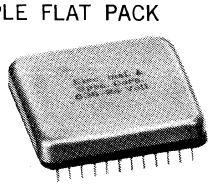
To order, specify Catalog Number, Coil Voltage and Optional Electrostatic Shield if required.

Example: **2160S** Catalog Number; **12** Coil Voltage; **S** Electrostatic Shield

SPECIAL PURPOSE RELAYS

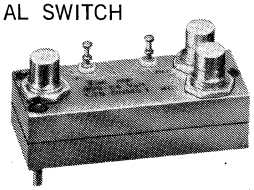
Electronic Instrument has produced a wide assortment of tailored relays beyond its standard lines. Some of these styles are shown below and are available with almost off-the-shelf delivery. If your requirement is not a standard, send us your specifications and let us prove our capability to produce **the** relay for **your** application at economical prices.

MULTIPLE FLAT PACK



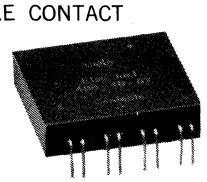
Relay designed to permit 0.5 inch PC board stacking; will insert easily in standard contact strip.

COAXIAL SWITCH



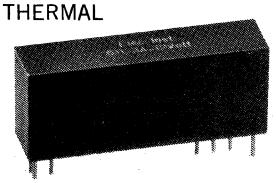
Fast switching, low power to operate and miniature size are several outstanding features offered in this series.

MULTIPLE CONTACT



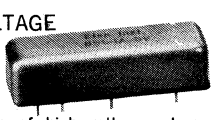
Pin accessibility from top of PC board along with a wide range of contact arrangements are available in this low profile relay.

LOW THERMAL



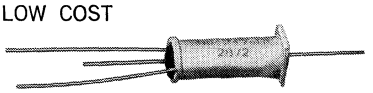
This relay illustrates one of many low thermal relays available. Differential thermals as low as 2 microvolts.

HIGH VOLTAGE



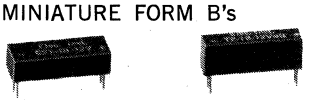
A wide range of high voltage relays capable of switching up to 27,500 volts are available. Package size varies with ratings.

LOW COST



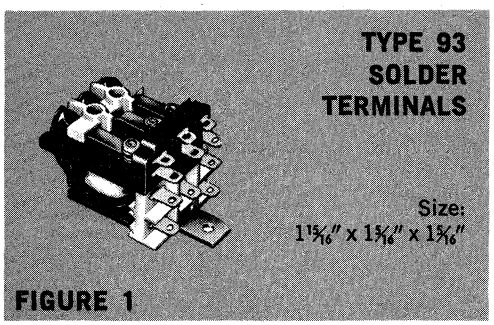
Axial Leads
Size: ⅜ dia. x ⅞ long (bobbin)
Rating: ½ amp., 200 VDC, 10 watts

SUBMINIATURE FORM B's



These relays offer the ultimate in high density packaging.
Rating: ¼ amp., 100 volts, 10 watts

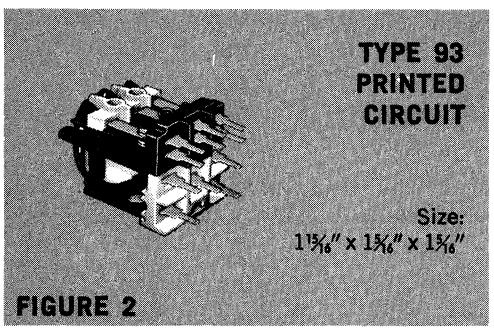
A.C. D.C. GENERAL PURPOSE RELAYS



TYPE 93 SOLDER TERMINALS

Size: 1 15/16" x 1 3/16" x 1 5/16"

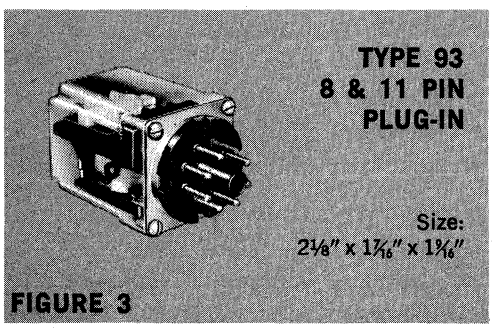
FIGURE 1



TYPE 93 PRINTED CIRCUIT

Size: 1 15/16" x 1 3/16" x 1 5/16"

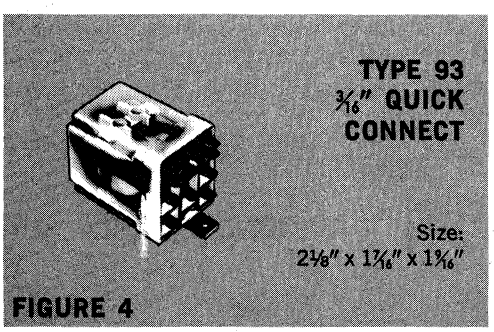
FIGURE 2



TYPE 93 8 & 11 PIN PLUG-IN

Size: 2 1/8" x 1 7/16" x 1 5/16"

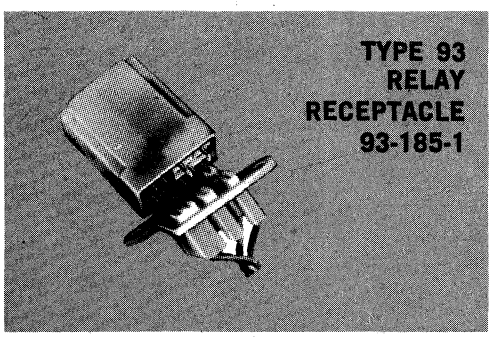
FIGURE 3



TYPE 93 3/16" QUICK CONNECT

Size: 2 1/8" x 1 7/16" x 1 5/16"

FIGURE 4



TYPE 93 RELAY RECEPTACLE 93-185-1

SINGLE POLE DOUBLE THROW
TWO AND THREE POLE DOUBLE THROW

Coil Voltage	D.C. Resistance in Ohms @ 25°C	Contact Form	Open Type		
			Solder Terminals (Fig.1)		Printed Circuit (Fig. 2)
			10 Amp. Button Contacts	5 Amp. Cross-Bar Contacts	5 Amp. Cross-Bar Contacts
			Catalog Number	Catalog Number	Catalog Number
24 (50/60 Hz)	55	1PDT	93-904	93-934	*93-964
		2PDT	93-905	93-935	*93-965
		3PDT	93-906	93-936	*93-966
120 (50/60 Hz)	1400	1PDT	93-907	93-937	*93-967
		2PDT	93-908	93-938	*93-968
		3PDT	93-909	93-939	*93-969
208/240 (50/60 Hz)	4850	1PDT	93-910	93-940	—
		2PDT	93-911	93-941	—
		3PDT	93-912	93-942	—
12 D.C.	96	1PDT	93-916	93-946	*93-976
		2PDT	93-917	93-947	*93-977
		3PDT	93-918	93-948	*93-978
24 D.C.	384	1PDT	93-919	93-949	*93-979
		2PDT	93-920	93-950	*93-980
		3PDT	93-921	93-951	*93-981

The RBM Type 93 relays are used in vending machines, heating, air conditioning, business machines, control panels, appliances, data processing equipment, office machines, communications systems and instruments.

The coil bobbin and contact terminal block are molded plastic and is resistant to arc tracking. The contact terminal allows - (a) easy insertion and removal of connectors, (b) stresses caused by wiring hook-up cannot change relay adjustment. The contact springs are molded as an integral assembly and gives excellent stability in all environmental conditions. The armature contact springs are connected to the terminals by flexible insulated leads welded to the terminals. Connections for the contacts and coil are located on the front of the relay.

Solder terminal type has combined front, single hole screw and stud mounting. Printed*circuit type may be controlled by SCR if firing angle is no more than 10 degrees.

The plug-in relay has high impact case and standard pin connections.

Quick connect type designed for front mounting or polarized socket mounting. Use 93-153-1 socket kit. Relay has .20 x .187 terminals. UL & CSA recognized under Component Recognition Program: Hardware included in boxed units only.

Coil Voltage	D.C. Resistance in Ohms @ 25°C	Contact Form	Enclosed Type			
			Plug-In (Fig.3)		Quick Connect Terminals (Fig. 4)	
			10 Amp. Button Contacts	5 Amp. Cross-Bar Contacts	10 Amp. Button Contacts	5 Amp. Cross-Bar Contacts
			Catalog Number	Catalog Number	Catalog Number	Catalog Number
24 (50/60 Hz)	55	1PDT	93P-904	93P-934	93Q-904	93Q-934
		2PDT	93P-905	93P-935	93Q-905	93Q-935
		3PDT	93P-906	93P-936	93Q-906	93Q-936
120 (50/60 Hz)	1400	1PDT	93P-907	93P-937	93Q-907	93Q-937
		2PDT	93P-908	93P-938	93Q-908	93Q-938
		3PDT	93P-909	93P-939	93Q-909	93Q-939
208/240 (50/60 Hz)	4850	1PDT	93P-910	93P-940	93Q-910	93Q-940
		2PDT	93P-911	93P-941	93Q-911	93Q-941
		3PDT	93P-912	93P-942	93Q-912	93Q-942
12 D.C.	96	1PDT	93P-916	93P-946	93Q-916	93Q-946
		2PDT	93P-917	93P-947	93Q-917	93Q-947
		3PDT	93P-918	93P-948	93Q-918	93Q-948
24 D.C.	384	1PDT	93P-919	93P-949	93Q-919	93Q-949
		2PDT	93P-920	93P-950	93Q-920	93Q-950
		3PDT	93P-921	93P-951	93Q-921	93Q-951

CONTACT RATINGS

A.C. Voltage	A.C. CURRENT				D.C. CURRENT	
	Fine Silver Button		Gold-Alloy Cross Bar		Button	Cross Bar
	Inductive	Resistive	Inductive	Resistive	@ 28 V.D.C.	@ 28 V.D.C.
120	1/6 H.P.	10 Amp.	1/10 H.P.	5 Amp.	5 Amp. Resistive	5 Amp. Resistive
240	1/3 H.P.	5 Amp.	1/6 H.P.	3 Amp.	Consult Factory on U.L. and C.S.A.	

A.C. D.C. GENERAL PURPOSE RELAYS

ESSEX/RBM 3

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number Figure 1		Contact Rating 125/250 V.A.C.	
	1PNO	1PDT	Inductive	Resistive
6	84-901	84-905	N.O. 8 Amps. Continuous 25 Amps. Inrush	N.O. 16 Amps. Continuous
24	84-902	84-906		
120	84-903	84-907		
230/240	84-904	84-908		
Coil Voltage A.C.	Catalog Number Figure 2			
	1PNO	1PDT		
24	84-912	84-916	D.T. 8 Amps. Continuous 18 Amps. Inrush	D.T. 8 Amps. Continuous
120	84-913	84-917		
230/240	84-914	84-918		
24	84-922	84-926	3 Amps. @ 125 V.A.C. or 1.5 Amps. @ 250 V.A.C. Pilot Duty	
120	84-923	84-927		
230/240	84-924	84-928		

Coil Voltage D.C.	Resistance in Ohms @ 25°C	Catalog Number Figure 1	D.C. Contact Rating Inductive	
			Voltage	Current
12	90	84D-902	12	3 Amp.
24	280	84D-903	24	1.5 Amp.

TYPE 84

- Totally Enclosed
- Low Cost
- Screw or ¼" Quick Connect Termination
- Hardware Included in Boxed Units Only
- Operates Any Position
- Isolated Coil
- I or T Mounting Brackets
- A.C. Coils Rated 50/60 Hz
- U.L. and C.S.A.
- Size: 2⅜" x 1⅝" x 1½"

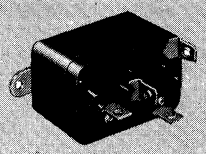


Figure 1

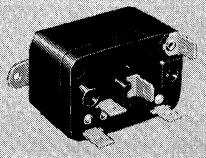


Figure 2

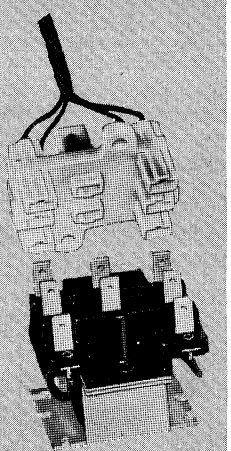
TWO POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number	Circuit Rating Terminals		Power Rating	
		1-2-3	4-5-6	Inductive	Resistive
24	91-901	Power	Power	12 Amp. Cont. 60 Amp. Inrush 125 V.A.C. 6 Amp. Cont. 35 Amp. Inrush 250 V.A.C.	15 Amp. 277 V.A.C. Max.
120	91-902				
230/240	91-903				
24	91-904	Power	Pilot		
120	91-905				
230/240	91-906			Pilot Rating	
24	91-907	Pilot	Pilot	Inductive	Resistive
120	91-908			125 V.A. 1/10 H.P. 125/250 V.A.C.	3 Amp. 277 V.A.C. Max.
230/240	91-909				

Coil Voltage D.C.	Catalog Number	Resistance in Ohms @ 25°C	D.C. Contact Rating - Resistive
12	91D-912	29	10 Amps. @ 32 V. Max.
24	91D-913	115	

TYPE 191

- ¼" Quick Connect Termination
- U.L. and C.S.A.
- Enclosed Contacts
- Operates Any Position
- Solenoid Action
- Wiring Terminals Included in Boxed Units Only
- A.C. Coils Rated 50/60 Hz
- Can Be Panel Mounted
- Separate 91-180-1 Socket and Terminal Kit
- Size: 2⅛" x 1⅞" x 2⅜"



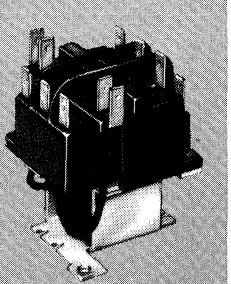
THREE POLE DOUBLE THROW

Coil Voltage A.C.	Catalog Number	Circuit Rating Terminals			Power Rating	
		1-2-3	4-5-6	7-8-9	Inductive	Resistive
24	92-901	Power	Power	Power	12 Amp. Cont. 60 Amp. Inrush 125 V.A.C. 6 Amp. Cont. 35 Amp. Inrush 250 V.A.C.	15 Amp. 277 V.A.C. Max.
120	92-902					
230/240	92-903					
24	92-904	Power	Pilot	Power	Pilot Rating	
120	92-905				Inductive	Resistive
230/240	92-906				120 V.A. 1/10 H.P. 125/250 V.A.C.	3 Amp. 277 V.A.C. Max.

Coil Voltage D.C.	Catalog Number	Resistance in Ohms @ 25°	D.C. Contact Rating - Resistive
12	92D-912	26	10 Amps. @ 32 V. Max.
24	92D-913	104	

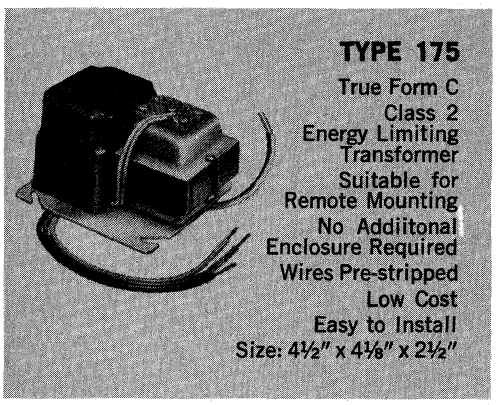
TYPE 192

- ¼" Quick Connect Termination
- U.L. and C.S.A.
- Enclosed Contacts Operates Any Position
- Solenoid Action
- Wiring Terminals Included in Boxed Units Only
- Manual Operating Button
- A.C. Coils Rated 50/60 Hz
- Size: 2⅜" x 2⅜" x 2¾"



4 **ESSEX/RBM**

FAN RELAY AND TRANSFORMER PKG.



TYPE 175

True Form C
Class 2
Energy Limiting
Transformer
Suitable for
Remote Mounting
No Addiitonal
Enclosure Required
Wires Pre-stripped
Low Cost
Easy to Install
Size: 4½" x 4⅛" x 2½"

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

White card listing — U.L. File E33034 fits standard 4-inch junction box. Transformer rated 40 V.A., 120 V.A.C. primary, 24 V.A.C. secondary. 7 inch lead wires

Catalog Number	Pole Form	Contact Rating — 250 V.A.C. Max.	
		Inductive	Resistive
175-901	SPNO	1 H.P. - 125 V. 1½ H.P. - 250 V.	18 Amps. Continuous
175-902	SPDT		
175-903	SPNO	¾ H.P. at 125/250 V. A.C. Max.	15 Amps at 277 V.A.C. Max.
175-904	SPDT		

Consult Factory. Resistive loads and U.L. Circuit diagram stamped on unit.

A.C. POWER RELAYS

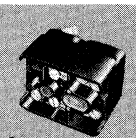


Figure 1

Figure 2

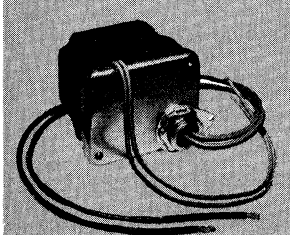
TYPE 129

Double-Break
Contacts
Totally Enclosed
Hi-Impact Case
Screw or ¼" Quick
Connect Termination
Hardware Included in
Boxed Units Only
U.L. and C.S.A.
Non-Positional
Size: 2⅜" x 1⅞" x 1⅞"

SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage (50/60 Hz)	Catalog Number				Contact Rating 250 V.A.C. Max.	
	Figure 1		Figure 2			
	1PNO	†1PDT	1PNO	†1PDT	Inductive	Resistive
6	129-901	129-905			18 Amp. Continuous 1 H.P. - 125 V. 2 H.P. - 250 V. Single Phase	25 Amp. Continuous
24	129-902	129-906	129-911	129-914		
120	129-903	129-907	129-912	129-915		
208/230	129-904	129-908	129-913	129-916		

† All contact terminals must be wired same polarity.



TYPE 129AR

Totally Enclosed
Hi-Impact Case
Double-Break
Contacts
Easy to Mount
U.L. and C.S.A.
Pre-Wired
No Enclosure
Required
Low Cost
Size: 2¾" x 2⅝" x 3⅛"

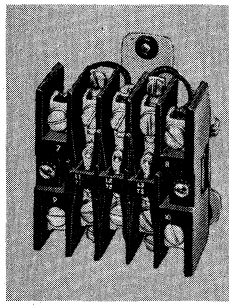
SINGLE POLE NORMALLY OPEN AND SINGLE POLE DOUBLE THROW

Coil Voltage (50/60 Hz)	Catalog Number		Contact Rating — 250 V.A.C. Max.	
	1PNO	†1PDT	Inductive	Resistive
24	129AR-901	129AR-904	18 Amp. Continuous 1 H.P. - 120 V. 1½ H.P. - 250 V. Single Phase	25 Amp. Continuous
120	129AR-902	129AR-905		
208/230	129AR-903	129AR-906		

FITS ANY ½" KNOCK-OUT. MEETS STANDARD CODE REQUIREMENTS.
Underwriters Lab. white card listed. File E12139D 184N13.13 7/17/63.
Aluminum die-cast base and bushing. High impact phenolic enclosure.
Locknuts and position locking washer included. Color coded 8" lead wires.

† All contact terminals must be wired same polarity.

A.C. POWER CONTACTORS



TYPE 85

Screw Terminals
#8 Solid Wire Max.
Double Make
Contacts
¼" Auxiliary Wiring
Terminals
Straight-Thru Wiring
Hi-Dielectric
Materials
Size: 3½" x 3⅛" x 2⅝"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.) — Inductive	
		250 V.	600 V.
24	85-901	25 Amp. Cont. 150 Amp. Inrush	12.5 Amp. Cont. 75 Amp. Inrush
120	85-902		
208/240	85-903		

No kiss position. Mounts any position.

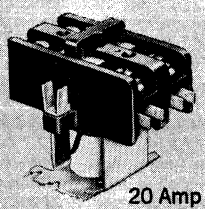
A.C. POWER CONTACTORS

ESSEX/RBM 5

TWO POLE NORMALLY OPEN

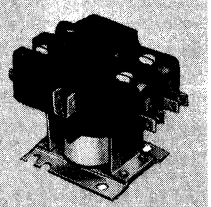
Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating	
		Inductive	Resistive
24	143-901	20 Amp. Cont. 100 Amp. Inrush @ 277 V.A.C. Per Pole	25 Amp. @ 600 V.A.C. Per Pole
120	143-902		
208/240	143-903		
24	143-914	25 Amp. Cont. 150 Amp. Inrush @ 277 V.A.C. Per Pole With Cover	35 Amp. @ 600 V.A.C. Per Pole With Cover
120	143-915		
208/240	143-916		
24	143-906	30 Amp. Cont. 150 Amp. Inrush @ 277 V.A.C. Per Pole With Cover	35 Amp. @ 600 V.A.C. Per Pole With Cover
120	143-907		
208/240	143-908		

TYPE 143



Straight-Thru Wiring
Low Cost
¼" Auxiliary Quick-Connect Terminals
U.L. and C.S.A.
Hardware Included in Boxed Units Only
Screw Power Terminals For #10 Solid Wire Max.
25 & 30 Amp Units Have Cover
Double-Make Contacts
Small Size
Size: 3¼" x 2⅜" x 2½"

20 Amp



25-30 Amp

TWO POLE NORMALLY OPEN

Coil Voltage (60 Hz)	Catalog Number Fig. 1	Catalog Number Fig. 2	Contact Rating (A.C.)	
			Inductive	Resistive
24	75-901	75-904	1 H.P. Per Pole 115/230 V. 2 Pole Rating 2 H.P. — 230 V. or 18 Amp. Cont. 90 Amp. Inrush	25 Amp. 240 V. Per Pole .75 P.F.
115/120	75-902	75-905		
230/240	75-903	75-906		

TYPE 75

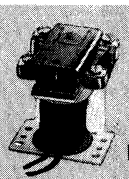


Figure 1

Contact Cover
Screw Power Termination #8 Solid Wire Max.
Low Wattage Coil
13" Lead Wire or Quick Connect Coil Terminals
Hardware Included in Boxed Units Only
Size: 2½" x 2⅛" x 2¼"

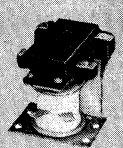
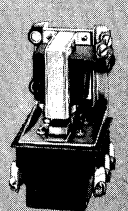


Figure 2

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.) — Inductive		
		Voltage	Continuous	Inrush
24	S30-901	250 600	30 Amp. 15 Amp.	180 Amp. 90 Amp.
115	S30-902			
230	S30-903			

TYPE S30

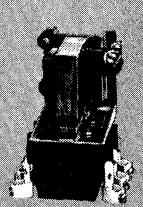


Solenoid Action
Enclosed Contacts
Resilient Mounting
Screw Power Termination For #8 Solid Wire Max.
Epoxy Coil
Hi-Dielectric
Double Make Contacts
Size: 3⅞" x 2⅜" x 2½"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating (A.C.) — Inductive		
		Voltage	Continuous	Inrush
24	S40-901	250 600	40 Amp. 20 Amp.	200 Amp. 100 Amp.
115	S40-902			
230	S40-903			

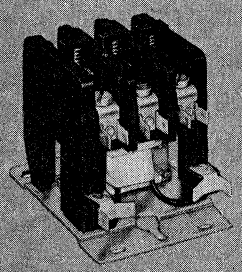
TYPE S40



Pressure Power Termination For #6 Solid Wire Max.
Solenoid Action
Enclosed Contacts
Resilient Mounting
Hi-Dielectric
Epoxy Coil
Double Make Contacts
Size: 3⅞" x 2¾" x 2½"

6 ESSEX/RBM

A.C. POWER CONTACTORS

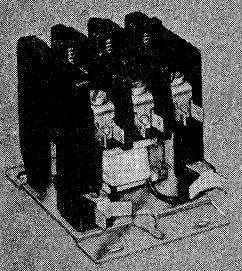


TYPE 154
20 AMPS
Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Size: 3⅛" x 3¾" x 2¾"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-901	Continuous 20 Amps. @ 600 V.	30 Amps @ 600 V. A.C. Max.
120	154-902	Inrush 120 Amps. @ 277 V. 100 Amps. @ 480 V. 80 Amps. @ 600 V.	
208/240	154-903		

Screw Connectors line and load sides for #14 thru #8 wire. ¼" Double Quick Connect auxiliary and coil terminals.

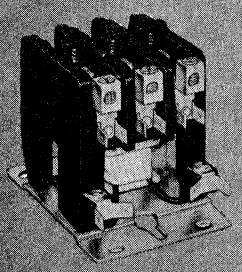


TYPE 154
25 AMPS
Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included
Boxed Units Only
Size: 3⅛" x 3¾" x 2¾"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-904	Continuous 25 Amps. @ 600 V.	35 Amps. @ 600 V. A.C. Max.
120	154-905	Inrush 150 Amps. @ 277 V. 125 Amps. @ 480 V. 100 Amps. @ 600 V.	
208/240	154-906		

Screw Connectors line and load sides for #14 thru #8 wire. ¼" Double Quick Connect auxiliary and coil terminals.

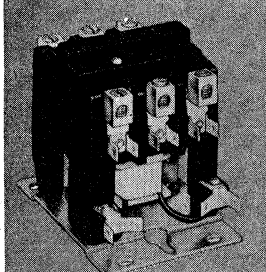


TYPE 154
30 AMPS
Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included
Boxed Units Only
Size: 3⅛" x 3¾" x 2¾"

THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number	Contact Rating Per Pole	
		Inductive	Resistive
24	154-907	Continuous 30 Amps. @ 600 V.	40 Amps. @ 600 V. A.C. Max.
120	154-908	Inrush 180 Amps. @ 277 V. 150 Amps. @ 480 V. 120 Amps. @ 600 V.	
208/240	154-909		

Pressure Connectors on line side for #14 thru #4 wire. Screw Connectors on load side. ¼" Double Quick Connect auxiliary and coil terminals.



TYPE 154
40 AMPS
Interchangeable Mounting
Non-Positional
Low Coil Wattage
Double-Break Contacts
Non-Corroding Structure
Low Temp. Rise
Riveted Terminal Assemblies
Hardware Included
Boxed Units Only
Size: 3¼" x 3¾" x 2¾"

TWO AND THREE POLE NORMALLY OPEN

Coil Voltage (50/60 Hz)	Catalog Number		Contact Rating Per Pole	
	2PNO	3PNO	Inductive	Resistive
24	154-913	154-910	Continuous 40 Amps. @ 600 V.	50 Amps. @ 600 V. A.C. Max.
120	154-914	154-911	Inrush 240 Amps. @ 277 V. 200 Amps. @ 480 V. 160 Amps. @ 600 V.	
208/240	154-915	154-912		

Pressure Connectors on line and load side for #14 thru #4 wire. ¼" Double Quick Connect auxiliary and coil terminals.

D.C. POWER RELAYS

ESSEX/RBM 9

SINGLE POLE NORMALLY OPEN

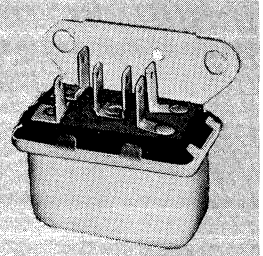
D.C. Coil Voltage	Resistance in Ohms	Catalog Number	Contact Rating	
			Voltage	Current
6	18	150-901	6	25 Amp.
12	44	150-902	12	25 Amp.
24	176	150-903	24	12 Amp.

SINGLE POLE DOUBLE THROW

D.C. Coil Voltage	Resistance in Ohms	Catalog Number	Contact Rating	
			Voltage	Current
6	18	150-904	6	15 Amp.
12	44	150-905	12	15 Amp.
24	176	150-906	24	7.5 Amp.

TYPE 150

Metal Case
Totally Enclosed
Isolated Coil
Side Bracket
¼" Quick-Connect Termination
Hardware Included in Boxed Units Only
Low Cost
Size: 2¼" x 1½" x 2"



D.C. POWER CONTACTORS

CONTACT RATING

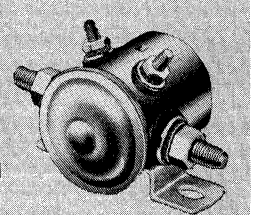
D.C. INDUCTIVE LOAD — 36 V. MAX.

Voltage (D.C.)	Normally Open		Normally Closed	
	Continuous	Inrush	Continuous	Inrush
6	80 Amp.	300 Amp.	60 Amp.	100 Amp.
12	80 Amp.	150 Amp.	60 Amp.	60 Amp.
24-36	50 Amp.	50 Amp.	30 Amp.	30 Amp.

NON-TURNING STUDS • DRAWN STEEL DUST PROOF ENCLOSURE • COPPER STUD POWER & COIL TERMINALS • DOUBLE BREAK ROTATING DISC MOVABLE CONTACT • SOLENOID ACTUATED • SUGGESTED MOUNTING — CAP DOWN

TYPE 70 4 TERMINAL

Isolated Coil
Silver or Copper Contacts
Hardware Included
Continuous Duty Coil
Ease In Wiring
Size: 2½" x 3½" x 2½"

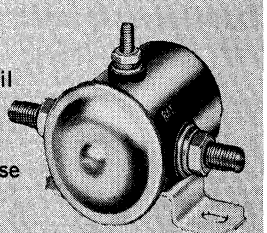


SINGLE POLE NORMALLY OPEN — 4 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-901	Copper
12	19	70-902	
24	60	70-903	
36	114	70-904	
6	4	70-905	Silver
12	19	70-906	
24	60	70-907	
36	114	70-908	

TYPE 70 3 TERMINAL

Continuous Duty Coil
Copper Contacts
Hardware Included
Coil Common to Case or Coil Common to Battery
Rugged Construction
Size: 2½" x 3½" x 2½"

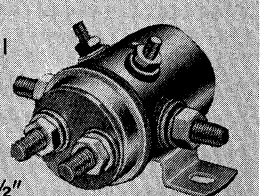


SINGLE POLE NORMALLY OPEN — 3 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-913	Copper — Coil Grounded to Case
12	19	70-914	
24	60	70-915	
36	114	70-916	
6	4	70-917	Copper — Coil Common to Load
12	19	70-918	
24	60	70-919	
36	114	70-920	

TYPE 70 6 TERMINAL

Continuous Duty Coil
Isolated Coil
Hardware Included
Choice of 2 Types Contacts
Size: 3⅜" x 3⁵⁄₁₆" x 2½"



SINGLE POLE DOUBLE THROW — 6 TERMINAL

Coil Voltage (D.C.)	Resistance in Ohms @ 25°C	Catalog Number	Contact Material
6	4	70-909	N.O. and N.C. Silver
12	19	70-910	
24	60	70-911	
36	114	70-912	
6	4	70-921	N.O. Copper and N.C. Silver
12	19	70-922	
24	60	70-923	
36	114	70-924	

GLASS REED SWITCHES AND RELAYS

BRM-902 MINIATURE BI-REED®

BRS-901 STANDARD BI-REED®

TRM-901 MINIATURE TRI-REED®

Contact Form		Single Pole Normally Open						Single Pole Double Throw		
Miniature or Standard		Miniature			Standard			Miniature		
Catalog Number		BRM-902			BRS-901			TRM-901		
Non-Inductive Contact Rating	Make and Break	15 VA. A.C. — 10 Watts D.C. .5 Amp. Maximum 250 Volts Max.			15 VA. A.C. — 15 Watts D.C. 1.0 Amp. Maximum 250 Volts Max.			10 VA. A.C. — 5 Watts D.C. ¼ Amp. Maximum up to 125 V.A.C. or 32 V.D.C.		
	No Make or Break	1.0 Amp. 250 V.			5 Amp. 250 V.			1 Amp. 125 V.A.C. or 32 V.D.C.		
Contact Life Based on 10 Ohm Miss Test	Resistive Load D.C.	10 Micro-Amp @ 10 Milli-Volts	⅛ Amp. @ 32 Volts		10 Micro-Amp @ 10 Milli-Volts	⅛ Amp. @ 32 Volts		10 Micro-Amp @ 10 Milli-Volts	⅛ Amp. @ 32 Volts	
	Number Operations	100,000,000	10,000,000		200,000,000	125,000,000		100,000,000	1,000,000	
Approximate Overall Dimensions		Over Leads 1.5″	Glass Length 0.77″	Glass Diameter 0.100″	Over Leads 3.20″	Glass Length 2.1″	Glass Diameter 0.200″	Over Leads 1.36″	Glass Length 0.60″	Glass Diameter 0.125″
Minimum Breakdown Voltage (60 Hz R.M.S.)		250 V.			500 V.			200 V.		
Minimum Insulation Resistance (Megohms)		500,000			500,000			100,000		
Initial Contact Resistance (Milliohms Max.)		100			100			150		
Maximum Operate Time (Milliseconds)		Pull-In (Including Bounce)		Release	Pull-In (Including Bounce)		Release	Pull-In (Including Bounce)		Release
		1.0		0.5	2.0		0.5	1.0		0.5
Ampere-Turns To Operate		Pull-In		Nominal	Pull-In		Nominal	Pull-In		Nominal
		Nominal	Minimum	Drop Out	Nominal	Minimum	Drop Out	Nominal	Minimum	Drop Out
		40 ±15	20	50% of P.U.	80 ±15	60	45% of P.U.	50 ±15	35	70% of P.U.
Vibration		15G — 2000 C.P.S.			20G — 750 C.P.S.			15G — 2000 C.P.S.		
Shock (JAN S-44)		50G (Min.)			40G (Min.)			50G (Min.)		
Ambient Temperature Range		−55° to +85°C			−55° to +85°C			−55° to +85°C		
Standard Test Coil Specifications See Page 15	Wire Size	#44			#36			#44		
	Number Turns	10,000			10,000			10,000		
	Tube I.D.	0.150″			0.210″			0.150″		
	Tube O.D.	0.183″			0.375″			0.200″		
	Tube Length	0.75″			1.75″			0.75″		

Coil Power	Nominal Voltage	Maximum Pick-up Voltage	Minimum Drop-out Voltage	Maximum Pick-up Current	Resistance in Ohms ±10%	Catalog Number
SINGLE POLE NORMALLY OPEN — FIGURE 1						
.750 Watts Max. @ 25°C	5 V.	3.8	0.5	7.6 MA	500	197-901
	6 V.	4.5	0.5	36 MA	125	197-902
	12 V.	9.0	1.0	18 MA	500	197-903
	24 V.	18.0	3.0	9 MA	2000	197-904
TWO POLE NORMALLY OPEN — FIGURE 2						
.750 Watts Max. @ 25°C	5 V.	3.8	0.5	15.2 MA	250	197-907
	6 V.	4.5	0.5	45 MA	100	197-908
	12 V.	9.0	1.0	22.5 MA	400	197-909
	24 V.	18.0	2.0	11.3 MA	1600	197-910

TYPE 197 OPEN

See BRM-902 For Switch Specs.
Operate Time 1 M.S. Including Bounce
Release Time 0.5 M.S.
Shock 50 G/Min. JAN S-44
Vibration: 15G 2000 Hz Min.
Magnetically Shielded
Gold Plated Terminals
Low Cost
Fig. 1 1.250 x .430 x .350
Fig. 2 1.250 x .530 x .350

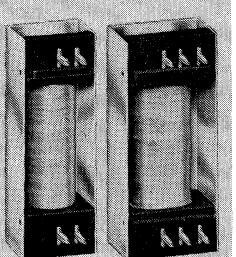


Figure 1 Figure 2

Coil Power	Nominal Voltage	Maximum Pick-up Voltage	Minimum Drop-out Voltage	Maximum Pick-up Current	Resistance in Ohms ±10%	Catalog Number
SINGLE POLE NORMALLY OPEN — FIGURE 1						
1.250 Watts Max. @ 25°C	5 V.	3.8	0.5	9.5 MA	400	97-901
	6 V.	4.5	0.5	45 MA	100	97-902
	12 V.	9.0	1.0	22.5 MA	400	97-903
	24 V.	18.0	3.0	11.3 MA	1600	97-904
TWO POLE NORMALLY OPEN — FIGURE 2						
1.250 Watts Max. @ 25°C	5 V.	3.8	0.5	19 MA	200	97-907
	6 V.	4.5	0.5	56 MA	80	97-908
	12 V.	9.0	1.0	28 MA	320	97-909
	24 V.	18.0	2.0	14 MA	1280	97-910

TYPE 97 ENCAPSULATED

See BRM-902 For Switch Specs.
Operate Time 1 M.S. Including Bounce
Release Time 0.5 M.S.
Shock 50G/Min. JAN-S-44
Vibration: 15G 2000 Hz Min.
Magnetically Shielded
Terminals .022 Dia.
Low Cost
Fig. 1 1.150 x .400 x .350
Fig. 2 1.150 x .500 x .350

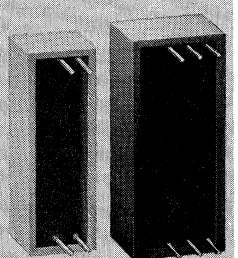
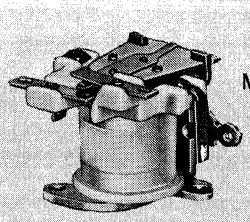


Figure 1 Figure 2

12 ESSEX/RBM MINIATURE D.C. SENSITIVE RELAYS

SINGLE POLE DOUBLE THROW — TWO POLE DOUBLE THROW — THREE POLE DOUBLE THROW

Electrical Life				Mechanical Life	Operate Time (Incl. Bounce)	Vibration	Shock	Operating Ambient
NON-INDUCTIVE LOAD	0.5 Amp.	1.0 Amp.	2.0 Amp.	50,000,000 At 180 Operations Per Minute (No Load)	20 Milliseconds	2G 10-55 Cycles	2G Operate 10G Non-Operate	−55°C to +85°C
NUMBER OPERATIONS	1,000,000	300,000	100,000					



TYPE MS40

Solder Terminals
Very Sensitive
Molded Construction
4-40 Mounting
Armature Common to Frame
Long Life
Low Cost
Gold Alloy Contacts
Size: 1⅛" x 1⅛" x 1⅛"

SINGLE POLE DOUBLE THROW — OPEN TYPE

Contact Rating	Coil Power		
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.	Minimum Required		0.050 Watts
	Maximum Capacity		1.0 Watts
D.C. Magnet Coil At 25°C			
Nominal Voltage or Current	Max. Pick-up Voltage or Current	Resistance in Ohms ±10%	Catalog Number
6 V.	3.5 V.	250	MS40-901
13.5 MA.	10 MA.	500	MS40-902
11.0 MA.	8.2 MA.	750	MS40-903
12 V.	7.0 V.	1000	MS40-904
7.7 MA.	5.8 MA.	1500	MS40-905
6.0 MA.	4.5 MA.	2500	MS40-906
4.3 MA.	3.2 MA.	5000	MS40-907
24 V.	19.5 V.	7500	MS40-908
3 MA.	2.3 MA.	10000	MS40-909

The MS64 Miniature Sensitive Relay is specifically designed for electronic applications where printed circuit termination and enclosed construction are of major importance. It has symmetrical configuration providing for minimum mounting space requirements and maximum protection to moving parts. A snap-on cover provides protection against contaminants and prevents damage to moving parts when handling. Mounting bracket versions of the relay are for conventional chassis mounting and "solder on" lead wire terminations.

The MS64 5 Amp. Relay utilizes ⅛" (.125") diameter Silver Alloy Contacts. The Button Contacts are rated 5 Amps. non-inductive @ 28 V.D.C. - 115 V.A.C. Electrical Life is 100,000 operations at rated load. The MS64 2 Amp. Relay utilizes Gold Alloy Cross-Bar Contacts, which are excellent for Switching low level or dry circuit loads.

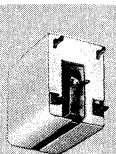


Figure 1

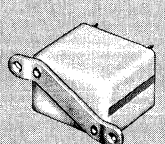


Figure 2

TYPE MS64 2 AMPS

Printed Circuit Terminals or Bracket Mounting
Long Life
Isolated Contacts
Low Cost
Snap-on Cover
Gold Alloy Contacts
Molded Construction
Size: 1⅜" x ¾" x 1⅛"

SINGLE POLE DOUBLE THROW — ENCLOSED TYPE

Contact Rating		Coil Power		
2 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.		Minimum Required		0.050 Watts
		Maximum Capacity		1.0 Watts
D.C. Magnet At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage or Current*	Resistance in Ohms†	Catalog Number Fig. 1	Catalog Number Fig. 2
6 V.	4.5 V.	400	MS64-901	MS64-911
12 V.	9.0 V.	1600	MS64-902	MS64-912
24 V.	18.0 V.	6500	MS64-903	MS64-913
3 MA.	2.3 MA.	10000	MS64-904	MS64-914

* D.O. Approx. 35% of PU. † Nominal ±10%.

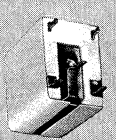


Figure 1

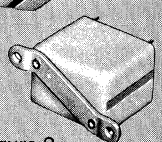


Figure 2

TYPE MS64 5 AMPS

Printed Circuit Terminals or Bracket Mounting
Long Life
Isolated Contacts
Low Cost
Snap-on Cover
Silver Alloy Contacts
Molded Construction
Size: 1⅜" x ¾" x 1⅛"

SINGLE POLE DOUBLE THROW — ENCLOSED TYPE

Contact Rating		Coil Power		
5 Amp. Non-Inductive 28 V.D.C. — 115 V.A.C.		Minimum Required		0.060 Watts
		Maximum Capacity		1.0 Watts
D.C. Magnet At 25°C				
Nominal Voltage or Current	Max. Pick-up Voltage*	Resistance in Ohms†	Catalog Number Fig. 1	Catalog Number Fig. 2
6 V.	4.5 V.	350	MS64-930	MS64-933
12 V.	9.0 V.	1300	MS64-931	MS64-934
24 V.	18.0 V.	5000	MS64-932	MS64-935

* D.O. Approx. 35% of PU. † Nominal ±10%.

Flight Systems, Inc.

P. O. BOX 25, MECHANICSBURG, PA. 17055
PHONE (717) 697-0333
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

SOLID STATE RELAYS

FLIGHT SYSTEMS, INC. solid state relays are *isolated* all-silicon construction which can perform the switching functions of conventional relays, but at a substantial increase in speed and versatility. Also, they have the ability to be mounted and function in any position, and an operation that is unaffected by shock, vibration, contaminants and humidity.

Solid state relays feature:

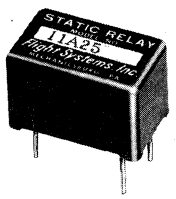
- High speed
- Excellent isolation
- Unlimited trouble-free life
- IC compatibility
- High sensitivity
- No contact bounce
- No arcing
- Noiseless

GENERAL PURPOSE RELAYS

SPST N.O. (Form A)

Our general purpose relays are the smallest available and are the ideal choice for a wide variety of switching applications. In addition to their high-performance specifications these IC-compatible relays will usually save you money by eliminating driver stages and protective devices. Unit can be customer adapted (by adding one jumper) to operate from any source, including all types of TTL or conventional control. They will function as an interface between any logic from control circuit and/or control functions. The relay modules are potted in a glass-filled Diallyl Phthalate case. Check the table below for specifications and prices.

SPECIFICATIONS:
Load Voltage (min-max): DC STATIC RELAY: 0 to 60 VDC
AC STATIC RELAY: 0 to 300 V peak, 20 to 450 Hz
Load Types: Resistive
Inductive: Max. Transient 1000VP for 10 μsec (transient protection recommended)
Capacitive: Max. inrush 3.5 times max. load current rating for 1 second.
Reactive: Power factor ≥0.5 leading or lagging
5V Control Response: On above 3.75V; Off below 2.00V
Actuating Time: 50 μsec, typical
Release Time: DC static relay: 50 μsec – AC static relay: 1/2 cycle at Load frequency
Repetition Rate: Up to 2000 operations/sec.
Operating Temperature Range: -20°C to +71°C case temp.
Mounting: Gold plated pins for either direct solder-in PCB mounting or Wire Wrap.
Shock, Vibration, Altitude, Humidity: Per Mil-E-5400
Isolation: Load-to-control: 50 MΩ min.



	AC STATIC RELAY			DC STATIC RELAY				PRICE
LOAD CURRENT RATING	CONTROL REQUIREMENTS	BIAS REQUIREMENTS	AC STATIC RELAY MODEL NUMBER	CONTROL REQUIREMENTS	BIAS REQUIREMENTS	DC STATIC RELAY MODEL NUMBER	SIZE (OD) L x W x H	1–10
300 ma				3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 10 mA	11D3G	.688" x 1.125" x .750"	19.50
1 AMP	3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 20 mA	11A10G	3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 30 mA	11D10G		19.75
2.5 AMPS	3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 20 mA	11A25G	3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 50 mA	11D25G		22.60
6 AMPS	3 to 6VDC at 2 mA TTL COMPATIBLE	5VDC at 25 mA	11A60G	3 to 6VDC at 2 mA TTL COMPATIBLE	12VDC at 100 mA	11D60G	1.50" x 1.50" x 1.00"	28.50

NEED A SPECIAL VERSION? WE SPECIALIZE IN SERVICE! 2 TO 3 WEEKS DELIVERY ON CUSTOM-BUILT RELAYS.

COMMUNICATION RELAYS

COMPATIBLE WITH AT&T, MILITARY, AND PRIVATE WIRE SYSTEMS

In addition to those in the table below, many other models are available, including side stable, TTL compatible, complementary, polar and side stable. Completely potted, they will mount in any position and will withstand severe shock and vibration.

Most models are *directly* interchangeable with existing electromechanical relays. Consult the factory for additional information and quantity prices.

APPLICATIONS

- Teletype Circuits
- Telegraph Circuits
- Data Concentration
- Data Acquisition
- Computer Peripherals
- Machine Controls
- Alarm Circuits

SPECIFICATIONS—FOR BOTH TRANSMIT AND RECEIVE RELAYS

Input to output isolation: 50 MΩ min.

Operating temperature Range: −20° to +71° C

Keying (repetition) rate: 0 to 4800 Baud (Up to 2400 operations/sec.)

Distortion: Less than 1% @ 400 Baud

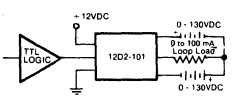
MEETS APPLICABLE PORTIONS MIL-R-27777 and MIL-STD-188.

1.36" sq. x 2.172" high
8-pin octal plug-in

1.00" x 1.50" x 0.687" high
PC mount

	MODEL NO.	INPUT (CONTROL) REQUIREMENTS	OUTPUT (LOAD) RATING Max Continuous	DESCRIPTION	PRICE 1 - 10
TRANSMIT	11D2-115	4 to 7VDC @ 20 mA	260VDC @ 150 mA	Neutral In-Neutral Out	27.75
	12D2-101	3 to 6VDC @ 1 mA TTL Compatible	+ and - 130VDC @ 150 mA	TTL in Polar Out	39.50
	12D2-102	+ and - 4 to 7VDC @ 20 mA	+ and - 130VDC @ 150 mA	Polar In - Polar Out	37.25

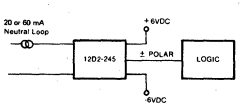
TYPICAL APPLICATION



TTL IN/ POLAR LOOP OUT

	MODEL NO.	INPUT (CONTROL) REQUIREMENTS	OUTPUT (LOAD) RATING, Max Continuous	DESCRIPTION	PRICE 1 - 10
RECEIVE	11D2-113	10 to 80 mA Universal loop Neutral	2 to 12 VDC @ 50 mA TTL Compatible	Neutral In - TTL Out	25.70
	12D2-245	10 to 80 mA Universal loop Neutral	+ and - 20VDC @ 150 mA Polar	Neutral In - Polar Out	29.50
	12D2-106	10 to 80 mA Universal loop Polar	+ and - 130 VDC @ 150 mA Polar	Polar In - Polar Out	34.60

TYPICAL APPLICATION



NEUTRAL IN - POLAR OUT

Flight Systems, Inc.

P.O. BOX 25, MECHANICSBURG, PA. 17055
PHONE (717) 697-0333
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

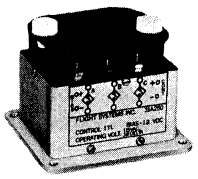
**SOLID STATE RELAYS
CIRCUIT BREAKERS
TIME DELAYS**

INDUSTRIAL RELAYS

These 10 horsepower, three phase solid state relays are fully-potted in an aluminum housing to withstand harsh industrial environments. They can be actuated directly from TTL circuitry, or by 12 VDC at 150 mA. Unique proprietary circuitry maintains triac dv/dt greater than the dv/dt of the impressed voltage and elimates false turn-on, and withstands transients up to 800 V peak non-recurring without damage. Models are available for 400 Vrms and/or 400 Hz operations, and full zero switching. Cost is $145 each in quantities of 1 to 10.

10 HORSEPOWER THREE PHASE INDUSTRIAL SOLID STATE RELAY

MODEL 31A250-1
Contact Configuration: 3 Pole Single Throw Normally Open
Load: 115 to 230 Vrms, 60 Hz. 30, 25 A Max.
Control: Can be actuated directly from TTL or by 12VDC at 150mA
Bias: TTL Control; 12VDC at 150mA
12VDC Control; None req'd
Power Factor: 0.2 to 1.0 leading or lagging
Temperature Range: -20° + 60°C flange temp.
Acturating Time: 50 μsec typ.
Release Time: At next zero crossing (Zero Switching on release)
Package Size: 3.25" x 3.75" (mounting flange size) x 3.00" tall



Price: Model 31A250-1
1-10 $145.00

SOLID STATE CIRCUIT BREAKERS

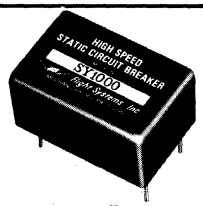
Flight Systems circuit breakers are fully solid state units with nothing to wear out, resulting in unlimited lifetime. They will mount anywhere, in any position, and are easily installed. Completely sealed, they are ideal for corrosive or explosive environments. Rugged, they are built to withstand severe shock and vibration.

750 mA to 1.75 A

Price: 1-10 Pieces $19.75.

SPECIFICATIONS MODEL SY1000:

Trip Point Range: 0.75 A. to 1.75 A. programmable.
Trip Time: 50 μsec. typ. at 133% overload, ext. capacitance = 0
Voltage Drop "ON" State: 1.0 VDC typ. 2.0 VDC max.
Leakage Current "OFF" State: 5mA. max. at 35 VDC.
Operating Voltage Range: 10 VDC min., 35 VDC max.
Reset: Automatic by momentary power interruption.
Trip Point Temp. Coefficient: 0.15%/°C max.
Operating Temp. Range: -20°C. to + 71°C case temp.
Construction: Potted module with 0.025" sq. gold plated wirewrap pins.



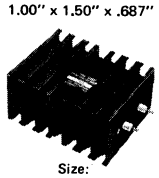
Size:
1.00" x 1.50" x .687"

2.5, 5 AND 10 A

SPECIFICATIONS:
Operating Voltage: 12VDC min., 65VDC max.
Trip Current Level Accuracy: ± 5%
Trip Time: 500 μsec typ at 100% overload
Voltage Drop: 2.0VDC max.
Leakage Current at 65VDC: 30 mA max.
Operating Temp. Range: -20° to + 70°C
Minimum Operating Current: 200 mA
Reset Method: By interrupting DC supply
Construction: Potted module in a heat shrink assembly.
Delivery: 2 to 3 weeks ARO.

TRIP POINT	MODEL NO.	PRICE 1-3
2.5 AMPS	144	66.75
5.0 AMPS	141	72.50
10 AMPS	137	79.75

Automatic Reset Available



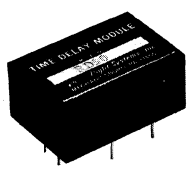
Size:
3.00" x 4.00" x 1.50"

SOLID STATE TIMERS

This time delay module may be connected directly to integrated circuit or transistor logic circuits. It is compatible with all logic families in use today. It can supply up to 100 mA of output current, enough to drive many types of relays directly, including all Flight Systems static relays.

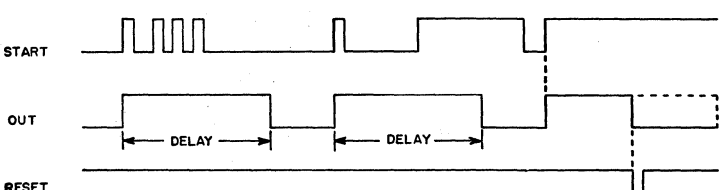
Delay time is resistor programmable over a 10 to 1 range on all models. The output may be inhibited or reset at any point in a timing cycle, and may be recycled almost immediately (up to 98% duty cycle). These all solid state timers will withstand severe shock, vibration and humidity and may be mounted in any position. Timing accuracy and repeatability is excellent over a wide voltage and temperature range.

DELAY PERIOD	MODEL NO.	UNIT PRICE (1-10)	SIZE L x W x H (OD)
50 to 500 msec	RD.5	$19.50	1.00" x 1.50" x 0.687"
100 msec to 1 sec	RD1		
0.5 sec to 5 sec	RD5		
1 sec to 10 sec	RD10		
5 sec to 50 sec	RD50		



Supply voltage: +5VDC to +16VDC regulated
"Start" input: starts on first rising edge of pulse or level
Rise time: 5 μsec max.
Duration: 10 μsec min.
Amplitude: 20 V max., 3 V min.

Modulation input: timing period may be modulated by applying a modulating voltage to this input
Reset input: grounding this input inhibits output and resets timer
Output current: 100mA max. for source current, 50mA for sync current
Input impedance: 10k Ω
Output impedance: 15 Ω nominal
Output rise & fall times: 500 μsec max. (no load)
Timing period range: Programmable from 10% to 100% of rated max. value
Timing period accuracy: ±2% typ. with temp. and voltage
Timing period repeatability: ± 0.2% typ., ± 0.5% max.
Recycle time: 2% of max. timing period
Oper. Temp. range: -20°C to +70°C



TIMING DIAGRAM

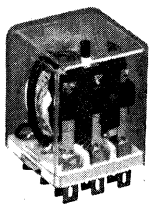
Flight Systems Inc. also offers solid state latching relays, voltage and frequency sensitive relays, zero switching AC relays, AC/DC relays, as well as a complete selection of current sensors. Write for complete catalog of standard and special solid state relays, circuit breakers, and timers.

RELAYS

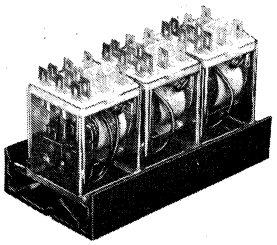
CR120 TYPE H GENERAL-PURPOSE RELAYS

These compact, economical relays are ideal for the highly repetitive operations required in the output of electronic and electric equipment and in small, built-in chassis-type control panels where space is at a premium.

For complete line of CR120 Type H relays, write for Bulletin GEA-7882



Socket plug-in form with manual operator



Back-mounted forms in optional mounting track

PLUG-IN RELAYS WITH DUST COVER

Coil Voltage Type	Contact Arr	Tube Plug-in for Customer Supplied Sockets¶ — 5 Amp Contacts CR120	5 Amp Contacts List Price	10 Amp Contacts CR120	10 Amp Contacts List Price	Socket Plug-in 0.205" Single Terminal — 5 Amp Contacts CR120	5 Amp Contacts List Price	10 Amp Contacts CR120	10 Amp Contacts List Price
AC Coils	SPDT	HG85C**‡	$15.40*	HC85C**‡	$15.66*	HG47C**‡	$13.48*	HC47C**‡	$13.74*
	DPDT	HG85J**‡	17.10*	HC85J**‡	17.62*	HG47J**‡	16.30*	HC47J**‡	16.82*
	3PDT	HG95W**‡	21.28*	HC95W**‡	22.04*	HG47W**‡	18.86*	HC47W**‡	19.62*
DC Coils	SPDT	HH85C**‡	15.26†	HF85C**‡	15.52†	HH47C**‡	13.04†	HF47C**‡	13.30†
	DPDT	HH85J**‡	16.96†	HF85J**‡	17.50†	HH47J**‡	15.04†	HF47J**‡	15.54†
	3PDT	HH95W**‡	21.14†	HF95W**‡	21.90†	HH47W**‡	17.72†	HF47W**‡	18.50†

BACK-MOUNTED AND FRONT-MOUNTED RELAYS WITH DUST COVER

Coil Voltage Type	Contact Arr	0.187" Single Straight Terminal — 5 Amp Contacts Back Mtd. CR120	Front Mtd. CR120	List Price	10 Amp Contacts Back Mtd. CR120	Front Mtd. CR120	List Price	0.187" Double Straight Terminal — 5 Amp Contacts Back Mtd. CR120	Front Mtd. CR120	List Price	10 Amp Contacts Back Mtd. CR120	Front Mtd. CR120	List Price
AC Coil	SPDT	HG73C**	HG74C**‡	$14.74*	HC73C**	HC74C**‡	$14.98*	HG03C**	HG04C**‡	$14.98*	HC03C**	HC04C**‡	$15.22*
	DPDT	HG73J**	HG74J**‡	16.60*	HC73J**	HC74J**‡	17.04*	HG03J**	HG04J**‡	17.08*	HC03J**	HC04J**‡	17.52*
	3PDT	HG73W**	HG74W**‡	19.14*	HC73W**	HC74W**‡	19.82*	HG03W**	HG04W**‡	19.86*	HC03W**	HC04W**‡	20.54*
DC Coil	SPDT	HH73C**	HH74C**‡	14.32†	HF73C**	HF74C**‡	14.58†	HH03C**	HH04C**‡	14.56†	HF03C**	HF04C**‡	14.82†
	DPDT	HH73J**	HH74J**‡	15.32†	HF73J**	HF74J**‡	15.82†	HH03J**	HH04J**‡	15.90*	HF03J**	HF04J**‡	16.30†
	3PDT	HH73W**	HH74W**‡	18.02†	HF73W**	HF74W**‡	18.78†	HH03W**	HH04W**‡	18.74†	HF03W**	HF04W**‡	19.50†

** See Coil Suffix Table at right.

* Prices apply to 115-volt, ac max coils. Add $1.10 for 230-volt, 60/50 hertz coil.

† Prices apply to 24-volt, dc max coils. Add $1.68 for 48- or 110 volt dc coil.

‡ Insert modification suffix, if desired, from Modification Suffix Table below.

¶ Single- and double-pole forms are octal (8-pin) type. 3-pole forms are 11-pin type.

‡ MODIFICATION SUFFIX

Feature	Suffix Use in place of ‡	List Price Addition
Manual Operator	A	$0.50
Indicating Light	B	2.50
Manual Operator and Indicating Light	C	3.00

** COIL SUFFIX TABLE

Voltage	Suffix No. — Use where ** appears in Nomenclature 60/50 Hz	DC
110	....	12
115	02	....
230	03	....
6	04	08
12	05	09
24	06	10
48	07	11

COIL DATA

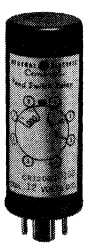
50/60 Hertz Forms — Voltage	Res. in Ohms	Hold. Cur. in mA	Voltage	DC Forms — Res. in Ohms	Hold. Cur. in mA
6	3	416	6	32	188
12	16	208	12	120	100
24	63	104	24	472	51
48	255	55	48	1840	26
115	1250	22	110	10000	11.5
230	6300	11	220	§	§

§ Use 110 v relay with 10,000-ohm, 5 w resistor in series.

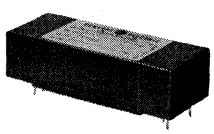
Prices subject to change without notice. OEM quantity prices available on request.

REED SWITCH RELAYS

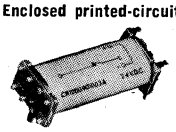
CR120 TYPE G



Tube-type plug-in



Enclosed printed-circuit



Open printed-circuit

Contact ratings (maximum):
15 watts, resistive
1.0 ampere
250 DC volts
60 milliohms resistance

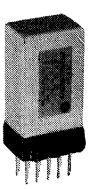
Life expectancy (electrical):
20 million operations at maximum rating
100 million operations at ½ max rating
200 million operations at low load

Resonant frequency (reed): 1080 cps

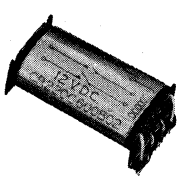
Operation

Nominal coil power:
SPDT 450 mw
DPDT 680 mw
3PDT 1000 mw
SPDT latch 270 mw
DPDT latch 580 mw

CR220 TYPE G



Plug-in with socket attached



Open printed-circuit

Contact ratings (maximum):
15 watts, resistive
1.0 ampere
250 DC volts
60 milliohms resistance

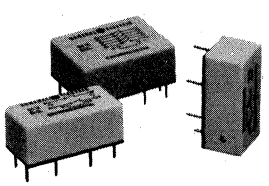
Life expectancy (electrical):
20 million operations at maximum rating
100 million operations at ½ max rating
200 million operations at low load

Resonant frequency (reed): 1100 cps

Operation

Nominal coil power:
Printed circuit: 1P 350 mw, 2P 600 mw, 3P 700 mw, 4P 900 mw, 5P 1200 mw, 6P 1600 mw
Plug-in & bracket: 1P 350 mw, 2P 600 mw, 3P 770 mw, 4P 1000 mw, 5P 1400 mw, 6P 2300 mw, 8P 2300 mw, 12P 4000 mw

CR120 TYPE M



Enclosed printed-circuit type

Contact ratings (maximum):
10 watts, resistive
0.5 ampere
200 DC volts
150 milliohms resistance

Life expectancy (electrical):
5 million operations at maximum rating
15 million operations at ½ max rating
200 million operations at dry circuit

Resonant frequency (reed): 2000 cps

Operation

Nominal coil Power:
1P 250 mw
2P & 3P 500 mw
4P & 5P 800 mw

Write for Bulletin GEA 8937

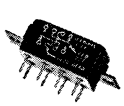
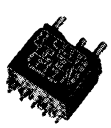
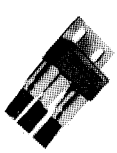
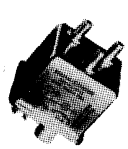
For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section 998-60. Schenectady, N. Y. 12345.

GENERAL ELECTRIC

HERMETICALLY SEALED RELAYS

Unmatched for reliability, the light weight, thermal capabilities, and high resistance to shock of these hermetically sealed relays make them ideally suited for military and industrial electronic applications.
The reliability factor stems from exacting assembly (in a "White Room" where necessary), rigid quality control, well-equipped lab facilities and precise testing procedures. These manufacturing techniques, combined with GE's advanced engineering design, produce top-quality relays with dependable characteristics exceeding those of static switching devices.

Contact resistance is held to a minimum by silver contacts (with gold flash) combined with high contact forces.
All high-temperature components allow the operation of these relays in ambient temperatures between −65°C to +125°C.
Units are available with studs or brackets for mounting. The micro line has tab brackets for printed-circuit board application. Headers can be furnished with solder hooks, three-inch leads, plug-in (with socket availability information) and many special terminals. *Write for Bulletin GEA-6628*

		Contact Form	Contact Rating	Sensitivity	Size & Weight	Vibration Capabilities	Shock	Operate Time	Release Time
	TRANSISTOR SIZE TO-5[2] (3SBS) All-welded including coils High contact forces, overtravel Low contact resistance High thermal margin Meets MIL-5757/40	2PDT	1A at 28 Vd-c 0.2A at 28 Vd-c Ind.	120 mw	0.37″x0.37″x0.275″ 0.09 oz.	30 G's to 3000 Hz	100 G's for 11 ms	2 ms max	1 ms max
	TRANSISTOR SIZE TO-5[2] (3SCS) INDUSTRIAL TYPE All welded Low cost	2PDT	1A at 28Vd-c 0.2A at 28Vd-c Ind.	160 mw	0.37″x0.37″x0.275″ 0.09 oz.	10 G's to 2000 Hz		4 ms max	3 ms max
	150 GRID-SPACE (3SBC, 3SBH, 3SBM) New small size Low profile — only 0.32″ high Terminals on 0.150″ centers Meets MIL-5757/37, 80 and 85 4PDT magnetic latch	1PDT 2PDT 4PDT	2A at 28Vd-c 2A at 28Vd-c ½ at 115Va-c	50 mw 135 mw 250 mw	0.32″x0.61″x0.31″ 0.13 oz. 0.32″x0.61″x0.61″ 0.24 oz.	30G's to 3000 Hz	50 G's for 11 ms	4 ms max	4 ms max
	**HALF-SIZE MICRO (3SAV)** Terminals on 0.2″ centers All-welded construction Bifurcated contacts Power or low-level switching Meets MIL-5757/9	2PDT	2A at 28 Vd-c 1A at 115Va-c	260 mw	0.4″x0.8″x0.4″ 0.35 oz.	30 G's to 3000 Hz	50 G's for 11 ms	4 ms max	4 ms max
	HALF-SIZE MICRO (3SCV) INDUSTRIAL TYPE 100 million life at low level Low contact resistance Normal overload capability Replaces reeds	2PDT	10^5 at 2A 28Vd-c 10^8 low level	340 mw	0.4″x0.8″x0.4″ 0.35 oz.	10 G's to 2000 Hz		6 ms max	6 ms max
	**4-POLE MICRO (3SAH)** All-welded construction No solder, solder flux Power or low-level switching Terminals on 0.2″ centers Meets MIL-5757/12	4PDT	2A at 26.5 Vd-c 1A at 115 Va-c	400 mw	0.81″x1.01″x0.61″ 1.0 oz.	30 G's to 3000 Hz	50 G's for 11 ms	6 ms max	5 ms max
	**HALF-SIZE RF** Frequency 0 to 2.0 GHz Co-ax or PCB terminations Low cost RF and auxiliary contacts 50-ohm impedance	2PDT	10^6 at 15W RF 10^5 at 25W RF 2A at 28 Vd-c	260 mw	0.4″ x 0.8″ x 0.4″ 0.35 oz.	20 G's to 2000 Hz	— —	4 ms	4 ms
	**RF RELAY** Frequency 0 to 2.0 GHz 50-ohm impedance RF and auxiliary contacts SMA, co-ax and PCB termination Low cost	1PDT RF 1PDT Aux	2 x 10^5 at 15W RF 4 x 10^4 at 150W RF Aux 2A at 28 Vd-c	250 mw	1.15″ x 0.95″ x 0.840″ 1.0 oz.	10 G's to 500 Hz	— —	10 ms	10 ms

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Relay Sales, Waynesboro, Va. 22980.

GENERAL ELECTRIC

MICROMINIATURE DIP REED RELAYS

SERIES B

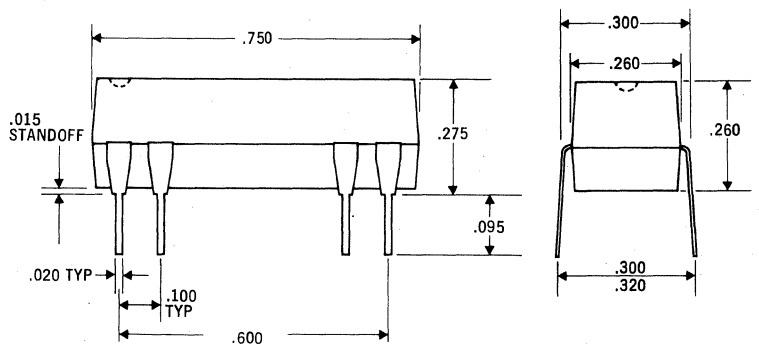
8 AND 14 PIN — .275" PROFILE

FEATURES

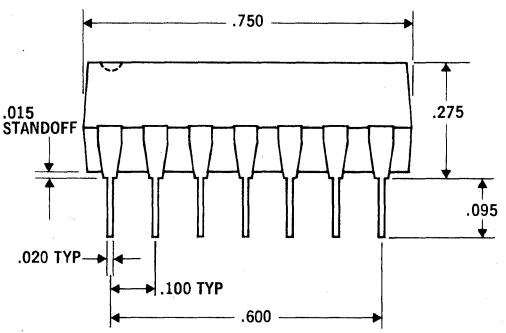
- INDUSTRY STANDARD TO-116 TERMINAL GRID
  FITS ALL STANDARD DIP SOCKETS
- OPTIONAL 8 OR 14 TERMINAL FOOTPRINT ASSURES
  MAXIMUM INTERCHANGEABILITY.
- AUTO-INSERTION COMPATIBLE
  MINIMIZES ASSEMBLY LABOR
- MOLDED EPOXY PACKAGES
  IMMUNE TO HOSTILE ENVIRONMENTS AND FLUIDS
- HIGH SENSITIVITY
  INTERFACES DIRECTLY WITH RTL, DTL, TTL, HTL LOGIC
- CONTACT FLEXIBILITY
  WIDEST VARIETY OF CONTACT CAPABILITIES
- PACKAGE VERSATILITY
  ELECTROSTATIC SHIELDS AND INTERNAL CLAMPING DIODES AVAILABLE

OUTLINES

SERIES B2, 8 PIN



SERIES B4, 14 PIN



CONTACT OPTIONS

Contact Code Contact Type	C Standard Form C	J Standard Form A	F† High Speed Form A
Power Rating, Watts DC, Max.	3	10	3
Current Rating, Amperes DC, Max.	.100	.250	.250
Voltage Rating, Volts DC, Max.	20	100	28
Breakdown Voltage, DC, Minimum	250	250	250
Operate Time, Msec. Typical	.800	.400	.250
Bounce Time, Msec. Typical	.400	.200	.075
Initial Contact Resistance, Ω, Max.	.200	.200	.200
Life @ Max. Load, 10^6 Opers., Typ.	5	10	10
Life @ Low Level, 10^6 Opers., Typ.	20	20	100
Open Contact Capacitance, PF, Typ.	.8	.2	.2

†2 Form A Relay available in Code F Contacts only.

ORDERING CODE

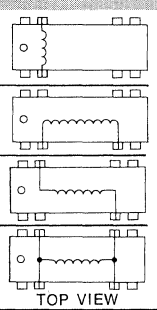
B2	1A	J	05	2	O	O
Relay Series	Contact Configuration	Contact Code	Rated Coil Voltage	Coil Terminal Location	Shielding	Internal Clamping Diode

RELAY DATA

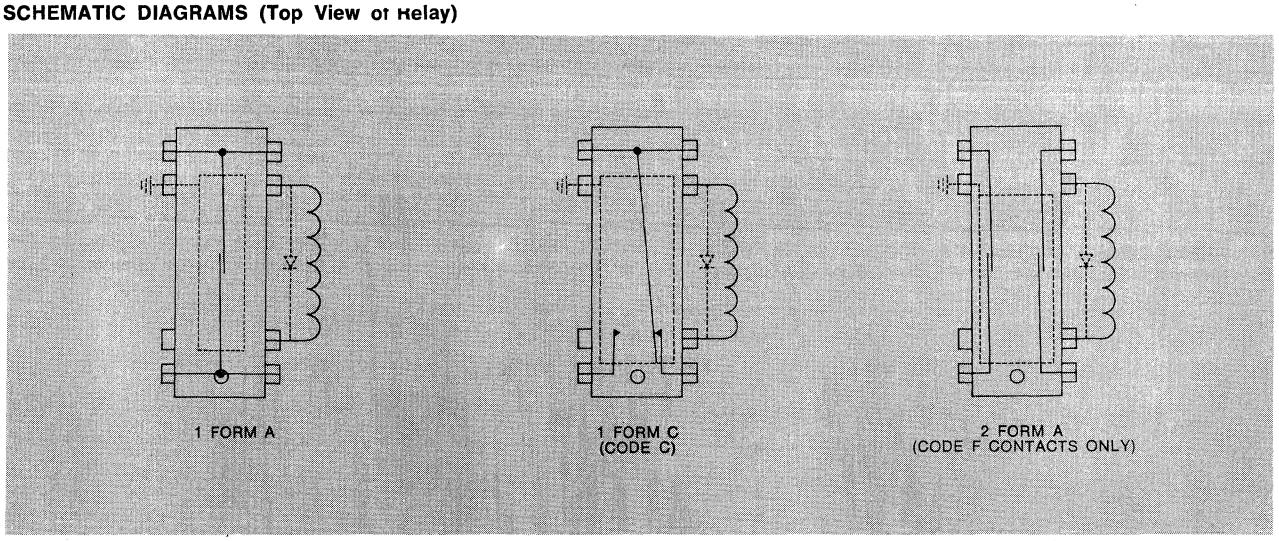
Configuration	Rated Coil Voltage	Coil Resistance Ω @ 20°C	Max. Operate* Power MW	Must Operate Voltage DC	Min. Release Voltage DC
1 Form A	5	380	.042	4.0	.4
	12	500	185	9.6	1.2
	24	2150	172	19.2	2.4
1 Form C	5	200	80	4.0	.4
	12	450	205	9.6	1.2
	24	1750	211	19.2	2.4
2 Form A	5	200	80	4.0	.4
	12	500	185	9.6	1.2
	24	2150	172	19.2	2.4
All	Coil to contact breakdown voltage: 500 DC @ < 50% RH Coil to contact capacitance (code 3 shielding): .4 picofarads typ.				

*At Must Operate Voltage

RELAY OPTIONS

OPTION	CODE	BENEFIT
Coil Terminal Location	1 — End 2 — Side (STANDARD LOCATION) 3 — Diagonal 4 — Common  TOP VIEW	Variable location permits optimum routing of circuit paths during PC board layout and assures second source capability
Shielding	0 — Internal Magnetic Shielding 3 — Internal Magnetic Shield + 'Static Shield Terminated to Ground Pin	Standard internal magnetic shielding minimizes interaction of adjacent relays and/or other EMI sources such as transformers and power lines. Electrostatic shielding minimizes capacitive coupling of coil and contacts to isolate spurious signals caused by the collapsing magnetic field during dropout.
Clamping Diode	0 — No Diode D — Diode	Internal diode across relay coil performs an arc suppressor function to protect the contacts of drivers.

SCHEMATIC DIAGRAMS (Top View of Relay)



MINIATURE MOLDED REED RELAYS

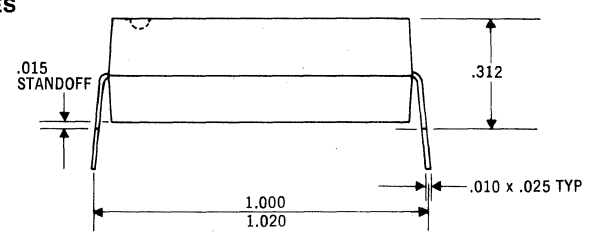
SERIES C

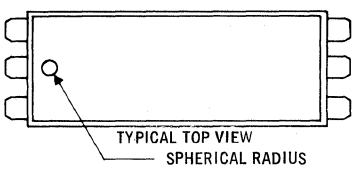
1" X .100" AND 1" X .150" GRIDS

FEATURES

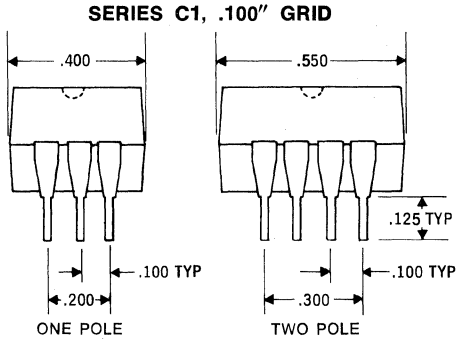
- OPTIONAL .100" OR .150" TERMINAL GRID
  ASSURES MAXIMUM INTERCHANGEABILITY
- LOW .312" PROFILE
  PERMITS STACKING PRINTED CIRCUIT BOARDS ON .400" CENTERS
- EXPOSED TERMINALS
  ALLOW TESTING FROM EITHER SIDE OF BOARD, EASY FIELD REPLACEMENT
- MOLDED EPOXY PACKAGES
  IMMUNE TO HOSTILE ENVIRONMENTS AND FLUIDS
- INTERNAL MAGNETIC SHIELDING
  MINIMIZES MAGNETIC INTERACTION
- CONTACT FLEXIBILITY
  WIDEST VARIETY OF CONTACT CAPABILITIES
- PACKAGE VERSATILITY
  ELECTROSTATIC SHIELDS AND INTERNAL CLAMPING DIODES AVAILABLE

OUTLINES

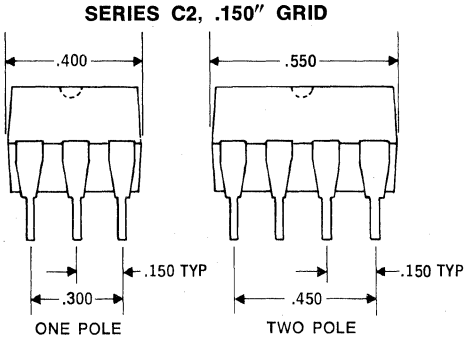




SERIES C1, .100" GRID



SERIES C2, .150" GRID

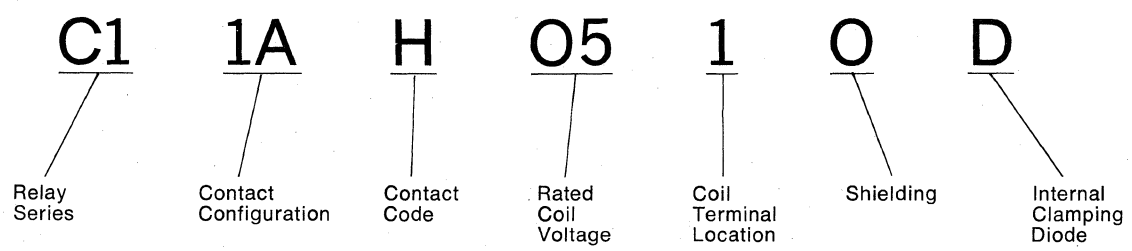


Note: Unused terminals do not appear on relays.

CONTACT OPTIONS

Contact Code	A	C	F	H
Contact Type	Standard Dry Form A	True Dry Form C	High Speed Dry Form A	Heavy Duty Mercury A
Power Rating, Watts DC, Max.	10	3	3	50
Current Rating, Amperes DC, Max.	.500	.250	.250	1.0
Voltage Rating, Volts DC, Max.	200	28	28	1000
Breakdown Voltage, DC, Minimum	350	250	250	2000
Operate Time, Msec. Typical	.700	.800	.250	2.0
Bounce Time, Msec. Typical	.300	.400	.750	None
Initial Contact Resistance, Ω, Max.	.200	.200	.200	.050
Life @ Max. Load, 10^6 Opers., Typ.	20	5	10	50
Life @ Low Level, 10^6 Opers., Typ.	100	50	100	200
Open Contact Capacitance, PF, Typ.	.2	.8	.2	.3

ORDERING CODE

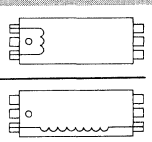


RELAY DATA

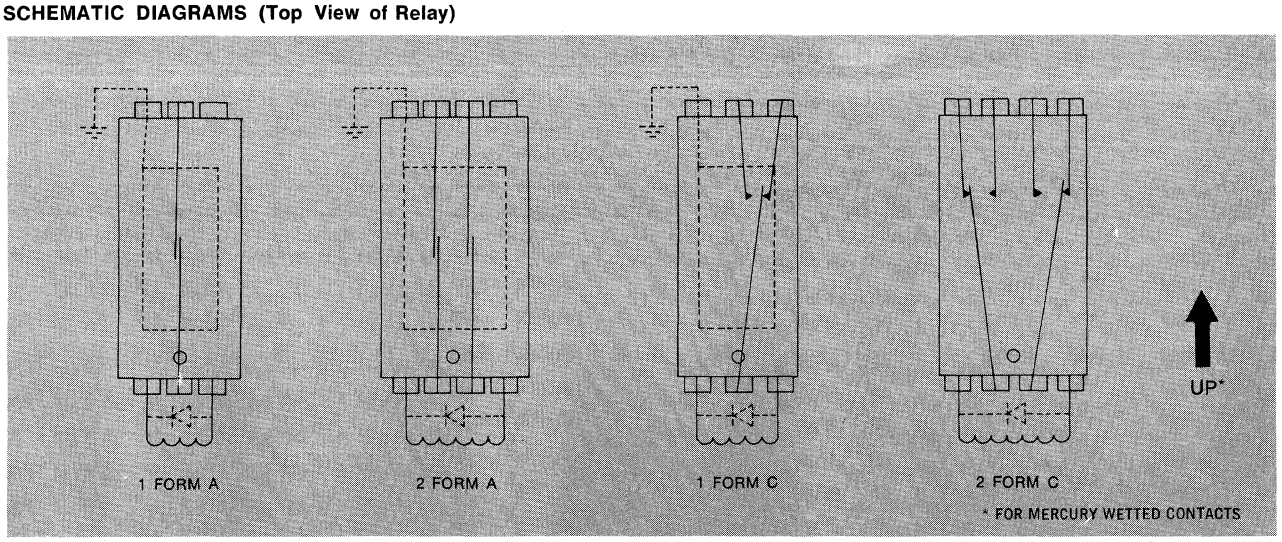
Configuration	Rated Coil Voltage	Coil Resistance Ω @ 20°C	Max. Operate* Power MW	Must Operate Voltage DC	Min. Release Voltage DC
One Pole	5	150	107	4.0	.5
	12	575	160	9.6	1.2
	24	2150	172	19.2	2.4
Two Pole	5	80	200	4.0	.5
	12	320	288	9.6	1.2
	24	1500	246	19.2	2.4
All	Coil to contact breakdown voltage: 1000 DC @ < 50% RH Coil to contact capacitance (code 3 shielding): .4 picofarads typ.				

*At Must Operate Voltage

RELAY OPTIONS

OPTION	CODE	BENEFIT
Coil Terminal Location	1 — End Standard location 2 — Side  TOP VIEWS	Variable location permits optimum routing of circuit paths during PC board layout and assures second source capability
Shielding	0 — Internal Magnetic Shielding 3 — Internal Magnetic Shield + 'Static Shield Terminated to Ground Pin	Standard internal magnetic shielding minimizes interaction of adjacent relays and/or other EMI sources such as transformers and power lines. Electrostatic shielding minimizes capacitive coupling of coil and contacts to isolate spurious signals caused by the collapsing magnetic field during dropout.
Clamping Diode	0 — No Diode D — Diode	Internal diode across relay coil performs an arc suppressor function to protect the contacts of drivers.

SCHEMATIC DIAGRAMS (Top View of Relay)



MINIATURE REED RELAYS

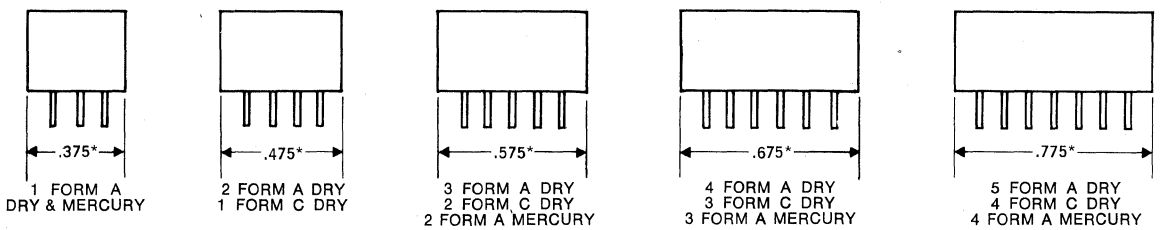
SERIES G2

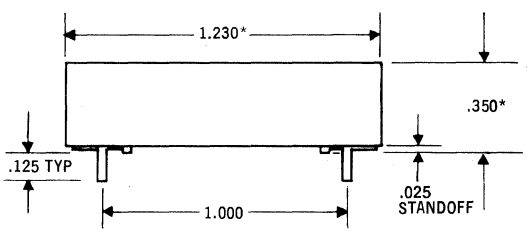
1 - 5 POLES, 1" X .100" GRID

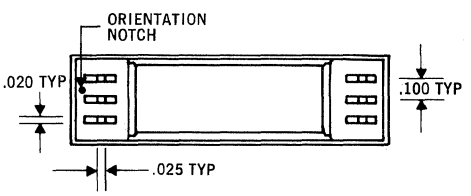
FEATURES

- INDUSTRY STANDARD 1.00" x .100" TERMINAL GRID
  ASSURES MAXIMUM INTERCHANGEABILITY AND MULTIPLE SOURCING
- LOW .350" PROFILE
  PERMITS STACKING PRINTED CIRCUIT BOARDS ON STANDARD ½" CENTERS
- FLEXPIN TERMINALS
  INSURE STRESS FREE SWITCH MOUNTING
- OPTIONAL COIL TERMINAL LOCATION
  FACILITATES OPTIMUM CIRCUIT PATH ROUTING
- MAGNETIC AND/OR ELECTROSTATIC SHIELDING
  MINIMIZES INTERACTION AND SPURIOUS SIGNALS
- REMOVABLE SHIELD
  PERMITS FIELD REPLACEMENT OF REED SWITCHES
- WIDE VARIETY OF CONTACT CAPABILITIES
  PERMIT DIVERSE RELAY FUNCTIONS IN COMMON PACKAGES

OUTLINES







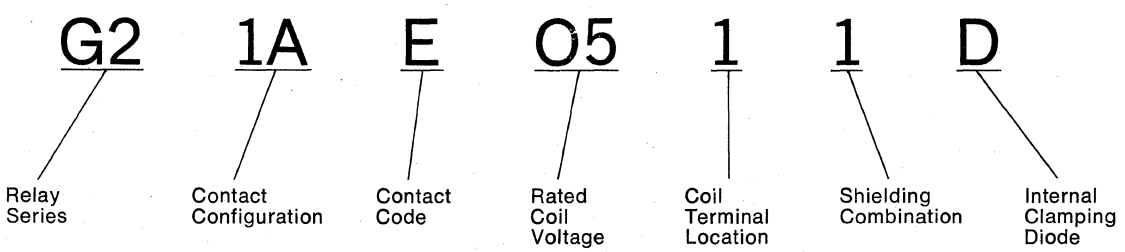
* Over magnetic box shield

Note: Unused terminals do not appear on relays.

CONTACT OPTIONS

Contact Code	A	C	E	F	H
Contact Type	Standard Dry Form A	True Dry Form C	High Voltage Dry Form A	High Speed Dry Form A	Heavy Duty Mercury A
Power Rating, Watts DC, Max.	10	3	10	3	50
Current Rating, Amperes DC, Max.	.500	.250	.200	.250	1.0
Voltage Rating, Volts DC, Max.	200	28	1000	28	1000
Breakdown Voltage, DC, Minimum	350	250	1700	250	2000
Operate Time, Msec. Typical	.700	.800	.750	.250	2.0
Bounce Time, Msec. Typical	.300	.400	.200	.750	None
Initial Contact Resistance, Ω, Max.	.200	.200	.200	.200	.050
Life @ Max. Load, 10^6 Opers., Typ.	20	5	10	10	50
Life @ Low Level, 10^6 Opers., Typ.	100	50	100	100	200
Open Contact Capacitance, PF, Typ.	.2	.8	.2	.2	.3

ORDERING CODE



RELAY DATA

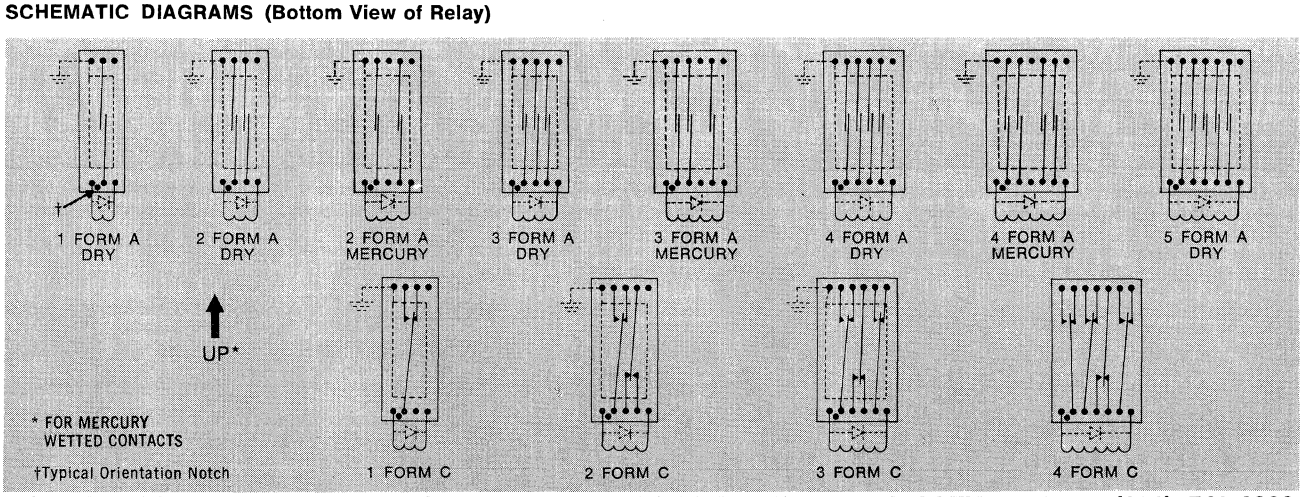
Configuration	Rated Coil Voltage	Coil Resistance Ω @ 20°C	Max. Operate* Power MW	Max. Operate Voltage DC	Min. Release Voltage DC
1 Form A Dry 1 Form A Mercury	5	225	71	4.0	.5
	12	1400	66	9.6	1.2
	24	4340	85	19.2	2.4
2 Form A Dry 1 Form C Dry	5	105	152	4.0	.5
	12	730	126	9.6	1.2
	24	2500	147	19.2	2.4
3 Form A Dry 2 Form C Dry 2 Form A Mercury	5	82	195	4.0	.5
	12	570	162	9.6	1.2
	24	1540	239	19.2	2.4
4 Form A Dry 3 Form C Dry 3 Form A Mercury	5	60	267	4.0	.5
	12	275	335	9.6	1.2
	24	1090	338	19.2	2.4
5 Form A Dry 4 Form C Dry 4 Form A Mercury	5	45	356	4.0	.5
	12	320	288	9.6	1.2
	24	790	467	19.2	2.4
All	Coil to contact breakdown voltage: 1000 DC @ < 50% RH Coil to contact capacitance (code 4 shielding): .4 picofarads typ.				

*At Must Operate Voltage

RELAY OPTIONS

OPTION	CODE	BENEFIT
Coil Terminal Location	1 — End (STANDARD LOCATION) 2 — Side 3 — Diagonal BOTTOM VIEWS	Variable location permits optimum routing of circuit paths during PC board layout and assures second source capability
Magnetic and Electrostatic Shielding Combinations	0 — No Shielding 1 — Magnetic Box Shield‡ 2 — Magnetic Foil Shield 3 — Grounded Electrostatic 4 — Magnetic Bax + 'Static‡ (1 + 3) 5 — Magnetic Foil + 'Static (2 + 3) ‡ Preferred configuration	Magnetic shields minimize interaction of adjacent relays and/or other EMI sources such as transformers and power lines. Electrostatic shielding minimizes capacitive coupling of coil and contacts to isolate spurious signals generated by the collapsing magnetic field during dropout.
Clamping Diode	0 — No Diode D — Diode	Internal diode across relay coil performs an arc suppressor function to protect the contacts of drivers.

SCHEMATIC DIAGRAMS (Bottom View of Relay)



COMPACT REED RELAYS

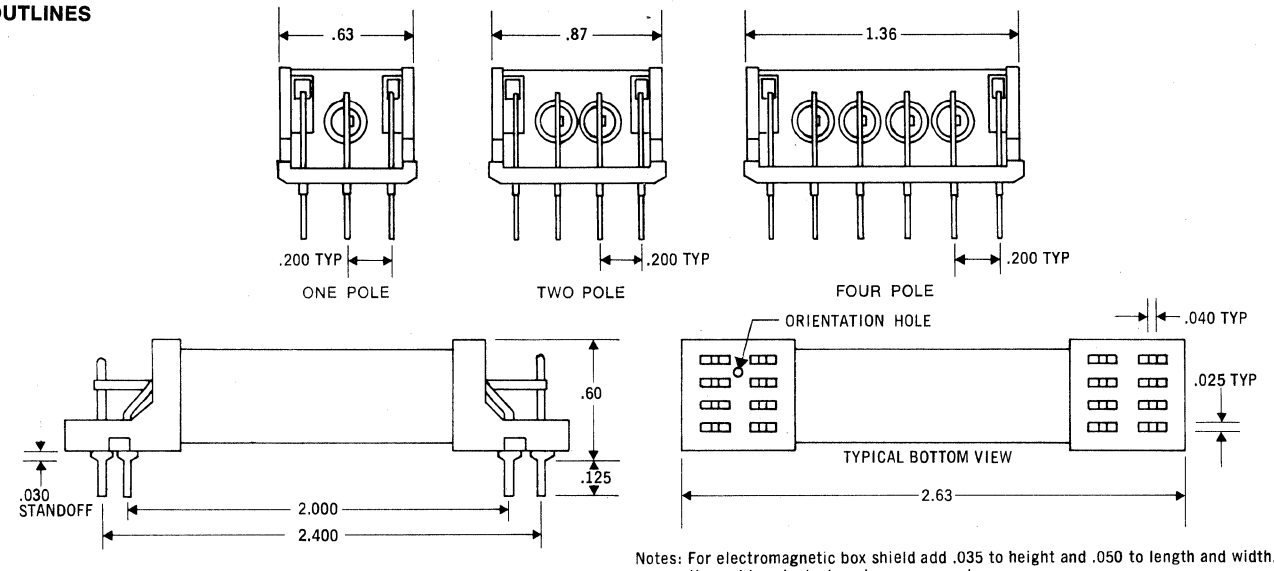
SERIES H1

1 - 4 POLES, 2" X .200" GRID

FEATURES

- INDUSTRY STANDARD 2.00" x .200" TERMINAL GRID ASSURES MAXIMUM INTERCHANGEABILITY AND MULTIPLE SOURCING
- OPEN CONSTRUCTION PERMITS FIELD REPLACEMENT OF REED SWITCHES
- RUGGED NYLON FRAME IMMUNE TO SOLVENTS AND CLEANING SOLUTIONS
- CONTACT FLEXIBILITY WIDEST VARIETY OF CONTACT CAPABILITIES

OUTLINES

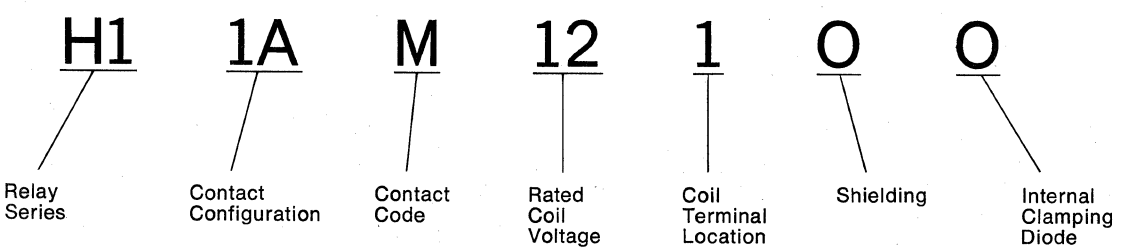


Notes: For electromagnetic box shield add .035 to height and .050 to length and width. Unused terminals do not appear on relays.

CONTACT OPTIONS

Contact Code / Contact Type	L Instrument Grade Form A	M High Inrush Form A	N High Current Form A	O High Voltage Form A	P True Form C	Q Mercury Wetted Form A	R Latching Form C
Power Rating, Watts DC, Max.	15	15	100	100	10	50	10
Current Rating, Amperes DC, Max.	1.0	1.0	3.0	3.0	.25	3.0	.25
Voltage Rating, Volts DC, Max.	250	250	200	1000	28	400	28
Breakdown Voltage, DC, Minimum	300	300	400	2000	250	1000	300
Operate Time, Msec. Typical	2.0	2.0	3.0	3.0	1.5	2.0	3.5
Bounce Time, Msec. Typical	.3	.3	1.0	1.0	1.5	0	2.0
Initial Contact Resistance, Ω, Max.	.100	.100	.5	.5	.2	.05	.2
Life @ Max. Load, 10^6 Opers., Typ.	5	5	.1	.1	5	50	5
Life @ Low Level, 10^6 Opers., Typ.	200	200	100	100	35	200	35
Open Contact Capacitance, PF, Typ.	1.0	1.0	1.0	1.0	4.0	•	5.0

ORDERING CODE



RELAY DATA

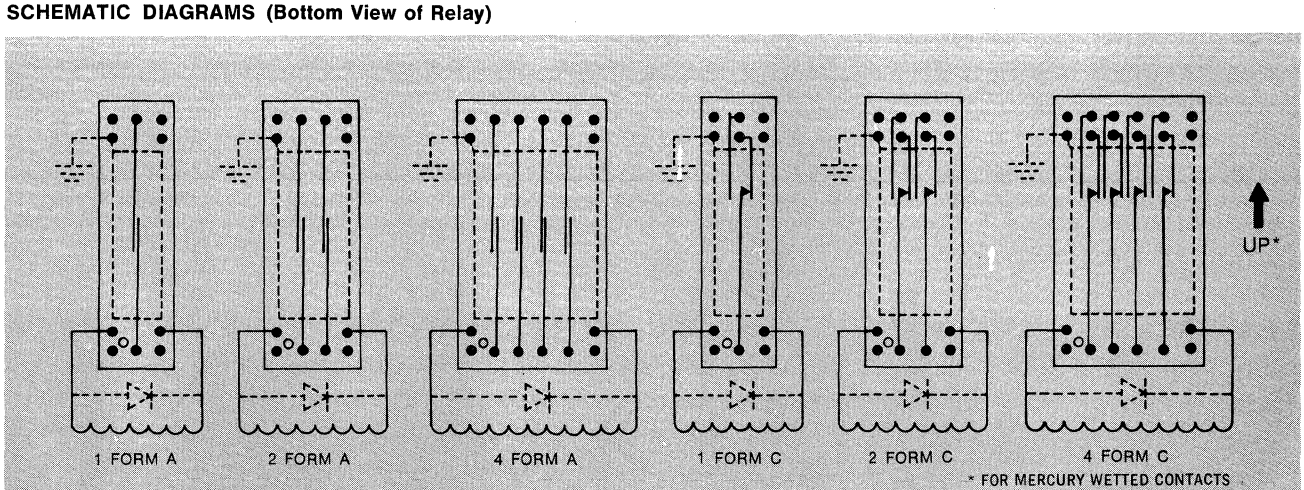
Configuration	Rated Coil Voltage	Coil Resistance Ω @ 20°C	Max. Operate* Power MW	Must Operate Voltage DC	Min. Release Voltage DC
One Pole	5	135	118	4.0	.5
	12	600	153	9.6	1.2
	24	2400	153	19.2	2.4
Two Pole	5	90	177	4.0	.5
	12	400	230	9.6	1.2
	24	1600	230	19.2	2.4
Four Pole	5	33	484	4.0	.5
	12	150	614	9.6	1.2
	24	600	614	19.2	2.4
All	Coil to contact breakdown voltage: 1000 DC @ < 50% RH Coil to contact capacitance (code 4 shielding): 2.0 picofarads typ.				

*At Must Operate Voltage

RELAY OPTIONS

OPTION	CODE	BENEFIT
Coil Terminal Location	1 — End (STANDARD LOCATION) 2 — Side 3 — Diagonal BOTTOM VIEWS	Variable location permits optimum routing of circuit paths during PC board layout and assures second source capability
Magnetic and Electrostatic Shielding Combinations	0 — No Shielding 1 — Magnetic Box Shield 2 — Magnetic Foil Shield 3 — Grounded Electrostatic 4 — Magnetic Box + 'Static (1 + 3) 5 — Magnetic Foil + 'Static (2 + 3)	Magnetic shields minimize interaction of adjacent relays and/or other EMI sources such as transformers and power lines. Electrostatic shielding minimizes capacitive coupling of coil and contacts to isolate spurious signals generated by the collapsing magnetic field during dropout.
Clamping Diode	0 — No Diode D — Diode	Internal diode across relay coil performs an arc suppressor function to protect the contacts of drivers.

SCHEMATIC DIAGRAMS (Bottom View of Relay)



LARGE REED RELAYS

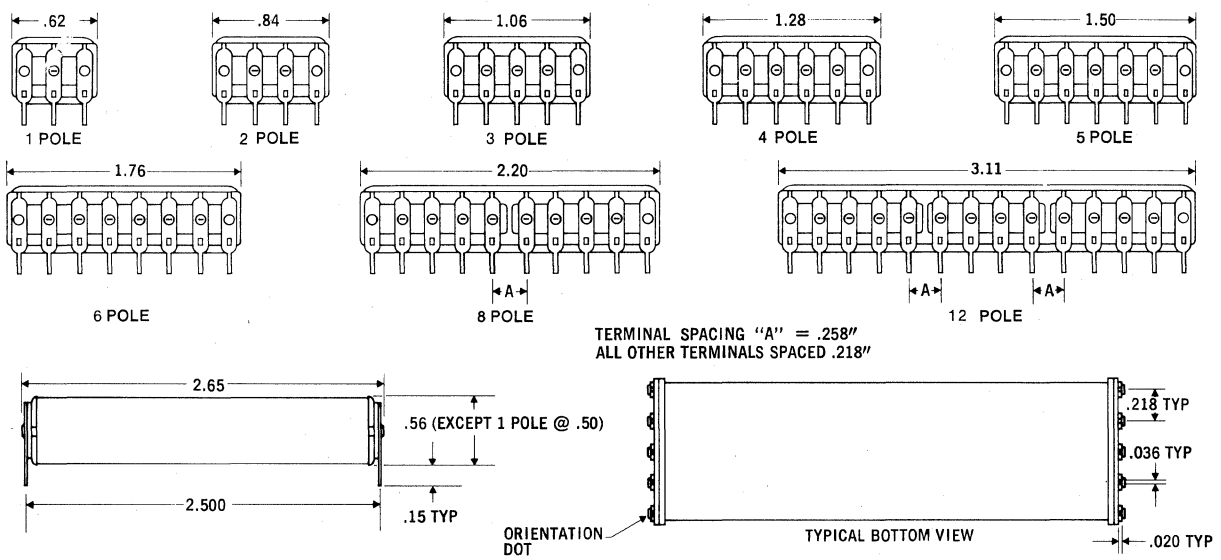
SERIES J1

1 - 12 POLES, 2.5″ X .218″ GRID

FEATURES

- INDUSTRY STANDARD 2.5″ x .218″ TERMINAL GRID
  ASSURES MAXIMUM INTERCHANGEABILITY AND MULTIPLE SOURCING
- LOW .562″ PROFILE
  PERMITS STACKING PRINTED CIRCUIT BOARDS ON STANDARD ¾″ CENTERS
- INTEGRAL MAGNETIC SHIELDING
  MINIMIZES MAGNETIC INTERACTION
- 1 THROUGH 12 POLES
  OCCUPY LESS THAN .65 IN² PER 3 AMP CONTACT
- CONTACT VERSATILITY
  WIDE VARIETY OF CONTACT CAPABILITIES
- SENSITIVE
  REQUIRE ONLY ABOUT 100 MILLIWATTS PER POLE

OUTLINES

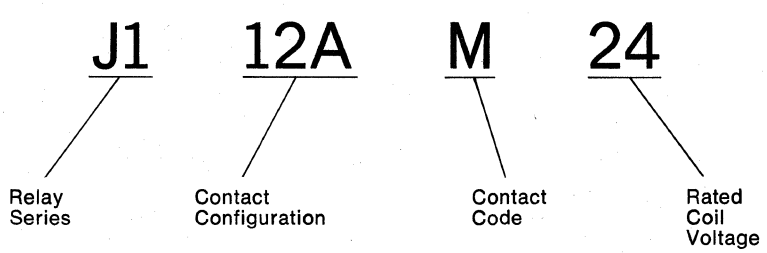


CONTACT OPTIONS

Note: Unused terminals do not appear on relays.

Contact Code / Contact Type	L Instrument Grade Form A	M High Inrush Form A	N High Current Form A	O High Voltage Form A	Q Mercury Wetted Form A
Power Rating, Watts DC, Max.	15	15	100	100	50
Current Rating, Amperes DC, Max.	1.0	1.0	3.0	3.0	3.0
Voltage Rating, Volts DC, Max.	250	250	200	1000	400
Breakdown Voltage, DC, Minimum	300	300	400	2000	1000
Operate Time, Msec. Typical	2.0	2.0	3.0	3.0	2.0
Bounce Time, Msec. Typical	.3	.3	1.0	1.0	0
Initial Contact Resistance, Ω, Max.	.05	.05	.5	.5	.05
Life @ Max. Load, 10^6 Opers., Typ.	5	5	.1	.1	50
Life @ Low Level, 10^6 Opers., Typ.	200	200	100	100	200
Open Contact Capacitance, PF, Typ.	1.0	1.0	1.0	1.0	•

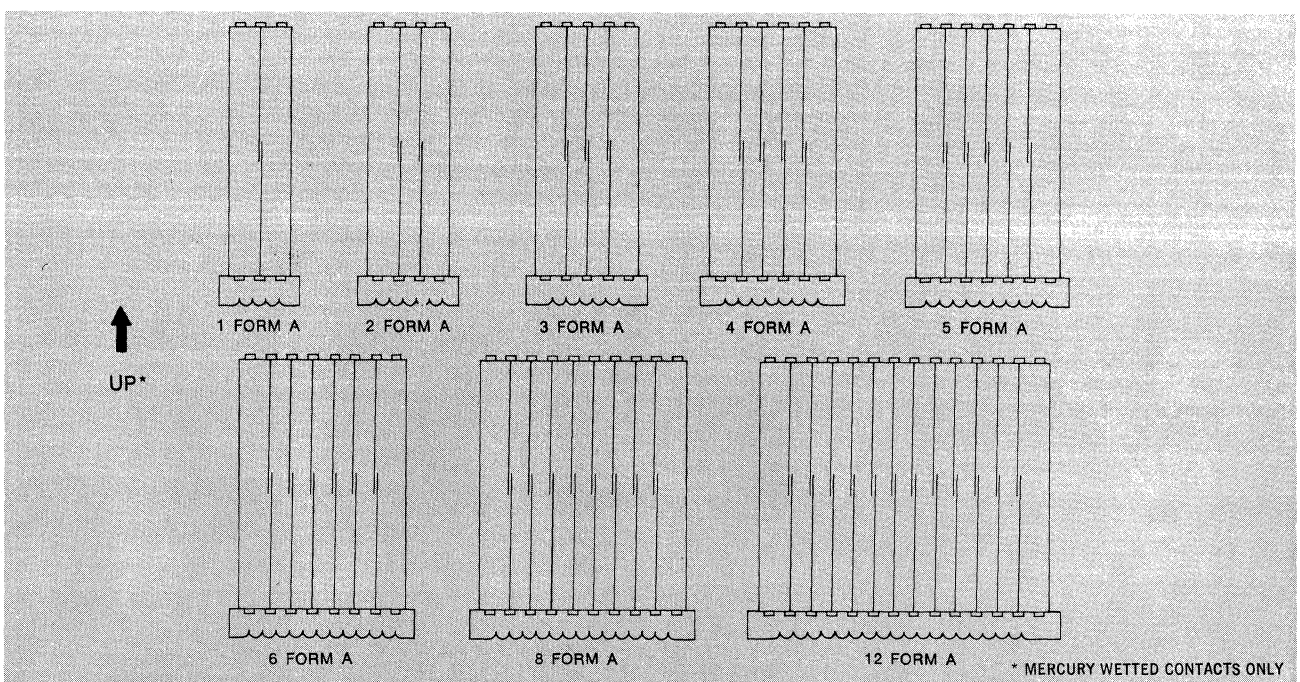
ORDERING CODE



RELAY DATA

Configuration	Rated Coil Voltage	Coil Resistance Ω @ 20°C	Max. Operate Power MW	Max. Operate Voltage DC	Min. Release Voltage DC
1 Form A	5	160	121	4.4	.6
	12	600	126	8.7	1.2
	24	2500	130	18.0	2.5
2 Form A	5	88	230	4.5	.6
	12	350	226	8.9	1.1
	24	1400	231	18.0	2.2
3 Form A	5	70	302	4.6	.6
	12	300	314	9.7	1.2
	24	1070	303	18.0	2.1
4 Form A	5	56	411	4.8	.6
	12	218	423	9.6	1.2
	24	835	432	19.0	2.1
5 Form A	5	40	484	4.4	.5
	12	155	488	8.7	1.0
	24	650	555	19.0	2.0
6 Form A	5	31	596	4.3	.48
	12	120	588	8.4	.9
	24	510	635	18.0	1.9
8 Form A	5	25	706	4.2	.35
	12	96	735	8.4	.9
	24	380	760	17.0	1.8
12 Form A	5	22	1091	4.9	.5
	12	86	1117	9.8	1.0
	24	340	1176	20.0	2.0

SCHEMATIC DIAGRAMS

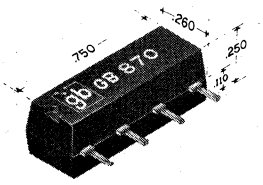


GRIGSBY-BARTON INC

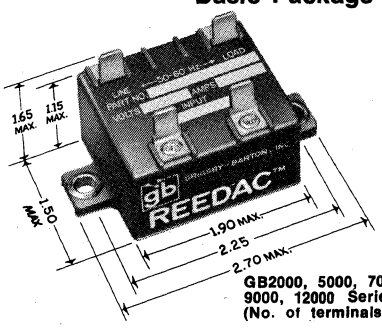
REEDAC™ RELAYS

Reedacs™ are hybrid or solid-state relays employing triacs. Most utilize our exclusive "bug" circuitry that prevents premature failure of reed-switch or transistor input caused by a previously unknown electrical characteristic of the triac. For complete information on Reedacs, write or call Grigsby-Barton; or contact your Grigsby-Barton representative.

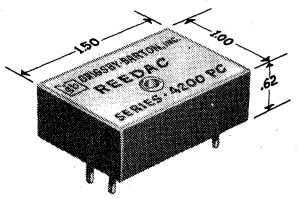
Basic Package Dimensions



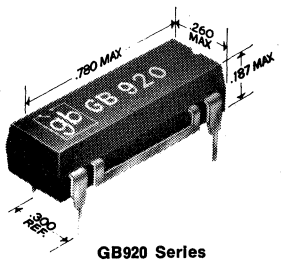
GB870 Series



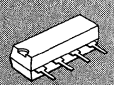
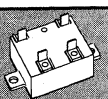
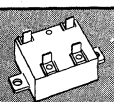
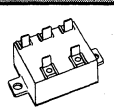
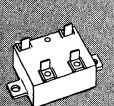
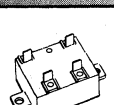
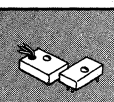
GB2000, 5000, 7000, 9000, 12000 Series (No. of terminals varies)



GB4000, 14000 Series



GB920 Series

	Description	Load Voltage (VAC)	Load Current Amps (60 Hz)	Input	Special Features
	**GB870 Series DIP Reedac™.** New 4-pin, edge-mounted Reedac handles up to 2 amps continuous at 70°C, and 80 amps inrush Compatible with GB840 Series edge-mounted DIP reed relay. Transfer-molded with no moving parts for shock proofing, unlimited life.	To 280	To 2.0	Reed relay or switch closure (see GB840)	Space-saving ½-DIP design. Exclusive "bug" circuitry. Use with GB840 Series edge-mounted DIP reed relay for input.
	GB920 Series SYNCHRO DIP™. A SPST A.C. Solid State Relay mounted in a modified TO-116, 4 lead dual-in-line plastic package. Input control terminals are L.E.D. coupled (photo isolated) from the output load terminals and is T^2L compatible. The output is zero voltage switching up to 280 VAC. Used for industrial controls, solenoids, fractional horsepower motors and actuators.	To 280	To 400 MA	2.0 to 32 VDC @ 16 MA max.	Photo isolation (L.E.D. coupled). Zero voltage switching. All solid state. UL/CSA compatible. Operates directly from AC to 280 VAC. Control any external TRIAC/SCR (no min. gate current and hard fired).
	**GB2000 Series Standard Reedac™.** Switch up to 280 VAC at 40 amps; 550 VAC at 10 amps. Available with new false-fire option that absorbs up to 55 joules of energy caused by line transients. Protected to 50 G shock in any plane. "Bug" circuitry.	To 550	To 40	5.0 VDC to 48 VDC, or switch closure	UL listed for many uses. Exclusive "bug" circuitry. False-fire option. Solder-lug, quick-connect, or screw-type terminals.
	GB4000 Series Miniature Reedac™. These medium-power Reedacs control resistive, capacitive or inductive loads. Excellent for interface between low-level logic and AC control. "Bug" circuitry. Available in PC, or flying-lead designs (as shown at left).	To 280	To 4.0	5.0 VDC to 48 VDC, or switch closure	UL listed for many uses. Exclusive "bug" circuitry. Choose from 2 termination types.
	**GB5000 Series Phase Controllers.** Available in 480 models. All consist of a triac, diac, and passive components mounted on a printed circuit board and packaged in a nylon case which can be mounted directly to metal equipment frames.	To 280	To 40	Potentiometer	Available with 16 circuit assemblies, 480 models. Some models UL listed. Solder-lug, quick-connect, or screw type terminals.
	**GB7000 Series Synchro-Reedac®.** Synchronous. Handle resistive and reactive loads, with no minimum load current. Circuitry prevents "halfwave phenomena" and delivers virtually zero RFI. Turn-on is less than 4 volts in the cycle, turn-off at zero current. Maximum noise immunity. 60 and 400 Hz models.	To 280	To 40	5.0 VDC to 48 VDC, or switch closure	UL listed for many uses. Zero voltage turn-on, zero current turn-off. Control any load. Solder-lug, quick-connect, or screw-type terminals.
	**GB9000 Series Synchro-Reedac®.** This 4-terminal synchronous Reedac gives equal performance to the GB7000 Series: No halfwave phenomena, no minimum load current, maximum noise immunity. Does not require across-the-line monitoring. Reduces field wiring. Turn-on is less than 4 volts in the cycle, and turn-off at zero current. This assures maximum lamp life, minimum RFI.	To 280	To 40	5.0 VDC to 48 VDC, or switch closure	Four terminals. Zero voltage turn-on. 200 V/micro sec. rate of rise in off state. Extended lamp life. UL listed for many uses. Solder-lug, quick-connect, or screw-type terminals.
	**GB12000 series Synchro-Reedac®.** This 4 terminal synchronous Reedac is true solid state having photo isolation (L.E.D.) input. No halfwave phenomina, no minimum load current, maximum noise immunity. Does not require across-the-line monitoring. Turn on is less than 4V in the cycle, and turn-off is at current zero.	To 280	To 40	5 to 24 VDC— Photo-Isolated (L.E.D.)	Four terminals. Zero voltage turn on. Photo isolated (L.E.D.) resistive or reactive loads. Synchronous switching.
	**GB14000 series miniature Synchro Reedac®.** This new line of medium power all solid state synchronous devices use photo-isolation (L.E.D. coupled) input. Excellent for interface between low-level logic and AC control. Available for PC mounting or with flying leads.	To 280	To 4.0	Photo-isolated (L.E.D. coupled) 5-24 VDC	All solid state synchronous switching. Resistive or reactive loads. Miniature size with 2 termination choices.

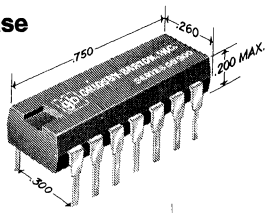
GRIGSBY-BARTON INC

DIP REED RELAYS

As the originator of DIP reed relays, Grigsby-Barton offers you the most complete selection, and the best technical help available. Patented (U.S. Pat. 3575678) lead-frame construction makes magnetic shielding integral. Transfer-molded housings provide excellent environmental protection.

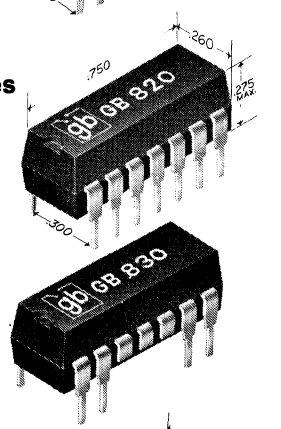
GB800 Series/T0116 Case

Compatible mechanically with all standard DIP-IC packages and conforming to JEDEC T0116 specifications. They mate with conventional 14-pin receptacles, as well as fit automatic insertion equipment. **Models listed:** GB-811A, 812A, 811C.



GB820 and GB830 Series

GB820 models have standard 14-pin configuration, GB830 have 8 pins. Package height of .275 allows use of standard miniature switches and larger coils to increase sensitivity, current-carrying capability, and contact rating, as well as reduce cost. Can be automatically inserted. **Models listed:** GB821A, 831A, 822A, 832A, 826AL, 821B, 831B, 821C, 831C, 823C, 825C, 835C.

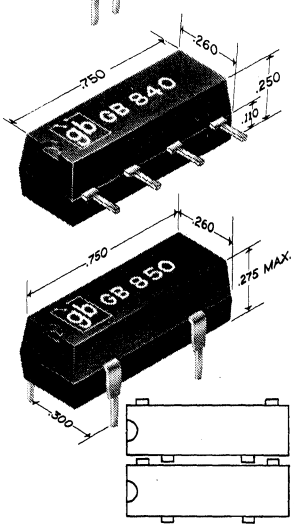


GB840 Series

These edge-mounted IC relays are designed for ultra high-density assemblies. They can also be used to "double up" by inserting them side by side in standard DIP sockets. **Models listed:** GB841A, 841B.

GB850 Series

These four terminal relays are designed for high-density IC assemblies. Staggered terminals (see drawing) permit tightest possible spacing. 1500 VAC minimum insulation breakdown between coil and switch. **Models listed:** GB851A, 851B.



COIL DATA

NOTE: All models marked by (*) are available with electrostatic shielding. Add Suffix "E" after coil suffix number.

Basic Model Numbers Available by Form	Coil Suffix No.	Nominal DC Coil Voltage @ 25°C	Ohms Resistance +20% −10% @ 25°C	Must Operate VDC	Must Release VDC	Clamp Diode
1 FORM A GB811A	Designed for 5 volt DC nominal coil voltage. 200 and 500 ohm coils available. Clamp diode, and electrostatic shield options. Consult factory for complete part number description.					
GB821A*, GB831A* GB841A, GB851A	−1	5.0	200	3.7	0.5	—
	−2	5.0	200	3.7	0.5	Yes
	−3	5.0	500	3.7	0.5	—
	−4	5.0	500	3.7	0.5	Yes
	−5	12.0	500	8.0	1.0	—
	−6	12.0	500	8.0	1.0	Yes
	−7	24.0	2150	18.0	2.0	—
	−8	24.0	2150	18.0	2.0	Yes
	−9	12.0	1000	8.0	1.0	—
	−10	12.0	1000	8.0	1.0	Yes
1 FORM A LATCHING GB826AL Bifiliar Coil, Reverse Pulse	−3	5.0	500	3.7		—
2 FORM A GB812A	−1	5.0	200	3.7	0.5	—
	−2	5.0	200	3.7	0.5	Yes
GB822A , GB832A	−1	5.0	150	3.7	0.5	—
	−2	5.0	150	3.7	0.5	Yes
	−3	12.0	450	8.0	1.0	—
	−4	12.0	450	8.0	1.0	Yes
	−5	24.0	1750	18.0	2.0	—
	−6	24.0	1750	18.0	2.0	Yes
1 FORM B GB821B , GB831B , GB841B, GB851B	−1	5.0	150	3.7	0.5	—
	−2	5.0	150	3.7	0.5	Yes
	−3	5.0	450	3.7	0.5	—
	−4	5.0	450	3.7	0.5	Yes
	−5	12.0	450	8.0	1.0	—
	−6	12.0	450	8.0	1.0	Yes
	−7	24.0	1750	18.0	2.0	—
	−8	24.0	1750	18.0	2.0	Yes
1 FORM C GB811C	−1B	5.0	125	4.0	0.5	—
	−2B	5.0	125	4.0	0.5	Yes
GB821C , GB831C	−1	5.0	150	4.0	0.5	—
	−2	5.0	150	4.0	0.5	Yes
	−3	12.0	450	8.0	1.0	—
	−4	12.0	450	8.0	1.0	Yes
	−5	24.0	1750	18.0	2.0	—
	−6	24.0	1750	18.0	2.0	Yes
GB825C , GB835C	−1	5.0	150	4.0	0.5	—
	−2	5.0	150	4.0	0.5	Yes
	−3	12.0	450	8.0	1.0	—
	−4	12.0	450	8.0	1.0	Yes
	−5	24.0	1750	18.0	2.0	—
	−6	24.0	1750	18.0	2.0	Yes
1 FORM C MERCURY-WETTED LATCHING GB823C (2 Coils)	−1	5.0	50	3.7	0.5	—

Electrical Characteristics

	811A 812A 822A 832A	811C	821A 831A 841A 851A 826AL	821B 831B 841B 851B	821C 831C	825C 835C	823C
Maximum DC Current Rating	110MA	10MA	250MA		250MA	200MA	1A
Maximum Switching Watts DC	3	.1	10		3	8	15
Maximum Switching Voltage	28	10	100		28	100	200
Breakdown Voltage DC	150	100	250		250	250	300
Initial Contact Resistance	.200	.250	.200		.200	.200	.100
Typical Operate Time in msec.	<.5	<.5	<.6		<1.0	<1.0	<2.5
Typical Release Time in msec.	<.35	<.35	<.35		<1.5	<1.5	<2.5

For more information on Grigsby-Barton reed relays, contact your Grigsby-Barton representative, or call or write:

The originators of DIP reed relays

GRIGSBY-BARTON INC

3800 INDUSTRIAL DRIVE • ROLLING MEADOWS, ILLINOIS 60008
TELEPHONE: AREA (312) 392-5900 TWX 910-687-3789

GUARDIAN® ELECTRIC

ALL PRODUCTS IN THIS CATALOG are immediately available from any franchised Guardian Distributor.

CATALOG PRICES: All prices in this catalog are list prices which were in effect at the time of printing. Contact your Guardian Distributor for quantity discounts or special bulk pricing.

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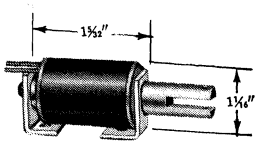
GUARDIAN ELECTRIC MANUFACTURING CO.
1550 WEST CARROLL AVENUE, CHICAGO, ILLINOIS 60607 — (312) 243-1100

GUARDIAN ELECTRIC MANUFACTURING COMPANY OF CALIFORNIA, INC.
5755 CAMILLE AVENUE, CULVER CITY, CALIFORNIA 90230 — (213) 870-4642

GUARDIAN® ELECTRIC SOLENOIDS

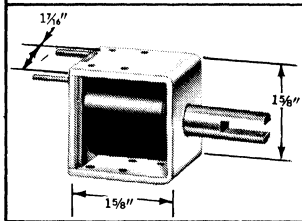


NO. 1A1 AC or DC

Low cost modified U-frame solenoid in six pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 4.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
1A1	Inter	120AC	300	8 oz. at 1/8"	2 oz. at 1/2"	$3.78
1A1	Cont	120AC	675	3 oz. at 1/8"	0.5 oz. at 3/8"	3.78

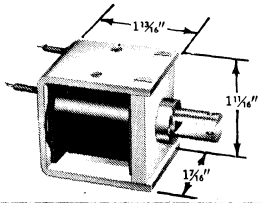


NO. 2 AC *

Box-frame solenoid in two pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 10 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
2	Inter	120AC	60	33 oz. at 1/8"	9 oz. at 7/8"	$5.30
2	Cont	120AC	166	10.5 oz. at 1/8"	3 oz. at 7/8"	5.47

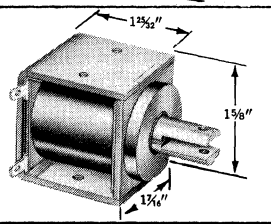


NO. 2HD AC or DC *

Heavy duty, long life box-frame solenoid in four pull type models. Insulation material: Class "A" (105°C) Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 13 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
2HD	Inter	120AC	36	38 oz. at 1/8"	16 oz. at 3/4"	$10.21
2HD	Cont	120AC	113	17 oz. at 1/8"	4 oz. at 3/4"	10.21
2HD	Inter	24DC	20	100 oz. at 1/8"	5 oz. at 3/4"	10.52
2HD	Cont	24DC	64	50 oz. at 1/8"	1 oz. at 5/8"	10.52

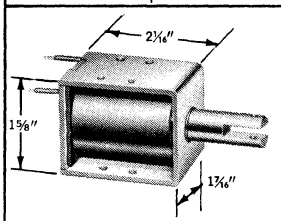


NO. 3HD DC *

Heavy duty box-frame solenoid in two pull type models. Insulation material: Class "A" (105°C) standard. Coil finish: Acetate yarn, coalesced with acetone. Termination: 3/16" quick disconnect. Shipping weight: 14 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
3HD	Inter	24DC	21	160 oz. at 1/16"	8 oz. at 3/4"	$7.07
3HD	Cont	24DC	52	100 oz. at 1/16"	3 oz. at 3/4"	7.07

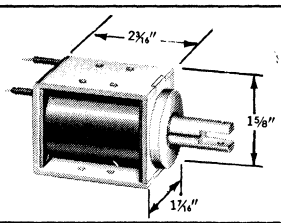


NO. 4 AC or DC *

Box-frame solenoid in six pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 14.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
4	Inter	120AC	37	24 oz. at 1/8"	22 oz. at 1"	$5.81
4	Cont	120AC	133	8 oz. at 1/8"	6 oz. at 1"	5.81
4	Inter	24DC	15	110 oz. at 1/8"	4 oz. at 1"	5.81
4	Cont	24DC	54	55 oz. at 1/8"	2.5 oz. at 7/8"	5.81
4	Inter	110DC	346	90 oz. at 1/8"	4 oz. at 1"	6.02
4	Cont	110DC	1300	55 oz. at 1/8"	2.5 oz. at 7/8"	6.02

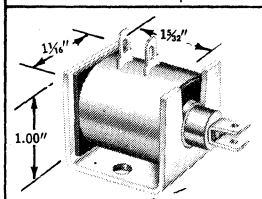


NO. 4HD AC or DC *

Heavy duty box-frame solenoid in six pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 15 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
4HD	Inter	120AC	15	107 oz. at 1/16"	30 oz. at 1 1/4"	$7.55
4HD	Cont	120AC	53	26 oz. at 1/8"	8 oz. at 1 1/4"	7.55
4HD	Inter	24DC	15	156 oz. at 1/8"	21 oz. at 3/4"	7.55
4HD	Cont	24DC	50	70 oz. at 1/8"	4 oz. at 3/4"	7.55
4HD	Inter	110DC	350	156 oz. at 1/8"	21 oz. at 3/4"	7.55
4HD	Cont	110DC	1200	70 oz. at 1/8"	4 oz. at 3/4"	7.55

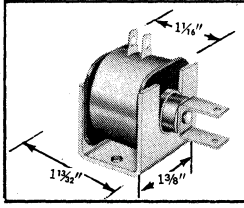


NO. 9 AC or DC

Box-frame solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: 3/16" quick disconnect. Shipping weight: 4 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
9	Inter	120AC	220	17 oz. at 1/8"	8 oz. at 1/2"	$3.26
9	Cont	120AC	350	11 oz. at 1/8"	4 oz. at 1/2"	3.26
9	Inter	24DC	52	16 oz. at 1/8"	1 oz. at 1/2"	3.06
9	Cont	24DC	90	10 oz. at 1/8"	1 oz. at 7/16"	3.06



NO. 10 AC or DC

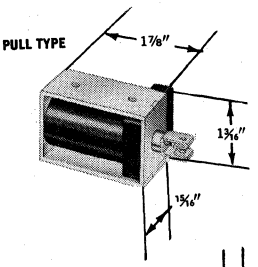
Box-frame solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: 3/16" quick disconnect. Shipping weight: 6.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
10	Inter	120AC	74	40 oz. at 1/8"	25 oz. at 1/2"	$3.47
10	Cont	120AC	172	20 oz. at 1/8"	10 oz. at 1/2"	3.47
10	Inter	24DC	37	26 oz. at 1/8"	4 oz. at 1/2"	3.26
10	Cont	24DC	69	16 oz. at 1/8"	1 oz. at 1/2"	3.26

* Recognized under the Component Program of Underwriters' Laboratories, Inc.

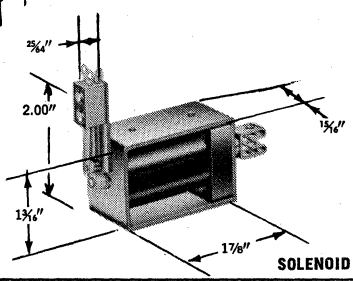
GUARDIAN® ELECTRIC SOLENOIDS



NO. 11 AC or DC*

Box-frame solenoid in 20 models and a choice of pull type, push type or solenoid switch. Insulation material: Class "A" (105°C). Coil finish: New Uni-Guard molded polyester. Termination: Dual purpose ³⁄₁₆" quick disconnect or solder type lugs. Shipping weight: 7.5 oz.

† Further savings available when purchased bulk packed in quantities of 250 or more.



SOLENOID WITH SWITCH

PULL TYPE

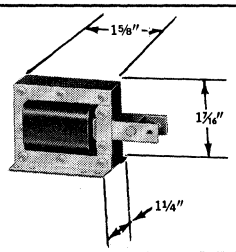
Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
11	Inter	24AC	3.5	25 oz. at ⅛"	6 oz. at 1"	$3.71
11	Cont	24AC	8	12 oz. at ⅛"	1 oz. at 1"	3.71
†11	Inter	120AC	85	25 oz. at ⅛"	6 oz. at 1"	3.71
†11	Cont	120AC	200	12 oz. at ⅛"	1 oz. at 1"	3.71
11	Inter	6DC	2	40 oz. at ⅛"	2 oz. at ¾"	3.71
11	Cont	6DC	4.5	25 oz. at ⅛"	1 oz. at ¾"	3.71
†11	Inter	24DC	31	40 oz. at ⅛"	2 oz. at ¾"	3.71
†11	Cont	24DC	72	25 oz. at ⅛"	1 oz. at ¾"	3.71

PUSH TYPE

11P	Inter	24AC	3.5	20 oz. at ⅛"	4.8 oz. at 1"	$4.25
11P	Cont	24AC	8	9.6 oz. at ⅛"	0.8 oz. at 1"	4.25
11P	Inter	120AC	85	20 oz. at ⅛"	4.8 oz. at 1"	4.25
11P	Cont	120AC	200	9.6 oz. at ⅛"	0.8 oz. at 1"	4.25
11P	Inter	6DC	2	32 oz. at ⅛"	1.6 oz. at ¾"	4.25
11P	Cont	6DC	4.5	20 oz. at ⅛"	0.8 oz. at ¾"	4.25
11P	Inter	24DC	31	32 oz. at ⅛"	1.6 oz. at ¾"	4.25
11P	Cont	24DC	72	20 oz. at ⅛"	0.8 oz. at ¾"	4.25

SOLENOID SWITCH - SPDT — 10 AMP

11S	Inter	120AC	85	25 oz. at ⅛"	6 oz. at 1"	$4.89
11S	Cont	120AC	200	12 oz. at ⅛"	1 oz. at 1"	4.89
11S	Inter	24DC	31	40 oz. at ⅛"	2 oz. at ¾"	4.89
11S	Cont	24DC	72	25 oz. at ⅛"	1 oz. at ¾"	4.99

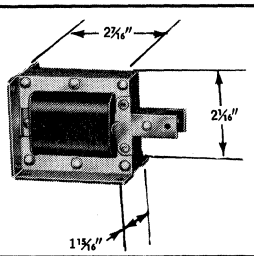


NO. 12 AC*

Efficient laminated solenoid in two pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 6 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
12	Inter	120AC	100	32 oz. at ⅛"	4 oz. at 1"	$5.26
12	Cont	120AC	150	22 oz. at ⅛"	3 oz. at ⅞"	5.26

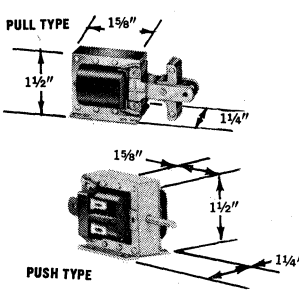


NO. 14 AC*

Efficient laminated solenoid in two pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: External leads. Shipping weight: 9 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
14	Inter	120AC	11	110 oz. at ⅛"	52 oz. at 1½"	$7.11
14	Cont	120AC	18	65 oz. at ⅛"	37 oz. at 1½"	7.11



NO. 16 AC*

Efficient laminated solenoid in six models and a choice of pull or push type. Insulation material: Class "A" (105°C). Coil finish: New Uni-Guard molded polyester. Termination: Dual purpose solder lugs or ³⁄₁₆" quick disconnect. Shipping weight: 7.5 oz.

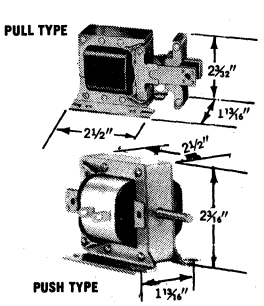
† Further savings available when purchased bulk packed in quantities of 250 or more.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
† 16	Inter	120AC	41	90 oz. at ⅛"	30 oz. at ¾"	$4.44
† 16	Cont	120AC	85	50 oz. at ⅛"	10 oz. at ¾"	4.44
16	Inter	240AC	200	90 oz. at ⅛"	30 oz. at ¾"	4.74
16	Cont	240AC	350	50 oz. at ⅛"	10 oz. at ¾"	4.74

PUSH TYPE

16P	Inter	120AC	41	90 oz. at ⅛"	30 oz. at ¾"	$4.98
16P	Cont	120AC	85	50 oz. at ⅛"	10 oz. at ¾"	4.98



NO. 18 AC*

Efficient laminated solenoid in six models and a choice of pull or push type. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: Solder lugs. Shipping weight: 16.5 oz.

PULL TYPE

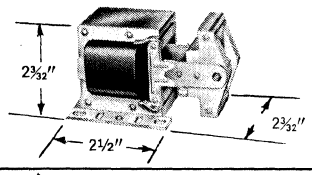
Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
18	Inter	120AC	8.8	280 oz. at ⅛"	80 oz. at 1"	$5.88
18	Cont	120AC	19.7	145 oz. at ⅛"	40 oz. at 1"	5.88
18	Inter	240AC	45	280 oz. at ⅛"	80 oz. at 1"	6.41
18	Cont	240AC	78	145 oz. at ⅛"	40 oz. at 1"	6.41

PUSH TYPE

18P	Inter	120AC	8.8	280 oz. at ⅛"	80 oz. at 1"	$6.42
18P	Cont	120AC	19.7	145 oz. at ⅛"	40 oz. at 1"	6.42

* Recognized under the Component Program of Underwriters' Laboratories, Inc.

GUARDIAN® ELECTRIC SOLENOIDS

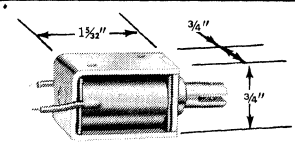


NEW NO. 18HD AC*

Heavy duty laminated solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn coalesced with acetone. Termination: Solder lugs. Shipping weight: 16 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
18HD	Inter	120AC	9.9	200 oz. at 1/8"	160 oz. at 1"	$14.80
18HD	Cont	120AC	15.2	172 oz. at 1/8"	128 oz. at 1"	14.80
18HD	Inter	240AC	40	200 oz. at 1/8"	160 oz. at 1"	14.80
18HD	Cont	240AC	60	172 oz. at 1/8"	128 oz. at 1"	14.80

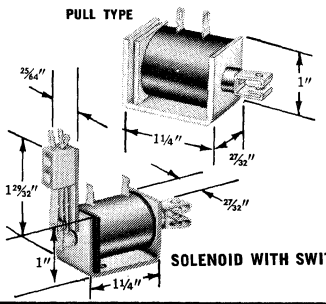


NO. 22 DC *

Box-frame solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn coalesced with acetone. Termination: External leads. Shipping weight: 2.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
22	Inter	6DC	4	24 oz. at 1/16"	1 oz. at 3/8"	$3.46
22	Cont	6DC	9	13 oz. at 1/16"	0.5 oz. at 1/4"	3.46
22	Inter	24DC	60	24 oz. at 1/16"	1 oz. at 7/16"	3.46
22	Cont	24DC	144	13 oz. at 1/16"	0.5 oz. at 3/8"	3.46



NO. 24 AC or DC *

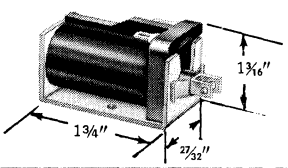
U-frame solenoid in six models and a choice of pull type or solenoid switch. Insulation material: Class "A" (105°C). Coil finish: Acetate yarn, coalesced with acetone. Termination: Solder lugs on pull type; 3/16" quick disconnect on solenoid switch. Shipping weight: 3 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
24	Inter	120AC	310	16 oz. at 1/16"	3 oz. at 5/8"	$4.02
24	Cont	120AC	500	10.5 oz. at 1/16"	2 oz. at 5/8"	4.02
24	Inter	24DC	52	36 oz. at 1/16"	3 oz. at 1/2"	4.02
24	Cont	24DC	114	18 oz. at 1/16"	0.5 oz. at 1/2"	4.02

SOLENOID SWITCH - SPDT — 10 AMP

24S	Inter	120AC	310	16 oz. at 1/16"	3 oz. at 5/8"	$8.17
24S	Cont	120AC	500	10.5 oz. at 1/16"	2 oz. at 5/8"	8.17

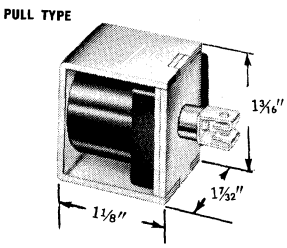


NO. 26 AC or DC *

U-frame solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: ¶New Uni-Guard molded polyester. Termination: Dual purpose solder lugs or 3/16" quick disconnect. Shipping weight: 4 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
26	Inter	120AC	140	28 oz. at 1/16"	3 oz. at 7/8"	$4.24
26	Cont	120AC	250	13 oz. at 1/16"	4 oz. at 5/8"	4.24
26	Inter	24DC	33	65 oz. at 1/16"	3 oz. at 3/4"	4.02
26	Cont	24DC	85	36 oz. at 1/16"	1.5 oz. at 1/2"	4.02



NO. 28 AC or DC*

Box-frame solenoid in 22 models and a choice of pull type, push type or solenoid switch. Insulation material: Class "A" (105°C). Coil finish: ¶New Uni-Guard molded polyester. Termination: Dual purpose solder lugs or 3/16" quick disconnect. Shipping weight: 3.5 oz.

PULL TYPE

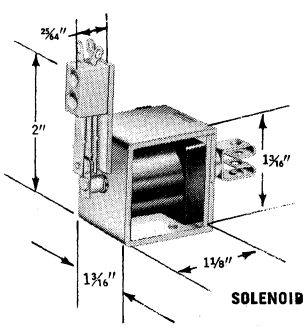
Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
28	Inter	24AC	7.5	35 oz. at 1/16"	5 oz. at 1/2"	$3.72
28	Cont	24AC	17.4	20 oz. at 1/16"	2.5 oz. at 1/2"	3.72
28	Inter	120AC	220	35 oz. at 1/16"	5 oz. at 1/2"	4.02
28	Cont	120AC	400	20 oz. at 1/16"	2.5 oz. at 1/2"	4.02
28	Inter	6DC	3.3	35 oz. at 1/16"	2 oz. at 1/2"	3.46
28	Cont	6DC	7.7	24 oz. at 1/16"	1 oz. at 3/8"	3.46
28	Inter	12DC	13	35 oz. at 1/16"	2 oz. at 1/2"	3.46
28	Cont	12DC	27	24 oz. at 1/16"	1 oz. at 3/8"	3.46
28	Inter	24DC	50	35 oz. at 1/16"	2 oz. at 1/2"	3.46
28	Cont	24DC	104	24 oz. at 1/16"	1 oz. at 3/8"	3.46

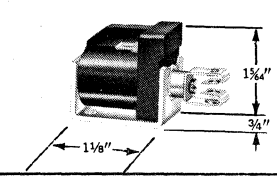
PUSH TYPE

28P	Inter	24AC	7.5	28 oz. at 1/16"	4 oz. at 1/2"	$4.25
28P	Cont	24AC	17.4	16 oz. at 1/16"	2 oz. at 1/2"	4.25
28P	Inter	120AC	220	28 oz. at 1/16"	4 oz. at 1/2"	4.55
28P	Cont	120AC	400	16 oz. at 1/16"	2 oz. at 1/2"	4.55
28P	Inter	6DC	3.3	28 oz. at 1/16"	1.6 oz. at 1/2"	4.00
28P	Cont	6DC	7.7	19 oz. at 1/16"	0.8 oz. at 3/8"	4.00
28P	Inter	12DC	13	28 oz. at 1/16"	1.6 oz. at 1/2"	4.00
28P	Cont	12DC	27	19 oz. at 1/16"	0.8 oz. at 3/8"	4.00
28P	Inter	24DC	50	28 oz. at 1/16"	1.6 oz. at 1/2"	4.00
28P	Cont	24DC	104	19 oz. at 1/16"	0.8 oz. at 3/8"	4.00

SOLENOID SWITCH - SPDT — 10 AMP

28S	Inter	24DC	50	35 oz. at 1/16"	2 oz. at 1/2"	$4.64
28S	Cont	24DC	104	24 oz. at 1/16"	1 oz. at 3/8"	4.64





NO. 34 AC or DC*

U-frame solenoid in four pull type models. Insulation material: Class "A" (105°C). Coil finish: ¶New Uni-Guard molded polyester. Termination: Dual purpose solder lugs or 3/16" quick disconnect. Shipping weight: 3 oz.

PULL TYPE

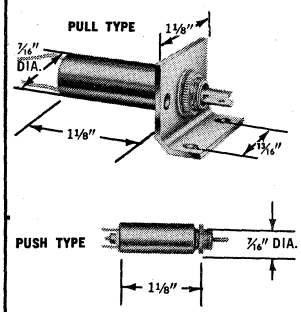
† Further savings available when purchased bulk packed in quantities of 250 or more.

Guardian No.	Duty	Coil Voltage	Ohms	LIFTS AND STROKES (Minimum)	(Maximum)	Net Ea. 1-24
† 34	Inter	120AC	400	15 oz. at 1/16"	1 oz. at 1/2"	$2.65
† 34	Cont	120AC	865	7 oz. at 1/16"	0.5 oz. at 1/2"	2.65
† 34	Inter	24DC	66	17 oz. at 1/16"	1 oz. at 7/16"	2.65
† 34	Cont	24DC	145	8.5 oz. at 1/16"	0.5 oz. at 1/4"	2.65

* Recognized under the Component Program of Underwriters' Laboratories, Inc.

¶ Available January 1, 1974

GUARDIAN® ELECTRIC TUBULAR SOLENOIDS



NO. T3.5 x 9*

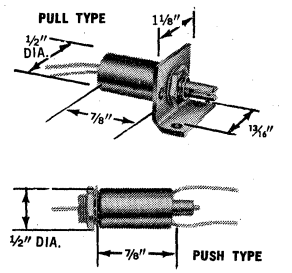
Tubular solenoid in eight models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 5/16"-32. Shipping weight: 3.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net Ea. 1-24
T3.5 x 9	Inter	12DC	11 oz. at 1/32"	1 oz. at 1/2"	14	10	$3.94
T3.5 x 9	Cont	12DC	4 oz. at 1/32"	.25 oz. at 5/16"	80	2	4.04
T3.5 x 9	Inter	24DC	11 oz. at 1/32"	1 oz. at 1/2"	57	10	3.94
T3.5 x 9	Cont	24DC	4.5 oz. at 1/32"	.25 oz. at 5/16"	260	2	4.04

PUSH TYPE

TP3.5x9	Inter	12DC	9 oz. at 1/32"	0.5 oz. at 1/2"	14	10	$4.67
TP3.5x9	Cont	12DC	3 oz. at 1/32"	.25 oz. at 1/4"	80	2	4.77
TP3.5x9	Inter	24DC	9 oz. at 1/32"	0.5 oz. at 1/2"	57	10	4.67
TP3.5x9	Cont	24DC	3.5 oz. at 1/32"	.25 oz. at 1/4"	260	2	4.77



NO. T4 x 7*

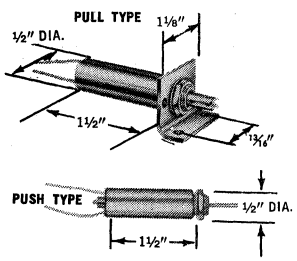
Tubular solenoid in six models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 3/8"-32. Shipping weight: 3.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T4 x 7	Inter	12DC	10 oz. at 1/32"	1 oz. at 1/4"	20	7	$4.50
T4 x 7	Cont	12DC	4 oz. at 1/32"	.25 oz. at 5/32"	60	2.4	4.61
T4 x 7	Inter	24DC	10 oz. at 1/32"	1 oz. at 1/4"	80	7	4.50
T4 x 7	Cont	24DC	4 oz. at 1/32"	.25 oz. at 5/32"	240	2.4	4.61

PUSH TYPE

TP4 x 7	Inter	24DC	5 oz. at 1/16"	.75 oz. at 1/4"	80	7	5.21
TP4 x 7	Cont	24DC	1.5 oz. at 1/16"	.25 oz. at 1/8"	240	2.4	5.32



NO. T4 x 12*

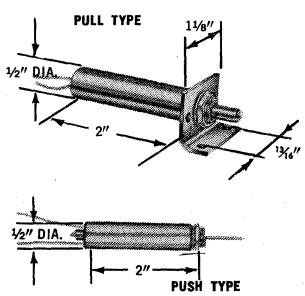
Tubular solenoid in six models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 3/8"-32. Shipping weight: 3.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T4 x 12	Inter	12DC	15 oz. at 1/32"	1 oz. at 3/4"	10	15	$4.82
T4 x 12	Cont	12DC	8 oz. at 1/32"	1 oz. at 5/16"	41	3.5	4.93
T4 x 12	Inter	24DC	15 oz. at 1/32"	1 oz. at 3/4"	38	15	4.82
T4 x 12	Cont	24DC	8 oz. at 1/32"	1 oz. at 5/16"	160	3.5	4.93

PUSH TYPE

TP4 x 12	Inter	24DC	12 oz. at 1/32"	0.5 oz. at 3/4"	38	15	5.56
TP4 x 12	Cont	24DC	6 oz. at 1/32"	0.5 oz. at 5/16"	160	3.5	5.67



NO. T4 x 16*

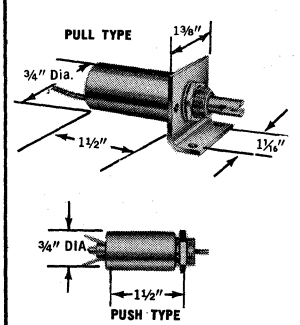
Tubular solenoid in eight models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 3/8"-32. Shipping weight: 3.5 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T4 x 16	Inter	12DC	17 oz. at 1/32"	2 oz. at 1⅛"	6	20	$5.14
T4 x 16	Cont	12DC	10 oz. at 1/32"	0.5 oz. at 7/8"	36	4	5.25
T4 x 16	Inter	24DC	17 oz. at 1/32"	2 oz. at 1⅛"	24	20	5.14
T4 x 16	Cont	24DC	10 oz. at 1/32"	0.5 oz. at 7/8"	145	4	5.25

PUSH TYPE

TP4 x 16	Inter	12DC	14 oz. at 1/32"	1.5 oz. at 1⅛"	6	20	$5.89
TP4 x 16	Cont	12DC	8 oz. at 1/32"	0.5 oz. at 3/4"	36	4	5.99
TP4 x 16	Inter	24DC	14 oz. at 1/32"	1.5 oz. at 1⅛"	24	20	5.89
TP4 x 16	Cont	25DC	8 oz. at 1/32"	0.5 oz. at 3/4"	145	4	5.99



NO. T6 x 12*

Tubular solenoid in eight models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 15/32"-32. Shipping weight: 5 oz.

PULL TYPE

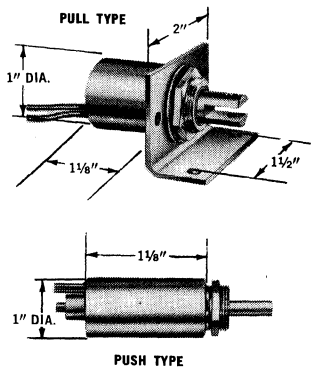
Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T6 x 12	Inter	12DC	30 oz. at 1/16"	2 oz. at 7/8"	6.5	22	$5.36
T6 x 12	Cont	12DC	16 oz. at 1/16"	1 oz. at 1/2"	41	3.5	5.47
T6 x 12	Inter	24DC	30 oz. at 1/16"	2 oz. at 7/8"	25	22	5.36
T6 x 12	Cont	24DC	16 oz. at 1/16"	1.5 oz. at 1/2"	165	3.5	5.47

PUSH TYPE

TP6 x 12	Inter	12DC	25 oz. at 1/16"	1.5 oz. at 7/8"	6.5	22	$6.10
TP6 x 12	Cont	12DC	13 oz. at 1/16"	1 oz. at 1/2"	41	3.5	6.20
TP6 x 12	Inter	24DC	25 oz. at 1/16"	1.5 oz. at 7/8"	25	22	6.10
TP6 x 12	Cont	24DC	13 oz. at 1/16"	1 oz. at 1/2"	165	3.5	6.20

* Recognized under the Component Program of Underwriters' Laboratories, Inc.

GUARDIAN® ELECTRIC TUBULAR SOLENOIDS



NO. T8 x 9*

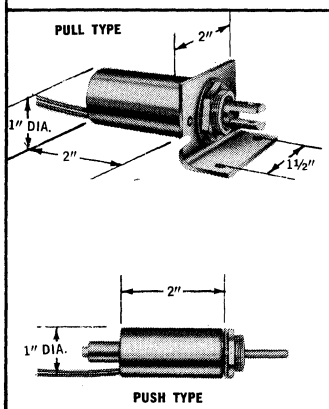
Tubular solenoid in six models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: ¾"-24. Shipping weight: 6 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T8 x 9	Inter	12DC	50 oz. at 1/16"	1 oz. at 9/16"	7.5	19	$5.52
T8 x 9	Cont	12DC	13 oz. at 1/16"	1 oz. at 3/8"	36	4	5.57
T8 x 9	Inter	24DC	50 oz. at 1/16"	1 oz. at 9/16"	30	19	5.52
T8 x 9	Cont	24DC	13 oz. at 1/16"	1 oz. at 3/8"	145	4	5.57

PUSH TYPE

TP8 x 9 — Inter — 24DC	40 oz. at 1/16"	1 oz. at 9/16"	30	19	6.23
TP8 x 9 — Cont — 24DC	11 oz. at 1/16"	1 oz. at 3/8"	145	4	6.28



NO. T8 x 16*

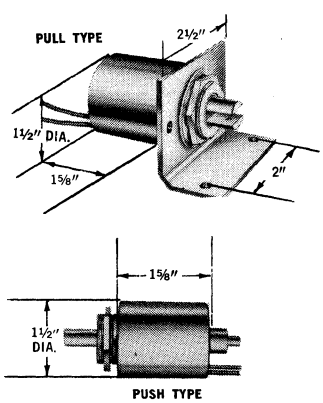
Tubular solenoid in eight models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: ¾"-24. Shipping weight: 6 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T8 x 16	Inter	12DC	80 oz. at 1/16"	2 oz. at 1¼"	2.7	38	$5.78
T8 x 16	Cont	12DC	32 oz. at 1/16"	2 oz. at 5/8"	26	5.5	5.90
T8 x 16	Inter	24DC	80 oz. at 1/16"	2 oz. at 1¼"	15	38	5.78
T8 x 16	Cont	24DC	32 oz. at 1/16"	2 oz. at 5/8"	105	5.5	5.90

PUSH TYPE

TP8 x 16 — Inter — 12DC	65 oz. at 1/16"	1.75 oz. at 1¼"	2.7	38	$6.50
TP8 x 16 — Cont — 12DC	26 oz. at 1/16"	1.75 oz. at 5/8"	26	5.5	6.61
TP8 x 16 — Inter — 24DC	65 oz. at 1/16"	1.75 oz. at 1¼"	15	38	6.50
TP8 x 16 — Cont — 24DC	26 oz. at 1/16"	1.75 oz. at 5/8"	105	5.5	6.61



NO. T12 x 13*

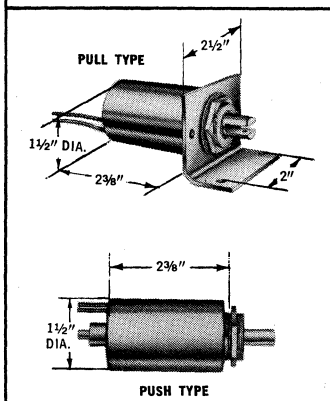
Tubular solenoid in six models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 1"-27. Shipping weight: 7 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T12 x 13	Inter	12DC	150 oz. at 1/8"	8 oz. at 7/8"	3.6	40	$6.97
T12 x 13	Cont	12DC	48 oz. at 1/8"	1 oz. at ¾"	20	7	7.18
T12 x 13	Inter	24DC	150 oz. at 1/8"	8 oz. at 7/8"	14	40	6.97
T12 x 13	Cont	24DC	48 oz. at 1/8"	1 oz. at ¾"	85	7	7.18

PUSH TYPE

TP12x13 — Inter — 24DC	120 oz. at 1/8"	6.5 oz. at 7/8"	14	40	7.70
TP12x13 — Cont — 24DC	48 oz. at 1/8"	1 oz. at ¾"	85	7	7.82



NO. T12 x 19*

Tubular solenoid in six models including choice of either pull or push type operation. Both types include mounting bracket. Insulation material: Class "A" (105°C). Termination: 6 inch leads. Mounting thread size: 1"-27. Shipping weight: 8 oz.

PULL TYPE

Guardian No.	Duty	Coil Voltage	LIFTS AND STROKES (Minimum)	(Maximum)	Ω	W.	Net ea. 1-24
T12 x 19	Inter	12DC	165 oz. at 1/8"	6 oz. at 1½"	2.4	60	$8.02
T12 x 19	Cont	12DC	80 oz. at 1/8"	1 oz. at 1¼"	14	10	8.12
T12 x 19	Inter	24DC	165 oz. at 1/8"	6 oz. at 1½"	9.5	60	8.02
T12 x 19	Cont	24DC	80 oz. at 1/8"	1 oz. at 1¼"	59	10	8.12

PUSH TYPE

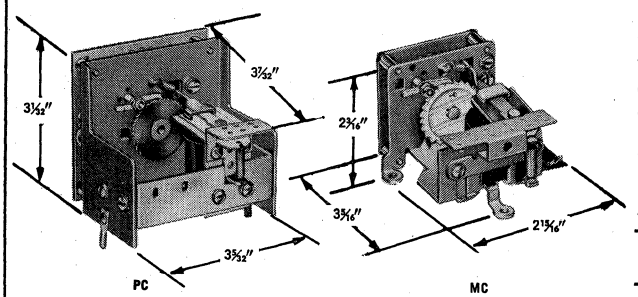
TP12x19 — Inter — 24DC	130 oz. at 1/8"	5 oz. at 1½"	9.5	60	8.73
TP12x19 — Cont — 24DC	65 oz. at 1/8"	1 oz. at 1"	59	10	8.83

* Recognized under the Component Program of Underwriters' Laboratories, Inc.

GUARDIAN® ELECTRIC STEPPERS

STEPPING CONTROLS

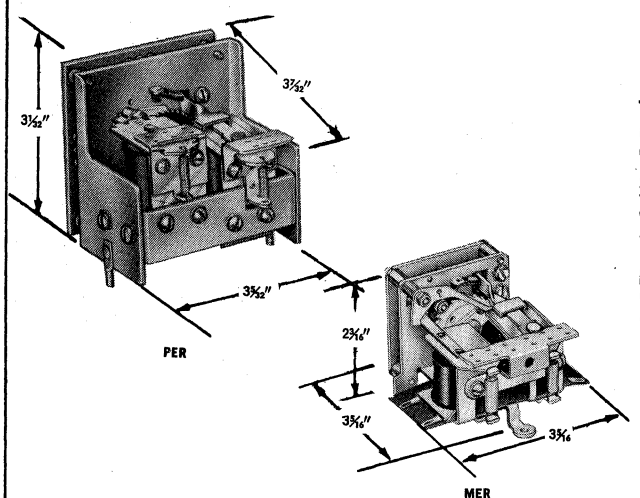
For accurate sequence selecting, pulse multiplying, pulse dividing, circuit selecting, automatic homing, remote homing, counting and latching. Guardian steppers are specified for automatic control of electrically operated business machines, accumulators (coin and other), animated displays, electrical scoreboards, automatic overhead garage doors, assembly line controls, automatic packaging (loading) controls, sump pump controls, commercial slide projectors, among others. All Guardian steppers except Series 705 are intermittent duty. All are direct-drive units with switching operations completed upon energization.



CONTINUOUS ROTATION

The circuit selection wiper on Continuous Rotation Steppers moves in one direction only, upon energization of the step coil. This type of stepper is available in standard 24 point (MC) or 40 point (PC). The Guardian MC Midget Continuous Rotation Stepper is particularly adaptable to repetitive sequence functions. The 24 bridging contact deck is evenly divisible by eight possible sequences. The PC stepper features self-stepping speeds up to 30 steps per second and mechanical life expectancy of over 4,000,000 steps.

Guardian No.	Watts	Volt Amperes	No. of Points	No. of Active Contacts	Max. Steps per Second	Shipping Weight Ounces	Net Ea. 1-24
PC-120AC	20	35	40	40	20	17	$24.92
MC-120AC	17	30	24	24	20	9½	18.45

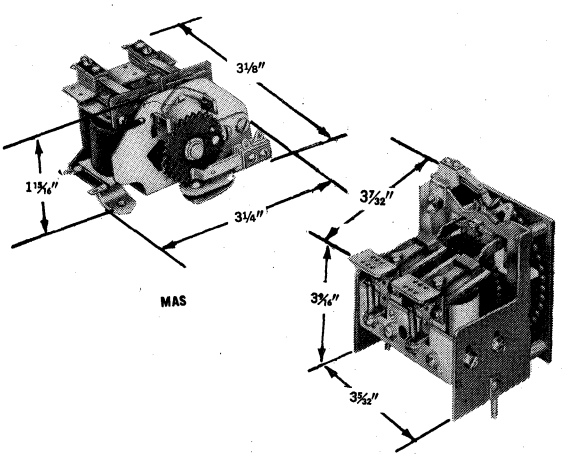


ELECTRICAL RESET

Type MER. A direct drive (steps on energization) with positive mechanical reset interlock actuated by the reset magnet and unlocked on the first energization of the step magnet. Assures positive reset on as short a pulse as one-hundredth of a second. By interconnecting two or more Steppers, count can be increased to any desired total counting by tens, or any convenient multiple. Will control a sequence of operation and then automatically reset to starting position. The circuit selecting wiper on Electrical Reset Steppers can be reset to zero or home from any desired position, by energization of the reset magnet. They are frequently employed to record counts by various numerical groups, then resetting automatically.

Type PER. Operation same as MER but with up to 48 active contacts.

Guardian No.	Watts	Volt Amperes	No. of Points	No. of Active Contacts	Max. Steps per Second	Shipping Weight Ounces	Net Ea. 1-24
PER/40-120AC	35-7¶	60-10¶	40	36	20	22	$32.80
PER/52-120AC	65-7¶	115-10¶	52	48	20	22	35.90
MER-120AC	20-7¶	40-10¶	24	22	20	11½	19.69
MER-24DC	20-8¶		24	22	20	11½	19.69



ADD AND SUBTRACT

Add and subtract steppers are basically continuous rotation types with the added feature of being able to reverse the movement of the selecting wiper when required.

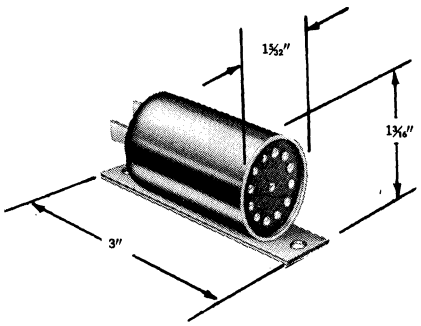
Type MAS. A midget add and subtract stepper incorporating a cam actuated switch which operates at zero position. Used primarily to indicate a zero balance between pulses supplied to the "add" coil as compared to pulses received by the "subtract" coil.

Type PAS. New Bi-directional steppers whereby the selector wiper moves either direction depending on which of the coils is energized. Supplied with .058" dia. AMP quick-connect terminals arranged in circle on deck, and also includes a form "C" cam switch.

Guardian No.	Watts	Volt Amperes	No. of Points	No. of Active Contacts	Max. Steps per Second	Shipping Weight Ounces	Net Ea. 1-24
MAS-120AC	9	12	30	‡	10	11	$21.56
PAS-120AC	35	60	40	40†	29	22	32.80

NOTES: All stepper contact points are rated 1½ amps resistive, at 120 V., 60 Hz Coil* Voltages are 120 AC, 60 Hz and 24 DC.
* Steppers will operate satisfactorily at 15% below or 10% above rated voltage.
¶ Listings are for stepping coil and reset coil, respectively.
† Includes Zero (0) position.
‡ Zero (0) position switch only.

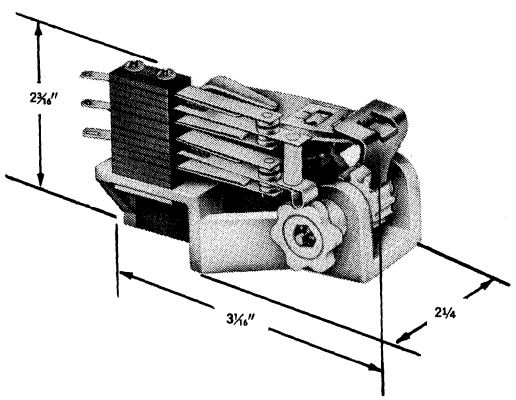
GUARDIAN® ELECTRIC — STEPPERS LEVER SWITCH



ROTOMITE STEPPER SERIES 705

An entirely new concept in stepper design, the Guardian "Rotomite" is first with maximum stepper control in minimum space. Offering high contact rating of 3 amps resistive, 1 amp inductive (50% PF). Featuring continuous duty operation with life well in excess of one million steps, the completely enclosed Rotomite is geared for continuous rotation of 12 positions. A few Rotomite applications presently include computers, business machines, lighting and vending controls, counting and sorting devices, and model trains. Shipping weight, 5 oz.

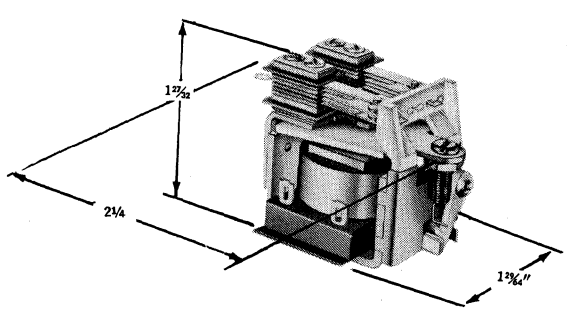
Guardian No.	No. Points	Coil Voltage	Net ea. 1-24
705-12P-6D	12	6DC	$7.70
705-12P-12D	12	12DC	7.70
705-12P-24D	12	24DC	7.70



SERIES 660 - 665 SEQUENCE

Intended to perform switching operations in a repetitive transfer sequence. Each electrical impulse moves the switch contacts to the opposite position in the sequence. Applications include lights, signs, motors, appliances and similar units. Contacts rated up to 12½ amps, 120V., 60 Hz, non-inductive load. Shipping weight, 8 oz. Mounting: 4 holes 8-32 (NC-2B).

Guardian No.	Coil Voltage	Contact Comb.	Net ea. 1-24
660-C-24A	24AC	SPDT	$7.84
660-2C-24A	24AC	DPDT	8.47
660-4C-24A	24AC	4PDT	12.31
660-C-120A	120AC	SPDT	7.84
660-2C-120A	120AC	DPDT	8.47
660-4C-120A	120AC	4PDT	12.31
665-C-24D	24DC	SPDT	7.84
665-2C-24D	24DC	DPDT	8.47
665-4C-24D	24DC	4PDT	12.31



SERIES 840L - 845L ON/OFF STEPPER

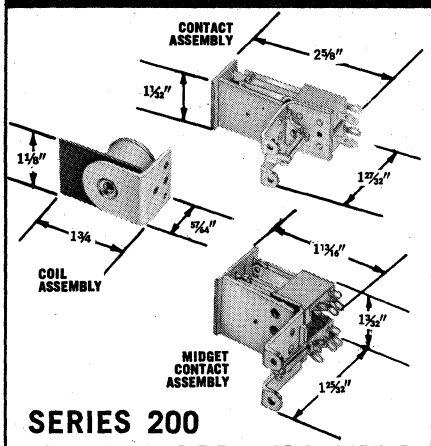
SINGLE COIL IMPULSE OPERATED MECHANICAL LATCHING RELAY STEPPER

Compact AC or DC Latching Relay for positive on/off control of positioning devices, remote controls, lighting circuits and many additional applications. SPDT, DPDT or 4PDT contact combinations. Impulse as short as 20 MS energizes coil to reverse position of switches. Holds last position of switch with coil de-energized. Contacts rated for 10 amps at 120VAC, 60 Hz non-inductive. Power requirement: 8.2 volt-amperes. Solder lug terminals for coils and contacts. Shipping weight, 5.2 oz. Mounting: Single mounting hole tapped 8-32 (NC-2B).

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Voltage	Cont. Comb.	Net ea. 1-24
840L-C-24A	24AC	SPDT	$5.33
840L-2C-24A	24AC	DPDT	6.43
840L-4C-24A	24AC	4PDT	9.18
840L-C-120A	120AC	SPDT	5.33
840L-2C-120A	120AC	DPDT	6.43
840L-4C-120A	120AC	4PDT	9.18
845L-C-12D	12DC	SPDT	$5.33
845L-2C-12D	12DC	DPDT	6.43
845L-4C-12D	12DC	4PDT	9.18
845L-C-24D	24DC	SPDT	5.33
845L-2C-24D	24DC	DPDT	6.43
845L-4C-24D	24DC	4PDT	9.18

GUARDIAN® ELECTRIC OPEN RELAYS



SERIES 200

RELAY WITH COMPLETELY INTERCHANGEABLE COIL AND CONTACT ASSEMBLIES

The coil consists of the coil and field piece; the contact assembly consists of switch blades, armature; return spring and mounting bracket. The Guardian Midget Contact Assembly is interchangeable with the standard Series 200 contact assembly. Available with SPDT, DPDT or 4PDT contact switch assemblies, each suitable for use with any AC or DC coil.

SERIES 200 RELAY

Guardian No.	Volts	Coil	Net ea. 1-24
200-6A	6	AC	$2.16
200-12A	12	AC	2.16
200-24A	24	AC	2.16
200-120A	120	AC	2.51
200-240A	240	AC	3.34
200-6D	6	DC	2.34
200-12D	12	DC	2.34
200-24D	24	DC	2.34
200-32D	32	DC	2.34
200-110D	110	DC	3.10
200-5,000D	†	DC	2.68
200-10,000D	†	DC	3.10

† Plate Circuit

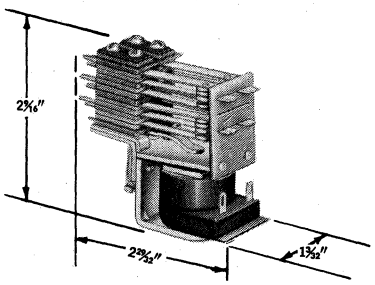
CONTACT SWITCH ASSEMBLIES

Guardian No.	Type	Cont. Amps	Cont. Comb.	Net ea. 1-24
200-1	Standard	8	SPDT	$1.98
200-2	Standard	8	DPDT	2.59
200-4	Standard	12.5	DPDT	2.91
200-5	Standard	8	4PDT	4.57
200-M1	Midget	10	SPDT	1.87
200-M2	Midget	10	DPDT	2.28
200-M5	Midget	8	4PDT	3.70

CONTACT SWITCH PARTS

Guardian No.	Type	Net ea. 1-24
200-3	Standard	$1.97
200-M3	Midget	1.97

Use contact switch parts 200-3 for adding poles to contact switch assemblies 200-1 and 200-2. Use midget contact switch parts 200-M3 for adding poles to midget contact switch assemblies 200-M1 and 200-M2.



SERIES 240U - 245U

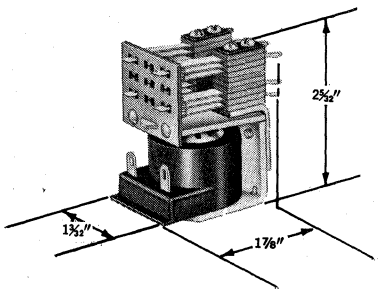
15 AMPERE RELAY

Designed for contact ratings up to 15 amps, Guardian series 240U AC and 245U DC relays are compact, reliable, inexpensive. Factory pretested and adjusted to be ready for assembly into your product. Contact rating is 15 amp, 120V., 60 Hz non-inductive load. Easy assembly with 8-32 single-screw, center-hole mounting. Shipping weight 4.5 oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Res.	Coil Voltage	Cont. Comb.	Net ea. 1-24
240U-2C-24A	24	24AC	DPDT	$4.75
240U-4C-24A	24	24AC	4PDT	6.97
240U-2C-120A	550	120AC	DPDT	4.75
240U-4C-120A	550	120AC	4PDT	6.97
245U-2C-12D	50	12DC	DPDT	4.75
245U-4C-12D	50	12DC	4PDT	6.97
245U-2C-24D	200	24DC	DPDT	4.75
245U-4C-24D	200	24DC	4PDT	6.97

* Normally open



SERIES 640U - 645U

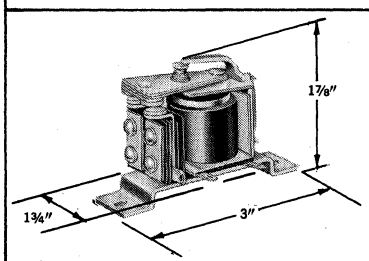
ALL PURPOSE ECONOMY RELAY 10 AMPERE

A compact, lightweight relay capable of unusually heavy power control for its size. Long life, high quality relay available in a variety of AC and DC voltages with a selection of contact combinations. All contact ratings are 10 amps. Contact ratings at 60 Hz 120V. non-inductive load. 8-32 single screw, center pole mounting. Shipping weight, 3.5 oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Res.	Coil Voltage	Cont. Comb.	Net ea. 1-24
640U-A-24A	24	24AC	SPST*	$3.39
640U-C-24A	24	24AC	SPDT	3.68
640U-2C-24A	24	24AC	DPDT	3.97
640U-4C-24A	24	24AC	4PDT	5.83
640U-A-120A	550	120AC	SPST*	3.39
640U-C-120A	550	120AC	SPDT	3.68
640U-2C-120A	550	120AC	DPDT	3.97
640U-4C-120A	550	120AC	4PDT	5.83
640U-2C-240A	2950	240AC	DPDT	4.90
645U-A-12D	50	12DC	SPST*	3.39
645U-C-12D	50	12DC	SPDT	3.68
645U-2C-12D	50	12DC	DPDT	3.97
645U-4C-12D	50	12DC	4PDT	5.83
645U-A-24D	200	24DC	SPST*	3.39
645U-C-24D	200	24DC	SPDT	3.68
645U-2C-24D	200	24DC	DPDT	3.75
645U-4C-24D	200	24DC	4PDT	5.83
645U-A-110D	4000	110DC	SPST*	3.75
645U-C-110D	4000	110DC	SPDT	4.31
645U-2C-110D	4000	110DC	DPDT	4.60
645U-4C-110D	4000	110DC	4PDT	6.13

* Normally open



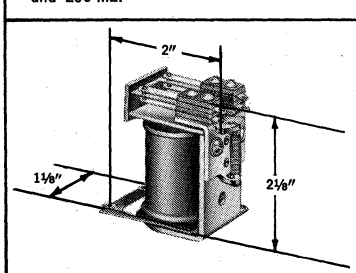
SERIES 220

HEAVY DUTY INDUSTRIAL AC RELAY 20 AMPERE

This rugged unit makes and breaks up to 20 amps, at 240 volts. Armature is equipped with phenolic contact mounting block carrying ⅝" dual contacts. Phenolic is tested at 1500 volts breakdown to ground. Contacts are silver alloy. Relay is available in dual SPST, normally open contact combination only. Contact rating 20 amps at 60 Hz, 240VAC non-inductive load. Mounting: Mounting holes — clearance for 8-32 with 2³²⁄₃₂" centers. Shipping weight, 5.5 oz.

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
220-A-24A	24AC	25	SPST*	$5.25
220-A-120A	120AC	600	SPST*	5.90
220-A-240A	240AC	2,500	SPST*	6.48

* Normally Open



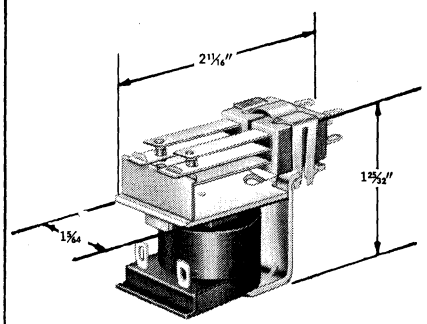
SERIES 625

PLATE CIRCUIT DC RELAY — 10 AMPERE

Has extra long coil for greater sensitivity. Adaptable to voltage operation as well as sensitive plate circuit control installations. Coil impregnated for reliability and longer life. Average power requirement, 0.2 watt. Contacts, fine silver. Contact ratings, 10 amps. Mounting: One 8-32 (NC-2) center hole. Shipping weight, 5.5 oz.

Guardian No.	Oper. Mils	Coil Res.	Cont. Comb.	Net ea. 1-24
625-2.5	9 M.A.	2,500	DPDT	$5.20
625-5	6.3 M.A.	5,000	DPDT	5.55
625-10	4.5 M.A.	10,000	DPDT	6.57

GUARDIAN® ELECTRIC OPEN RELAYS



SERIES 900-905
SERIES 910-915

10 AMP RELAY

- Designed with reduced number of parts for long, trouble-free service
- Has keyed and locked lifter

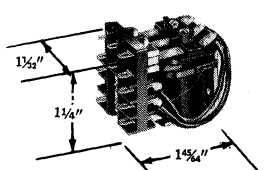
Series 910 is exactly the same as the 900 relay, both electrically and mechanically, but with 3/16" quick disconnects instead of soldered termination.

Dependable, low cost, DPDT relay featuring new, trouble-free design that incorporates a minimum of parts. Contacts all rated 10 amps, 120VAC resistive load. Has molded switches, one-piece mounting clip and return spring; molded bobbin and coil cover. Average shipping weight, 6 oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Res.	Coil Voltage	Net ea. 1-9
900-2C-24A	24	24AC	$2.05
900-2C-120A	750	120AC	2.05
900-2C-240A	2950	240AC	2.05
905-2C-6D	8	6DC	2.05
905-2C-12D	32	12DC	2.05
905-2C-24D	130	24DC	2.05
910-2C-24A	24	24AC	2.05
910-2C-120A	750	120AC	2.05
910-2C-240A	2950	240AC	2.05
915-2C-6D	8	6DC	2.05
915-2C-12D	32	12DC	2.05
915-2C-24D	130	24DC	2.05

Further savings are available when above Series relays are purchased in bulk packs of 50 units. Relays are supplied nested in new convenient "form fitted" asembly line trays.

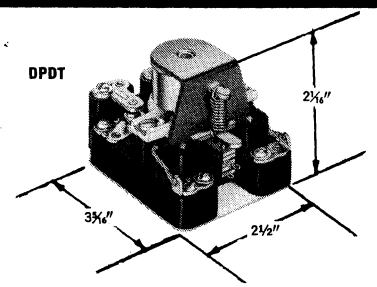


SERIES 1240 - 1245

NEW SMALL, EFFICIENT MEDIUM POWER RELAY — 10 AMPERE

Highly efficient relay for communications, automation, remote control switching circuits and laboratory applications. All terminals are solder lug type and molded in phenolic panel block for coils as well as contacts. Barriers in panel block raised to meet U/L over-surface spacing. Contacts rated 10 amps at 60 Hz, 120 VAC, non-inductive load. Mounting: Single mounting hole, 6-32 tap. Shipping weight, 2.5 oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.



SERIES 2600U - 2605U

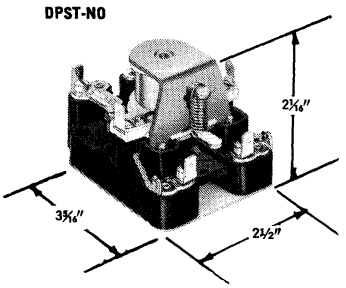
25 AMPERE POWER RELAY

Replaces Series 2100-2105 and Series 2300-2305

New line of power relays with double pole double throw contacts rated at 25 amperes. Inverted coil construction protects armature and contacts from inadvertent mechanical damage or electrical shorting. Series 2600U-DPDT-AC coils are rated for continuous duty at 240VAC, with 75% power factor; operating power requirement is 9.5 volt amperes, 60 Hz. Series 2600U and 2605U have easily accessible screw type terminals as pictured; also available are 1/4" AMP quick connect terminals as pictured on series 2620U and 2625U. (Purchase 2600 — Q.C. terminal kit for easy "do-it-yourself" conversion). "Press to Test" armature lever makes for convenient manual circuit testing. Recessed SPDT auxiliary switch as illustrated is not included but is simple to mount and may be purchased separately if needed; auxiliary switch has solder lug blade tails and is rated for 10 ampere operation. These new 25 ampere power relays are very compact with a shipping weight of only 8 ounces. For mounting there are two .196" diameter holes in the base; these are located on 1 7/8" centers.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Volts	Net ea. 1-24
2600U-DPDT-24A	24AC	$7.80
2600U-DPDT-120A	120AC	7.80
2600U-DPDT-240A	240AC	8.20
2605U-DPDT-12D	12DC	7.80
2605U-DPDT-24D	24DC	7.80
2605U-DPDT-110D	110DC	8.20



SERIES 2620U - 2625U

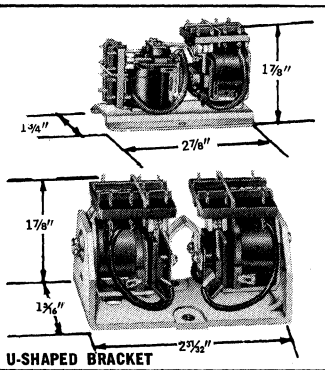
25 AMPERE POWER RELAY

Replaces Series 2110-2115

Compatible line of power relays with double pole single throw contacts (normally open). Same inverted coil construction as for 2600U and 2605U. Important note: Series 2620U and 2625U are manufactured with the easily accessible screw type terminals as pictured on series 2600U and 2605U. The 1/4" AMP quick connect terminals pictured here are available in the 2600 Q.C. terminal kit for easy "do-it-yourself" installation. Same "Press to Test" armature lever as for 2600U and 2605U. Auxiliary switch may be added if desired. Overall dimensions, shipping weight and mounting provisions are identical to the compatible DPDT units of the 2600U and 2605U series.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Volts	Net ea. 1-24
2620U-DPST-24A	24AC	$5.93
2620U-DPST-120A	120AC	5.93
2620U-DPST-240A	240AC	6.48
2625U-DPST-12D	12DC	5.99
2625U-DPST-24D	24DC	5.99
2625U-DPST-110D	110DC	6.48
2600U-SPDT-Aux.-SW	—	1.63
2600U-QC. Terminal Kit	—	.80



U-SHAPED BRACKET

INTERLOCK RELAYS
SERIES 1200/1200
SERIES 1200/1200UB

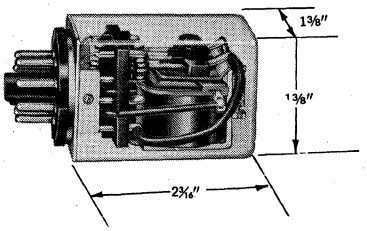
Two interlocking AC relays in sturdy metal frame bracket. Used to maintain circuits continuously without coil power consumption. Units are electrically pulse operated with mechanical hold and electrical release. Contacts rated for 10 amps, at 60 Hz, 120VAC, non-inductive load. Coil resistance is 1,100 ohms. Shipping weight, 5.5 oz.

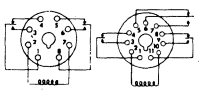
Guardian No.	Cont. Comb.	Coil Voltage	Net ea. 1-24
1200/1200-4C-120A	4PDT	120AC	$11.04
1200/1200UB-4C-120A	4PDT	120AC	11.04

Guardian No.	Coil Res.	Coil Voltage	Cont. Comb.	Net ea. 1-24
1240-2C-6A	2.8	6AC	DPDT	$4.21
1240-3C-6A	4	6AC	3PDT	4.77
1240-2C-24A	59	24AC	DPDT	4.21
1240-3C-24A	50	24AC	3PDT	4.77
1240-2C-120A	1190	120AC	DPDT	4.21
1240-3C-120A	1000	120AC	3PDT	4.77
1240-2C-240A	5340	240AC	DPDT	4.49
1240-3C-240A	4750	240AC	3PDT	5.05

Guardian No.	Coil Res.	Coil Voltage	Cont. Comb.	Net ea. 1-24
1245-2C-6D	18	6DC	DPDT	$3.81
1245-3C-6D	18	6DC	3PDT	4.32
1245-2C-12D	75	12DC	DPDT	3.81
1245-3C-12D	75	12DC	3PDT	4.32
1245-2C-24D	300	24DC	DPDT	3.81
1245-3C-24D	300	24DC	3PDT	4.32
1245-2C-110D	6500	110DC	DPDT	4.21
1245-3C-110D	6500	110DC	3PDT	4.77

GUARDIAN® ELECTRIC ENCLOSED RELAYS





8 pin for DPDT 11 pin for 3PDT

SERIES 1210 - 1215

ENCLOSED PLUG-IN RELAY — 10 AMPERE

A powerful and economical relay enclosed in a transparent, lightweight Lexan case which **has high impact strength, is unaffected by** weather, and is resistant to temperatures of 200°F. Relay available with 8 pin octal plug for DPDT and 11 pin for 3PDT. Contacts rated **for 10 amps at 60 Hz, 120VAC non-inductive load. Shipping weight, 3.5 oz.**

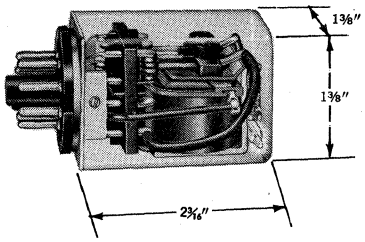
Recognized under the Component Program of Underwriters' Laboratories, Inc.

(5 amp only)

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
1210-2C-6A	6AC	33	DPDT	$6.73
1210-3C-6A	6AC	33	3PDT	8.42
1210-2C-24A	24AC	54	DPDT	6.73
1210-3C-24A	24AC	54	3PDT	8.42
1210-2C-120A	120AC	1,100	DPDT	6.73
1210-3C-120A	120AC	1,100	3PDT	8.42
1210-2C-240A	240AC	5,000	DPDT	7.02
1210-3C-240A	240AC	5,000	3PDT	8.70
1215-2C-6D	6DC	18	DPDT	6.73
1215-3C-6D	6DC	18	3PDT	8.42
1215-2C-12D	12DC	75	DPDT	6.73
1215-3C-12D	12DC	75	3PDT	8.42
1215-2C-24D	24DC	300	DPDT	6.73
1215-3C-24D	24DC	300	3PDT	8.42
1215-2C-110D	110DC	6,500	DPDT	7.29
1215-3C-110D	110DC	6,500	3PDT	8.98

ENCLOSED PLATE CIRCUIT PLUG-IN RELAY

Guardian No.	Coil Mils	Coil Res.	Cont. Comb.	Net ea. 1-24
1215-2C-2.5	10 MA	2,500	DPDT	$6.96
1215-3C-2.5	12 MA	2,500	3PDT	8.14
1215-2C-5	7.2 MA	5,000	DPDT	7.07
1215-3C-5	8.5 MA	5,000	3PDT	8.42
1215-2C-10	5 MA	10,000	DPDT	7.29
1215-3C-10	6 MA	10,000	3PDT	8.70

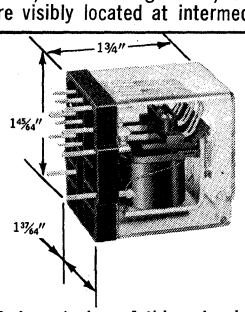


SERIES 1210N

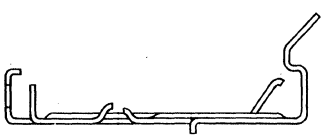
ENCLOSED PLUG-IN AC RELAY WITH BUILT-IN NEON LAMP TO INDICATE CIRCUIT FAULTS — 10 AMPERE

This plug-in relay utilizes a miniature neon lamp connected across coil terminals. The lamp lights each time the coil is energized, or indicates a circuit fault when lamp is "dark". Ideal for detecting circuit faults in relay banks, mass arrangements, or where relays are visibly located at intermediate switching points of the circuitry. Precludes the use of circuit testers. Available with 8 pin octal plug for DPDT and 11 pin for 3PDT. Contacts rated 10 amps at 120VAC 60 Hz, non-inductive load. Shipping weight, 3.5 oz.

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
1210N-2C-120A	120AC	1,100	DPDT	$7.88
1210N-3C-120A	120AC	1,100	3PDT	9.33



SERIES 1220 AC — 1225 DC



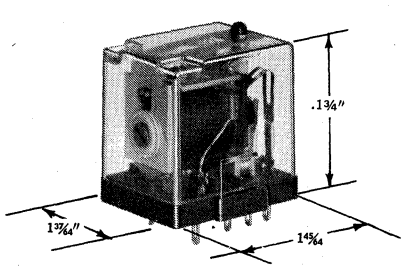
"Above Chassis" Snap Bracket accurately positions relay for quick connects or soldering.

Modern design of this relay has become the standard of the industry. Series 1220 and 1225 are reduced in height and cost by eliminating the radio-type plug and all the wiring between the relay and the plug. These series use the terminal panel itself as the male plug. **Famous "UNI-GUARD" continuous-loop moving** blades eliminate soldered connections. Cover snap-locks in place with a flush fit that guards against shorting. Universal terminals **function as solder-lug, .110" quick connect,** or socket plug-in. Mounting bracket for above chassis installation included with each relay. Contacts will safely switch 10 amperes at 120VAC non-inductive in most applications and are U/L approved at 7 amperes.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
1220-2C-24A	24AC	54	DPDT	$4.67
1220-2C-120A	120AC	1,110	DPDT	4.67
1220-2C-240A	240AC	5,000	DPDT	4.97
1220-3C-24A	24AC	54	3PDT	5.25
1220-3C-120A	120AC	1,110	3PDT	5.25
1220-3C-240A	240AC	5,000	3PDT	5.55
1225-2C-6D	6DC	18	DPDT	4.67
1225-2C-12D	12DC	75	DPDT	4.67
1225-2C-24D	24DC	300	DPDT	4.67
1225-2C-110D	110DC	6,500	DPDT	4.66
1225-3C-6D	6DC	18	3PDT	5.25
1225-3C-12D	12DC	75	3PDT	5.25
1225-3C-24D	24DC	300	3PDT	5.25
1225-3C-110D	110DC	6,500	3PDT	5.55

Further savings available when purchased in bulk packs of 50 units. Relays supplied nested in convenient "form fitted" assembly line trays.



SERIES 1220M AC - 1225M DC

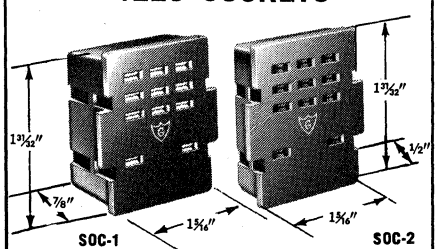
MANUAL RESET RELAY

Basic size and cost advantages of the Series 1220 AC and 1225 DC are obtainable off-the-shelf in a manual reset version. Height and cost are reduced through the elimination of the radio-type octal plug and the wiring between the relay and the plug. Unit is built to meet U/L requirements and features the "UNI-GUARD" continuous-loop moving blades. Double pole double throw contacts transfer when coil is energized, locking in the transferred position without further coil energy. Lock is released and contacts re-transfer **only** when manual reset button is pressed.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
1220M-2C-24A	24A	54	DPDT	$6.42
1220M-2C-120A	120A	1,110	DPDT	6.42
1225M-2C-24D	24D	300	DPDT	6.42

1220 SOCKETS

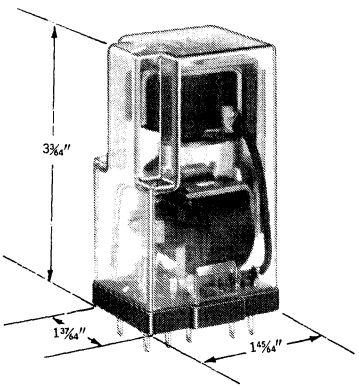


1-9 — Net 65¢ each **10-up — Net 60¢ each**

The 1220 snap-in socket has U/L component recognition when used with Guardian Relays. Socket terminal lugs can be soldered to or will accept AMP Series 110 quick connects.

Further savings available when purchased in bulk packs.

GUARDIAN® ELECTRIC ENCLOSED RELAYS

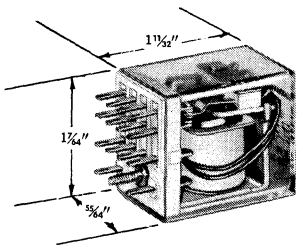


SERIES 1220/1220

ENCLOSED INTERLOCK

For an enclosed interlock or electrical reset relay the Guardian Series 1220/1220 has all the mounting and cost advantages of the Series 1220 and Series 1225. Double pole double throw contacts on relay transfer when relay coil is energized, locking in the transferred position without further coil energy. Lock is released and contacts re-transfer **only** when interlock (reset) magnet is energized. Contacts are rated for 10 amperes at 120VAC non-inductive.

Guardian No.	Coil Voltage	Coil Res.	Cont. Comb.	Net ea. 1-24
1220/1220-2C-24A	24A	54	DPDT	$14.59
1220/1220-2C-120A	120A	1110	DPDT	14.59
1225/1225-2C-24D	24D	300	DPDT	14.59



SERIES 1310 - 1315

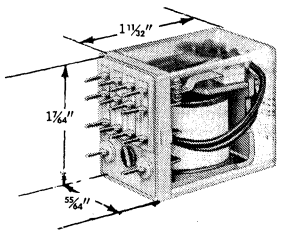
LONG LIFE 4PDT, 5 AMP — MINIATURE RELAY

4PDT . . . 5 amp Plug-In Relay available AC or DC. Contacts rated 5 amps at 30VDC or 120VAC resistive. Heat resistant, Lexan cover. Life in excess of 100 million operations. Weight: 1⅛ oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Voltage	Net ea. 1-24
1310-4C-6A	6AC	$5.20
1310-4C-12A	12AC	5.20
1310-4C-24A	24AC	5.20
1310-4C-120A	120AC	5.41
1315-4C-6D	6DC	4.48
1315-4C-12D	12DC	4.48
1315-4C-24D	24DC	4.48
1315-4C-110D	110DC	5.05

Further savings available when purchased in bulk packs of 50 units. Relays supplied nested in convenient "form fitted" assembly line trays.



SERIES 1310P - 1315P

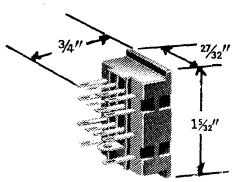
MINIATURE RELAY WITH PRINTED CIRCUIT TERMINATION

4PDT . . . 5 Amp Plug-In Relay available AC or DC. Contacts rated 5 amps at 30VDC or 120VAC resistive. Heat resistant Lexan cover. Life in excess of 100 million operations. Weight: 1⅛ oz.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Guardian No.	Coil Voltage	Net ea. 1-24
1310P-4C-6A	6AC	$5.20
1310P-4C-12A	12AC	5.20
1310P-4C-24A	24AC	5.20
1310P-4C-120A	120AC	5.41
1315P-4C-6D	6DC	4.48
1315P-4C-12D	12DC	4.48
1315P-4C-24D	24DC	4.48
1315P-4C-110D	110DC	5.05

Further savings available when purchased in bulk packs of 50 units. Relays supplied nested in convenient "form fitted" assembly line trays.



SERIES 1310 SOCKET

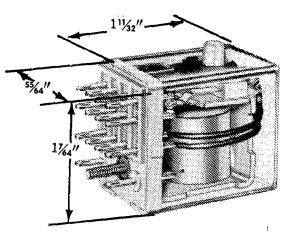
Select either the 1310-1 ST Series Relay Socket with solder terminals or the 1310-2 PC Relay Socket with printed circuit terminals for mounting your miniature relays. Panel cutout for socket should measure 1.015" x .858" with .025" radii at all four corners.

1310-1 ST Series Relay Socket (SOLDER TERMINALS) ..... 60¢ ea.

1310-2 PC Series Relay Socket (PRINTED CIRCUIT) ..... 60¢ ea.

1310-3SN Series Relay Socket (SOLDER TERMINAL SNAP-IN) ..... 60¢ ea.

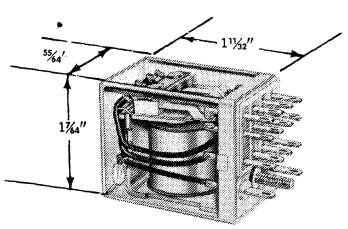
Further savings available when purchased in bulk packs.



SERIES 1310B - 1315B PUSH-TO-TEST RELAY

The same basic characteristics, size and cost advantages of the Series 1310-1315 relays, now available off-the-shelf in a "push-to-test" version. This 4PDT, 5 amp miniature relay is equipped with a readily accessible, insulated button which provides for checking relay and circuit performance without applying voltage to the relay coil. Weight: 1⅛ oz.

Guardian No.	Coil Voltage	Net ea. 1-24
1310B-4C-120A	120AC	$6.04
1315B-4C-24D	24DC	5.10
1315B-4C-110D	110DC	5.67



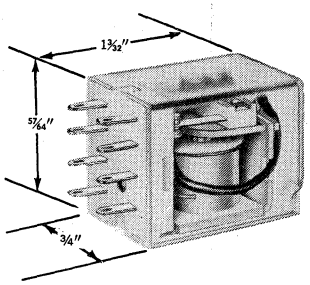
SERIES 1310N - 1315N

ENCLOSED, LONG LIFE MINIATURE PLUG-IN AC OR DC RELAY WITH BUILT-IN NEON LAMP TO INDICATE CIRCUIT FAULTS

This plug-in relay utilizes a miniature neon lamp connected across the coil terminals. The lamp glows each time the coil is energized, or indicates a circuit fault when lamp fails to glow upon circuit energization. Ideal for detecting circuit faults in relay banks, mass arrangements, or where relays are visibly located at intermediate switching points of the circuitry. Precludes the use of circuit testers. Relay is 4PDT with 120VAC operating coil. Contacts rated at 5 amps at 30VDC or 120VAC resistive. Heat resistant Lexan cover. Weight: 1⅛ oz.

Guardian No.	Coil Voltage	Cont. Comb.	Net ea. 1-24
1310N-4C-120A	120AC	4PDT	$6.04
1315N-4C-24D	24DC	4PDT	5.10
1315N-4C-110D	110DC	4PDT	5.67

GUARDIAN® ELECTRIC — MINIATURE ENCLOSED RELAYS



SERIES 1330 - 1335

LOW COST DPDT PLUG-IN RELAYS FOR LARGE CONTROL CAPACITY IN A SMALL SIZE

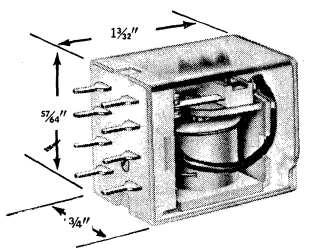
Compact new DPDT... 5 amp Plug-In Relay available AC or DC. Ideal for circuitry found in business machines, photocopy equipment, computers, appliances... wherever you need reliable control with economy of space and cost. Contacts rated 5 amp at 30VDC or 120VAC resistive. Heat resistant Lexan cover. Weight: ¾oz.

Guardian No.	Coil Voltage	Coil Res.	Net ea. 1-24
1330-2C-6A	6AC	15	$3.96
1330-2C-12A	12AC	50	3.96
1330-2C-24A	24AC	245	3.96
1330-2C-120A	120AC	5400	4.16
1335-2C-6D	6DC	30	3.87
1335-2C-12D	12DC	125	3.87
1335-2C-24D	24DC	500	3.87

Recognized under the Component Program of Underwriters' Laboratories, Inc.

"Above Chassis" Snap Bracket included with each relay. Similar to Series 1220 Bracket shown on page 11.

Further savings available when purchased in bulk packs of 100 units. Relays supplied nested in convenient "form fitted" assembly line trays.



SERIES 1330P - 1335P

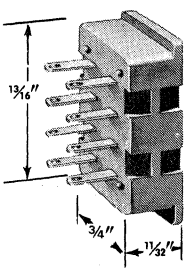
COMPACT, LOW COST MINIATURE RELAY WITH PRINTED CIRCUIT TERMINATION

DPDT... 5 amp Plug-In Relay available AC or DC. Contacts rated 5 amps at 30VDC or 120VAC resistive. Heat resistant Lexan cover. Weight: ¾ oz.

Guardian No.	Coil Voltage	Coil Res.	Net ea. 1-24
1330P-2C-6A	6AC	15	$3.96
1330P-2C-12A	12AC	50	3.96
1330P-2C-24A	24AC	245	3.96
1330P-2C-120A	120AC	5400	4.16
1335P-2C-6D	6DC	30	3.87
1335P-2C-12D	12DC	125	3.87
1335P-2C-24D	24DC	500	3.87

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Further savings available when purchased in bulk packs of 100 units. Relays supplied nested in convenient "form fitted" assembly line trays.



SERIES 1330 SOCKETS

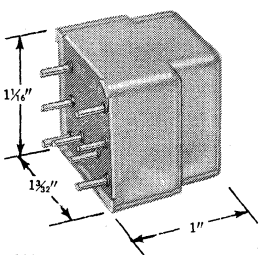
Select either the 1330-1ST Series Relay Socket with solder terminals or the 1330-2PC Relay Socket with printed circuit terminals for mounting your miniature relays. Panel cutout for socket should measure .759" x .830" with .025" radii at all four corners. Recommended for .031" to .062" thick chassis.

1330-1 ST Series Relay Socket (Solder Terminals) ..... $.50 ea.

1330-2 PC Series Relay Socket (Printed Circuit) ..... $.50 ea.

Further savings available when purchased in bulk packs.

Socket Retainer Clip and Relay Retainer Clip included with each socket.



SERIES 1360PC - 1365PC

PRINTED CIRCUIT RELAYS — DPDT SWITCHING

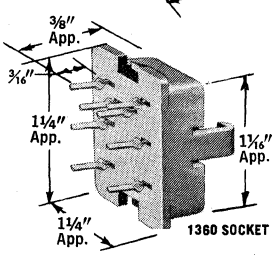
For low power solid state circuitry. .060" dia. terminals on .1" grid spacing for standard printed circuit board. Solders right on PC board or use mating socket. 1 watt normal power... 3500 ohms coil resistance (120VAC-60 Hz). Mechanical life in excess of 10 million operations. 5 amp resistive 120VAC 60 Hz contact rating. DPDT switching. Weight: 1 oz.

Guardian No.	Coil Voltage	Net ea. 1-24
1360PC-2C-24A	24AC	$3.74
1360PC-2C-120A	120AC	4.06
1365PC-2C-6D	6DC	3.74
1365PC-2C-12D	12DC	3.74
1365PC-2C-24D	24DC	3.74

Also available in SPDT and SPST configurations on special order.

Recognized under the Component Program of Underwriters' Laboratories, Inc.

Further savings available when purchased in bulk packs of 100 units. Relays supplied nested in convenient "form fitted" assembly line trays.



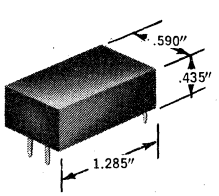
SERIES 1360 SOCKET

May be soldered directly to PC board or snapped through underside of chassis. Connections by wire wrapping may be made before or after insertion of socket into chassis. Panel cutout for socket should measure 1.265" x 1.078" with .015" radii at all four corners. .062" chassis thickness recommended.

1360-1 ..... 50¢ ea.

Further savings available when purchased in bulk packs.

Recognized under the Component Program of Underwriters' Laboratories, Inc.



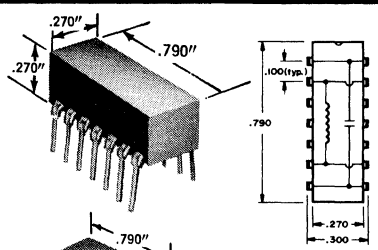
SERIES 1435

THIN NEW MINIATURE RELAYS IN CHOICE OF SPDT OR DPDT

Specifically designed for applications with either demanding space limitations or operating requirements that cannot be met with reed relays or conventional contact type relays. Contacts rated 1 amp at 26VDC. PC terminals in 0.10" grid spacing. Mechanical life in excess of 10⁷. Blue plastic dust cover with mylar bottom. Weight: 10 grams.

Guardian No.	Coil Res.	Coil Voltage	Cont. Comb.	Net ea. 1-24
1435-1C-6D	66	6DC	SPDT	$3.46
1435-2C-6D	66	6DC	DPDT	4.80
1435-1C-12D	330	12DC	SPDT	3.46
1435-2C-12D	330	12DC	DPDT	4.86
1435-1C-24D	950	24DC	SPDT	3.70
1435-2C-24D	950	24DC	DPDT	5.06
1435-1C-48D	4700	48DC	SPDT	4.14
1435-2C-48D	4700	48DC	DPDT	5.18

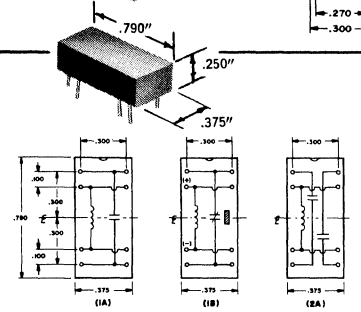
GUARDIAN® ELECTRIC REED RELAYS



SERIES MDR MINI REED RELAYS

Compatible with pin spacing for 14-terminal dual-in-line integrated circuit sockets or PC board use. The operating sensitivity of the 5-volt relay makes this unit operational with DTL and TTL logic families which will give a 3.75VDC minimum output voltage at +25°C. **Contacts:** 1 A only. **Rating:** 3 watts at 28 VDC or 0.25A. **Contact Resistance:** 200 milliohms max. **Breakdown Voltage:** 200VDC min. **Capacitance:** 0.25 pF max. **Operate Time:** 0.5 ms. including contact bounce. **Release Time:** 0.1 ms. including contact bounce. **Insul. Resistance:** 10^9 ohms min. **Temp. Range:** −55°C to +85°C.

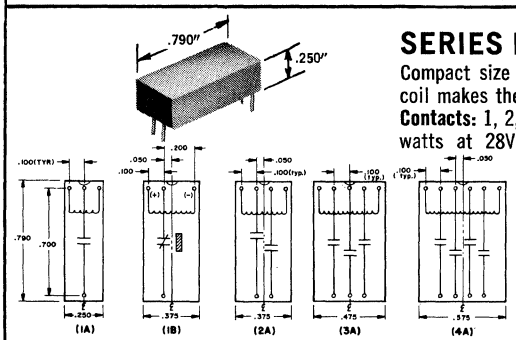
Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
MDR-1A005	5	1A	500	$5.46
MDR-1A006	6	1A	500	5.46
MDR-1A012	12	1A	1400	5.46
MDR-1A024	24	1A	3600	5.46



SERIES MDX MINI REED RELAYS

Guardian now offers a series of reed relays that are compatible with DTL and TTL logic families (5VDC). The relays can be inserted into the same printed circuit board as a 14 terminal dual-in-line IC. **Contacts:** 1A, 1B or 2A. **Ratings:** 3 watts at 28VDC or 0.25A. **Breakdown Voltage:** 200VDC min. **Contact Resistance:** 200 milliohms max. **Capacitance:** 0.25 pF max. **Insulation Resistance:** 10^9 ohms min. **Operate Time:** 0.5 ms. including contact bounce. **Release Time:** 0.1 ms. including contact bounce. **Temperature Range:** −55°C to +85°C. **Pins:** .023" dia. x .125" long.

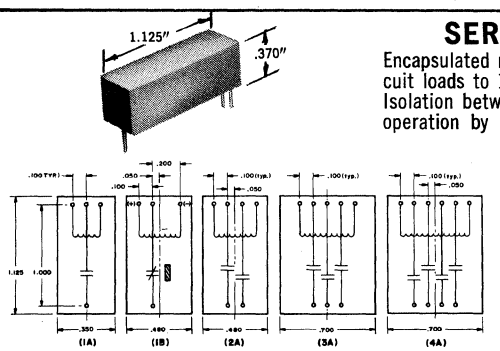
Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
MDX-1A005	5	1A	350	$5.20
MDX-1A006	6	1A	350	4.39
MDX-1A012	12	1A	1400	4.39
MDX-1A024	24	1A	3600	4.90
MDX-2A005	5	2A	150	6.43
MDX-2A006	6	2A	150	5.00
MDX-2A012	12	2A	600	5.00
MDX-2A024	24	2A	2400	5.41
MDX-1B005	5	1B	150	6.22
MDX-1B006	6	1B	150	4.79
MDX-1B012	12	1B	600	4.79
MDX-1B024	24	1B	2400	5.20



SERIES MRR MINI REED RELAYS

Compact size with 5, 6, 12 or 24VDC coil. The 5-volt coil makes the relay compatible with solid state logic. **Contacts:** 1, 2, 3 or 4 Form A and 1 Form B. **Ratings:** 3 watts at 28VDC or 0.25A. **Contact Resistance:** 200 milliohms max. **Breakdown Voltage:** 200 VDC min. **Capacitance:** 0.25 pF max. **Operate Time:** (A) 0.5 ms. (B) 0.1 ms. including contact bounce. **Release Time:** (A) 0.1 ms. (B) 0.5 ms. including contact bounce. **Insulation Resistance:** 10^9 ohms min. **Temperature Range:** −55°C to +85°C. **Pins:** .020" dia. x .125" long.

Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
MRR-1A005	5	1A	350	$5.20
MRR-1A006	6	1A	350	4.39
MRR-1A012	12	1A	1400	4.39
MRR-1A024	24	1A	3600	4.90
MRR-2A005	5	2A	150	6.43
MRR-2A006	6	2A	150	5.00
MRR-2A012	12	2A	600	5.00
MRR-2A024	24	2A	2400	5.41
MRR-3A006	6	3A	130	5.71
MRR-3A012	12	3A	520	5.71
MRR-3A024	24	3A	2000	6.02
MRR-4A006	6	4A	110	6.83
MRR-4A012	12	4A	450	6.83
MRR-4A024	24	4A	1600	7.04
MRR-1B005	5	1B	150	6.22
MRR-1B006	6	1B	150	4.79
MRR-1B012	12	1B	600	4.79
MRR-1B024	24	1B	2400	5.20



SERIES GRR REED RELAYS

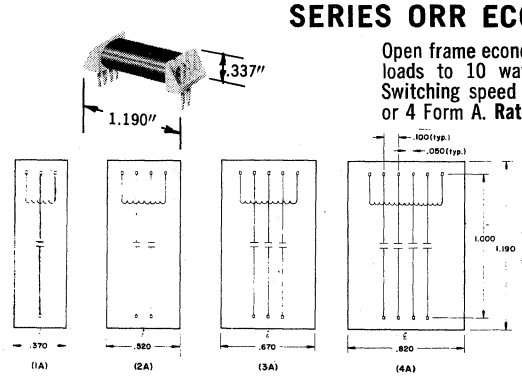
Encapsulated reed relays capable of switching dry circuit loads to 10 watts and 0.5 amp switching current. Isolation between coil and contacts: Immune to false operation by transients. Switching speed as fast as 1.0 ms. **Contacts:** 1, 2, 3 or 4 Form A; 1 Form B. **Rating:** 10 watts at 200VDC or 0.5A. **Contact Resistance:** 200 milliohms max. **Breakdown Voltage:** 300VDC min. **Capacitance:** 0.5 pF max. **Operate Time:** (A) 1.0 ms. (B) 0.25 ms. including contact bounce. **Release Time:** (A) 0.25 ms. (B) 1.0 ms. including contact bounce. **Insulation Resistance:** 10^9 ohms min. **Temperature Range:** −55°C to +85°C. **Pins:** .023" dia. x .125" long.

Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
GRR-1A005	5	1A	125	$3.57
GRR-1A006	6	1A	125	3.57
GRR-1A012	12	1A	500	3.57
GRR-1A024	24	1A	2000	3.98
GRR-2A005	5	2A	110	4.69
GRR-2A006	6	2A	110	4.69
GRR-2A012	12	2A	440	4.69
GRR-2A024	24	2A	1750	5.10
GRR-3A006	6	3A	75	6.02
GRR-3A012	12	3A	300	6.02
GRR-3A024	24	3A	1200	6.22
GRR-4A006	6	4A	55	7.04
GRR-4A012	12	4A	220	7.04
GRR-4A024	24	4A	900	7.14
GRR-1B006	6	1B	110	4.39
GRR-1B012	12	1B	440	4.39
GRR-1B024	24	1B	1750	4.79

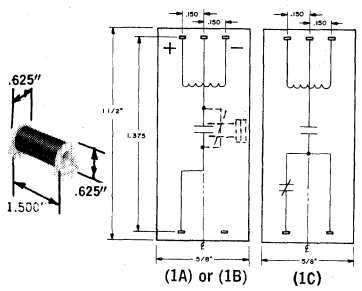
SERIES ORR ECONOMY REED RELAYS

Open frame economy reed relays that switch dry circuit loads to 10 watts and 0.5 amp switching current. Switching speed as fast as 1.0 ms. **Contacts:** 1, 2, 3, or 4 Form A. **Rating:** 10 watts at 200VDC or 0.5 amps. **Contact Resistance:** 200 milliohms max. **Breakdown Voltage:** 300VDC min. **Capacitance:** 0.5 pF max. **Operate Time:** 1.0 ms. including contact bounce. **Release Time:** 0.25 ms. including contact bounce. **Insulation Resistance:** 10^9 ohms min. **Temperature Range:** −55°C to +85°C. **Pins:** Fits in .035" dia. hole x .125" long.

Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
ORR-1A006	6	1A	125	$2.55
ORR-1A012	12	1A	500	2.55
ORR-1A024	24	1A	2000	2.96
ORR-2A006	6	2A	110	3.57
ORR-2A012	12	2A	440	3.57
ORR-2A024	24	2A	1760	3.98
ORR-3A006	6	3A	80	4.28
ORR-3A012	12	3A	320	4.28
ORR-3A024	24	3A	1280	4.69
ORR-4A006	6	4A	60	5.51
ORR-4A012	12	4A	240	5.51
ORR-4A024	24	4A	960	5.92



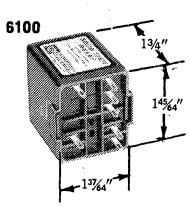
GUARDIAN® ELECTRIC

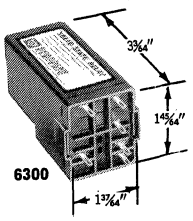


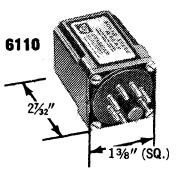
SERIES ERR ECONOMY REED RELAYS

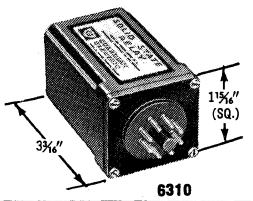
Open frame reed relay offers high quality at low cost. **Contacts:** 1A, 1B or 1C. **Switching Voltage:** 100VDC. **Max. Wattage:** (A&B) 15 watts, (C) 10 watts. **Max. Current:** (A&B) 0.5 amps, (C) 0.25 amps. **Capacitance:** (A&B) 0.5 pF, (C) 2.0 pF. **Operate Time:** (A) 2.0, (B) 0.1, (C) 1.0 ms. including contact bounce. **Release Time:** (A) 0.1, (B) 2.0, (C) 3.0 ms. including contact bounce. **Contact Resistance: 200** milliohms max. **Insulation Resistance:** 10^9 ohms min. **Pins:** .045" x .025" x .180" long.

Guardian No.	Nominal Voltage VDC	Cont. Comb.	Coil Res.	Net ea. 1-24
ERR-1A006	6	1A	75	$1.96
ERR-1A012	12	1A	300	2.14
ERR-1A024	24	1A	1200	2.28
ERR-1B006	6	1B	75	2.61
ERR-1B012	12	1B	300	2.79
ERR-1B024	24	1B	1200	2.94
ERR-1C006	6	1C	75	4.79
ERR-1C012	12	1C	300	4.79
ERR-1C024	24	1C	1200	5.00







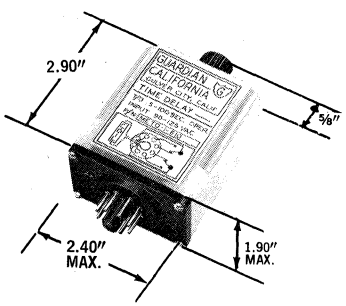


SOLID STATE RELAYS SERIES 6100 - 6300

Universal AC or DC control voltage with complete circuit isolation from load switching circuit. Externally adjustable pull-in voltage level from 80-130 volts AC or DC with close differential between pull-in and drop-out where accurate voltage sensing is required. Control of high inrush lamp, inductive or normal resistive loads from 10 mA to 3 amps. Internal filtering prevents random turn-on of "off" contacts.

"O" - Designates Octal Plug "T" - Designates .110 QC base

Guardian No.	Weight	Net ea. 1-24
6100-THA-1 Amp-SPST N.O.	4 oz.	$18.66
6110-OHA-1 Amp-SPST N.O.	4 oz.	19.62
6100-THC-1 Amp-SPDT	4 oz.	24.35
6110-OHC-1 Amp-SPDT	4 oz.	24.93
6300-THA-3 Amp-SPST N.O.	8 oz.	21.70
6310-OHA-3 Amp-SPST N.O.	8 oz.	22.23
6300-THC-3 Amp-SPDT	8 oz.	29.12
6310-OHC-3 Amp-SPDT	8 oz.	30.70

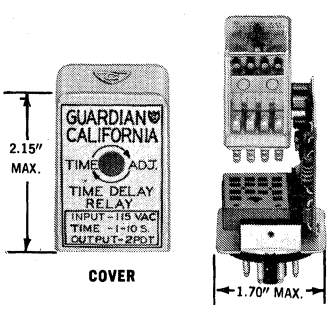


MET SERIES TIME DELAY

The MET Series of Time Delays are designed to replace many expensive units now on the market. They offer close tolerance repeatability at a low price. Designed for on-operate and on-release, with a range of .5 to 300 seconds, these low cost Time Delays provide a DPDT relay output of 10 amp resistive, 120VAC, 50-60 Hz and operate on inputs of 120VAC, 50-60 Hz, 24VDC, 50-60 Hz or 24VDC, polarity protected. These new Time Delays feature accuracy of ±10% of nominal setting over voltage and temperature range, repeatability to 1% within fixed conditions, a single turn potentiometer and time delays of .5 to 100 and 100 to 300 seconds over a temperature range of 0°C to 55°C.

Guardian No.	Volts	Delay Range (Sec.)	Net ea. 1-24
MET-O-100-24A	24 VAC	.5 to 100	$18.90
MET-O-300-24A	24 VAC	100 to 300	20.05
MET-O-100-120A	120 VAC	.5 to 100	18.48
MET-O-300-120A	120 VAC	100 to 300	20.05
MET-O-100-24D	24 VDC	.5 to 100	18.90
MET-O-300-24D	24 VDC	100 to 300	20.05
MET-R-100-24A	24 VAC	.5 to 100	27.51
MET-R-300-24A	24 VAC	100 to 300	28.24
MET-R-100-120A	120 VAC	.5 to 100	26.77
MET-R-300-120A	120 VAC	100 to 300	27.56
MET-R-100-24D	24 VDC	.5 to 100	27.51
MET-R-300-24D	24 VDC	100 to 300	28.24

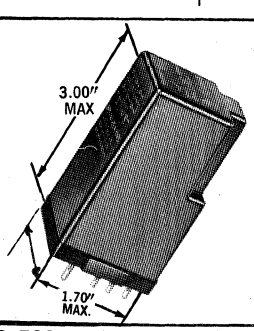
O in part number indicates delay on operate, R delay on release.



BDT SERIES TIME DELAY

A Time Delay with unusual features which include operation on high or low line, replaceable electro-mechanical relay, repeatability, temperature stability and small size. The Time Delay incorporates all silicon transistor circuits that operate over a wide input range of 75-125 VAC, 50-60 Hz and draw only 5 mA prior to time out. 24VDC units also available. Enclosed in a standard relay housing, terminated with an octal plug (8 pin), they are available with time delay periods from 1-10 to 10-60 seconds, adjustable. BDT Time Delays operate in the most severe industrial applications. The solid state circuit is immune to most transient noise found on commercial power lines. Voltage up to 2500 volts peak (short duration) can be tolerated. In the area of machine control, where large numbers of control cycles are expected, the BDT offers another advantage, ability to replace the internal relay. The solid state timing control has the minimum capability of 5 x 10^7 operations under normal conditions with 5 amp DPDT relay output.

Guardian No.	Volts	Delay Range (Sec.)	Net ea. 1-24
BDT-0-10-120A	120 VAC	1 to 10	$17.95
BDT-0-60-120A	120 VAC	10 to 60	18.48
BDT-0-10-24D	24 VDC	1 to 10	17.74
BDT-0-60-24D	24 VDC	10 to 60	17.95

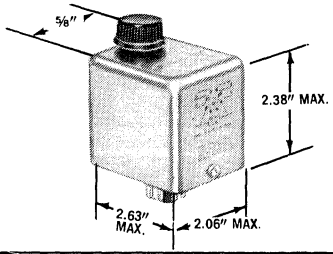


SERIES TD TIME DELAY

The most accurate, compact time-delay relay available from stock. Adjustable delays from 1 to 180 seconds. 15 turn potentiometer provides high adjustment resolution. Accurate to 5% of nominal setting over complete temp. and voltage range. Repeatability, 2% after line interruption of 50 MS. Delays on attract. 3PDT contacts rated at 10 amps resistive.

Guardian No.	Volts	Delay Range (Sec.)	Net ea. 1-24
TD-33C15-24D	24 VDC	1 to 15	$25.41
TD-33C60-24D	24 VDC	10 to 60	26.45
TD-33C180-24D	24 VDC	50 to 180	33.69
TD-63C15-120A	120 VAC	1 to 15	31.18
TD-63C60-120A	120 VAC	10 to 60	31.56
TD-63C180-120A	120 VAC	50 to 180	38.69

GUARDIAN® ELECTRIC — SOLID STATE CONTROLS

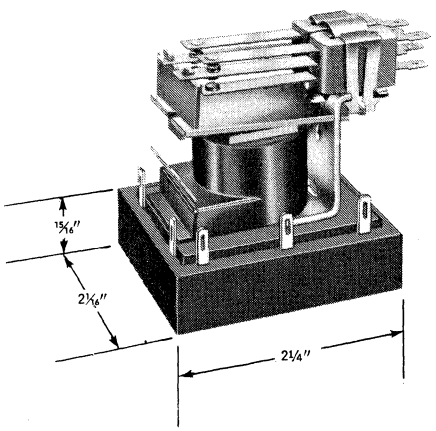


TDO SERIES TIME DELAY

Series TDO incorporates many features of more expensive units, but is most economical, offering contacts rated at 5 amps, DPDT, 120VAC with adjustable delay of 0.5 to 30 seconds on attract with a ten turn potentiometer. Repeatability is within 5% after a line interruption of 100 milliseconds. Standard unit available is 120VAC.

Guardian No.	Volts	Delay Range (Sec.)	Net ea. 1-24
TDO62C30-120A	120 VAC	.5 to 30	$17.14

SERIES 6900 - 6905 TIME DELAY MODULES



REPLACES SERIES TMT TIME DELAY MODULES

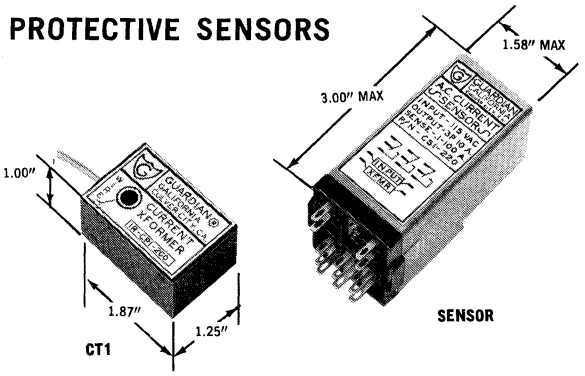
Low cost, totally solid state "long time delay" module — perfectly mated to popular Guardian relays. Time delay externally adjustable in four ranges: .5 to 10 seconds, 5 to 120 seconds, 10 to 300 seconds, and 300 to 2000 seconds. Choice of either delay on operate or delay on release. Accuracy and repeatability after first time out: Accuracy, ±10% of setting for combined variations of ambient temperature and power supply regulation; Repeatability, ±2% for fixed line input. Minimum life expectancy is one million operations.

Guardian No.	Volts	Time Range Sec.	Net ea. 1-24
6900-0-10-A	120 VAC	.5 to 10	$10.47
6900-0-120-A	120 VAC	5 to 120	10.53
6900-0-300-A	120 VAC	10 to 300	12.16
6900-0-2000-A	120 VAC	300 to 2000	14.44
6905-0-10-D	12 to 24 VDC	.5 to 10	10.24
6905-0-120-D	12 to 24 VDC	5 to 120	10.32
6905-0-300-D	12 to 24 VDC	10 to 300	11.95

Guardian No.	Volts	Time Range Sec.	Net ea. 1-24
6900-R-10-A	120 VAC	.5 to 10	$12.51
6900-R-120-A	120 VAC	5 to 120	12.57
6900-R-300-A	120 VAC	10 to 300	14.20
6905-R-10-D	12 to 24 VDC	.5 to 10	12.28
6905-R-120-D	12 to 24 VDC	5 to 120	12.36
6905-R-300-D	12 to 24 VDC	10 to 300	14.00

:n part number indicates delay on operate, R delay on release.
:eries 900-905 Relay illustrated is NOT included in prices.

PROTECTIVE SENSORS



A complete line of industrial sensors is available from Guardian including 3-phase (IR-AV2), Close Differential (IR-VS3), Over-Voltage (IR-VS1), Under-Voltage (IR-VS2), 4 wire Phase Sequence (IR-PR1), Adjustable Frequency (IR-FS1) and AC Current Sensors (CS1 Sensor with CT1 XFormer). These sensors are bi-products of designs for military application with solid state networks. The relay is 3PDT 10 amps resistive with 24VDC, 24VAC or 120VAC, available. Mounting is by socket, chassis mount or directly into a printed circuit (110). Temperature range is from 0°C to +50°C. Life is 100,000 operations minimum and protection for transient voltages is to 600 volts for the 3 phase model, 2500 volts for all others. All units come with a dust cover enclosure except the CT1 series which is a transfer molded part.

Guardian No.	Nominal Input	Current Sensing Range	Net ea. 1-24
CS1-220	90-125 VAC, 50-60 Hz		$32.76
CT1-201		.1 to 1.5 amps, 50-60 Hz	15.22
CT1-202		1 to 10 amps, 50-60 Hz	14.28
CT1-203		5 to 50 amps, 50-60 Hz	14.28
CT1-204		10 to 100 amps, 50-60 Hz	14.28

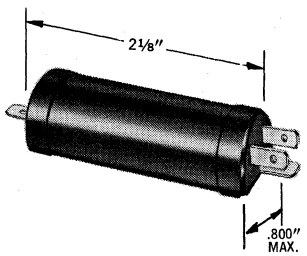
Guardian No.	Nominal Input	Sense Point	Differential	Net ea. 1-49
AV2-611	120 VAC, 60 Hz			$35.91
AV2-621	120 VAC, 400 Hz			35.91
VS3-610	120 VAC, 60 Hz	105 to 130 VAC	2.5 to 15 VAC	57.54
VS3-620	120 VAC, 400 Hz	105 to 130 VAC	2.5 to 15 VAC	57.54
VS3-300	24 VDC	23 to 32 VDC	1 to 5 VDC	56.07
VS3-410	24 VAC, 60 Hz	23 to 32 VAC	1 to 5 VAC	56.86
VS3-420	24 VAC, 400 Hz	23 to 32 VAC	1 to 5 VAC	56.86

Guardian No.	Nominal Input	Adjustable Voltage Range	Net ea. 1-49
VS1-610	120 VAC, 60 Hz	90 to 130 VAC	$45.04
VS1-620	120 VAC, 400 Hz	90 to 130 VAC	45.04
VS1-300	24 VDC	18 to 32 VDC	43.78
VS1-410	24 VAC, 60Hz	18 to 32 VAC	44.26
VS1-420	24 VAC, 400 Hz	18 to 32 VAC	44.26
VS2-610	120 VAC, 60 Hz	90 to 130 VAC	45.04
VS2-620	120 VAC, 400 Hz	90 to 130 VAC	45.04
VS2-300	24 VDC	18 to 32 VDC	43.78
VS2-410	24 VAC, 60 Hz	18 to 32 VAC	44.26
VS2-420	24 VAC, 400 Hz	18 to 32 VAC	44.26
PR1-610	120 VAC, 60 Hz		41.95
PR1-620	120 VAC, 400 Hz		41.95

Guardian No.	Nominal Input	Adjustable Frequency Range	Net ea. 1-49
FS1-610	120 VAC, 60 Hz	45 to 66 Hz	$57.96
FS1-620	120 VAC, 400 Hz	360 to 440 Hz	57.96
FS2-610	120 VAC, 60 Hz	45 to 66 Hz	57.96
FS2-620	120 VAC, 400 Hz	360 to 440 Hz	57.96

GUARDIAN® ELECTRIC — SOLID STATE CONTROLS

SERIES 6405 "FLAT BOTTOM" INLINE TIME DELAY



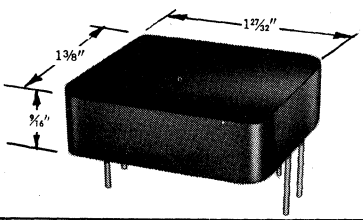
REPLACES SERIES GU INLINE TIME DELAY

Economical, totally solid state Inline Time Delay — in an ingenious new semi-cylinder configuration that combines the low cost of tubular design with a flattened bottom for quick, easy PC board installation. Available in low (12 to 48VDC) and high (90 to 130 VDC) voltage versions in your choice of three externally-adjustable time ranges: .1 to 10 seconds, 5 to 120 seconds and 10 to 300 seconds. Accuracy and repeatability after first time out: Accuracy, ±10% of setting for combined variations of ambient temperature and power supply regulation; Repeatability, ±2% for fixed line input. Operating temperature range of −20° to +55°C. Minimum operations 10^7. Termination in your choice of ¾" quick connect or solid lead. Delay on operate. Adjustment by 1 meg. ohm potentiometer.

Guardian No.	Volts	Time Range Sec.	Net ea. 1-24
6405-2L-10	12 to 48 VDC	.1 to 10	$9.26
6415-2L-10			9.34
6405-2H-10	90 to 130 VDC	.1 to 10	9.26
6415-2H-10			9.34
6405-2L-120	12 to 48 VDC	5 to 120	9.34
6415-2L-120			9.42
6405-2H-120	90 to 130 VDC	5 to 120	9.34
6415-2H-120			9.42
6405-2L-300	12 to 48 VDC	10 to 300	10.95
6415-2L-300			11.57
6405-2H-300	90 to 130 VDC	10 to 300	10.95
6415-2H-300			11.57

6405 part number = solid lead termination.
6415 part number = 3/16" QC termination.

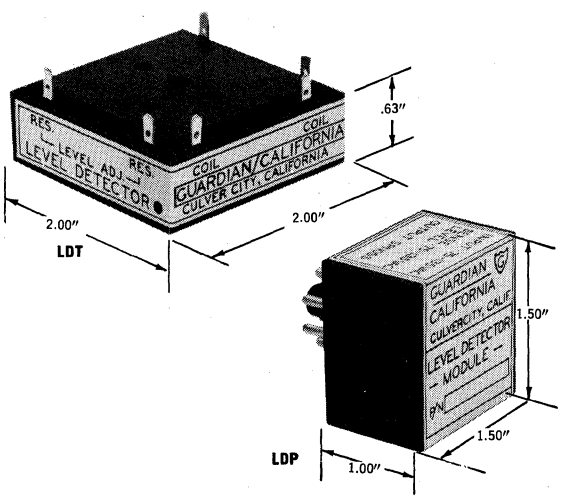
SERIES 6505 ELECTRONIC "ZERO CROSSOVER" SWITCHES



A low cost module that assures true "zero crossover" switching by forming an electrical "cushion" between signal input and load power. Solid state output switching circuit isolated from input signal through a long-life reed relay. Load is normally de-energized when "load power" is applied. Application of signal input causes load to become energized. Crossover: 0.0VAC ±10 V. Load Power: 120VAC. (240VAC available on special order.) Contact Combination: SPST-NO. Contact Ratings: 1.0 amp @ 120VAC, 56/60 Hz. Operating Temperature: −20° to +55°C. Minimum Operations: 10^7. Termination: Printed Circuit .047" x dia. .375" pins.

Guardian No.	Volts	Net ea. 1-24
6505--6D	6 VDC	$14.16
6505-12D	12 VDC	14.16
6505-24D	24 VDC	14.16

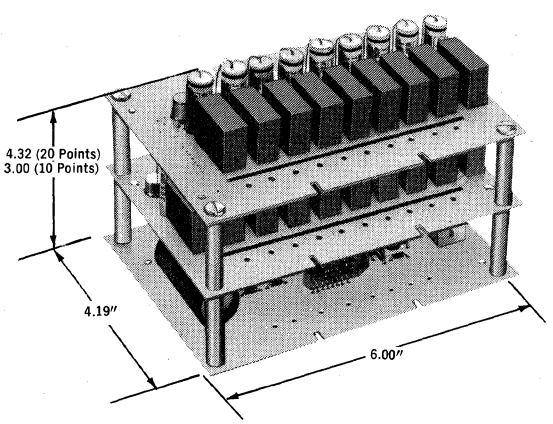
LEVEL DETECTORS



Inexpensive Voltage Level Detector with unusual operating characteristics. These molded modules incorporate circuits comprised of silicon semiconductor devices to form a peak detecting voltage differential amplifier, signal amplifier and a solid state output switch suitable for driving a number of Guardian relays. The unit's sense level is adjustable (either fixed or variable) over ranges of 85-135VAC, 50-60 Hz, 20-30VAC, 50-60 Hz, 20-30VDC, 180-250VAC, 50-60 Hz by external resistance. This broad adjustment range permits operation as either an under or over level detector. Two units may be used to form band pass or pedestal level sensing. When used with Guardian Series 6900-6905 timing modules, they provide inexpensive time delayed voltage detection systems that allow them to ignore normal line fluctuations. Transient suppressed, they will withstand 2500 V peak (short duration) without damage or malfunction. On DC units, transient protection is 600 volts.

Guardian No.	Volts	Net ea. 1-24
LDT-100-24A	24 VAC	$15.54
LDT-100-120A	120 VAC	15.54
LDT-100-240A	240 VAC	20.16
LDT-100-24D	24 VDC	15.85
LDP-100-24A	24 VAC	18.79
LDP-100-120A	120 VAC	18.79
LDP-100-240A	240 VAC	23.41
LDP-100-24D	24 VDC	18.43

SLS SOLID STATE LOGIC STEPPER



The SLS 100 Series Solid State Steppers are the only power solid state steppers to accept either high level or logic level inputs with high noise immunity for industrial applications. The output of each step is a 120VAC 2½ amp switch. They are modularly constructed so that many configurations can be accomplished from stacked modules. Standard "off the shelf" models have ten or twenty steps. Units may be obtained with pulsers to make them self-stepping steppers. They can be cascaded or paralleled to perform complex switching and control functions. These versatile Guardian Steppers are built for operation on input power of 120VAC, 50-60 Hz or 400 Hz and 24VDC. All solid state construction offers the advantages of mechanical noise free operation and, under proper operating conditions, practically unlimited life.

Guardian No.	Volts	Steps	Net ea. 1-24
SLS110-2A111*	120 VAC	10	$136.50
SLS110-1A211*	24 VDC	10	117.60
SLS120-2A111*	120 VAC	20	236.25
SLS120-1A211*	24 VDC	20	198.87
SLS110-25111†	120 VAC	10	144.37
SLS110-15211†	24 VDC	10	125.47
SLS120-25111†	120 VAC	20	244.12
SLS120-15211†	24 VDC	20	206.74
SLS Connector Kit			1.05

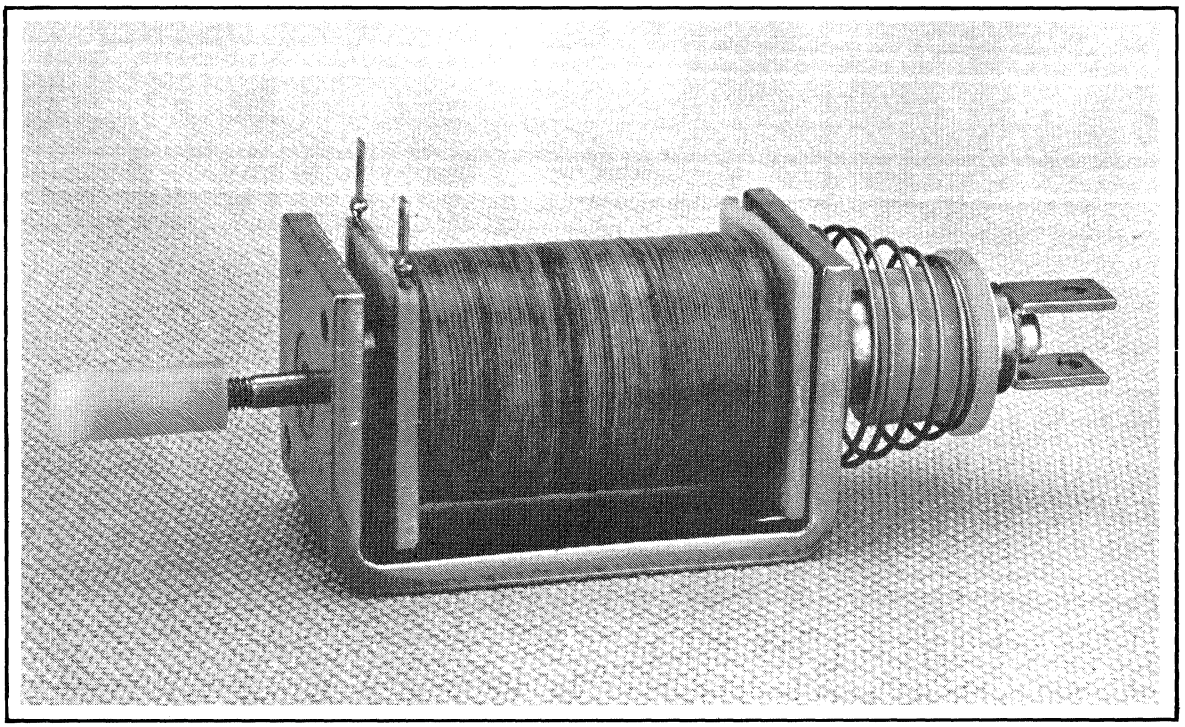
* Step advance by either mechanical switch closure or D.C. Pulse.
† Self-stepping.

All units come with Molex connector terminations (3 sets required for 10 step unit).

HI-G INCORPORATED PRESENTS "THE PROBLEM SOLVER"

INDUSTRIAL SOLENOIDS

STANDARD OPTIONS FEATURE:
CLEVIS, PUSHROD, NYLON TIP, SHOCK DAMPENER, AND RETURN SPRING.



HI-G "S" SERIES SOLENOID SHOWN WITH CLEVIS, PUSHROD, NYLON TIP, SHOCK DAMPENER, AND RETURN SPRING.

STANDARD FEATURES

1. 2,304 combinations of size, coil voltage, duty cycle and coupling options.
2. 8 frame sizes from 3/8 thru 1¼ inch.
3. 4 coil voltage ratings.
4. 4 duty cycle ratings at each coil voltage.
5. Optimum force stroke performance.
6. 5 standard options; a) clevis, b) pushrod, c) pushrod nylon tip, d) shock dampener, e) return spring, and/or combinations thereof.
7. 3 sets of mounting holes.
8. UL approved materials.
9. Designed for Extended LIFE with close tolerance parts and heavy duty frames.
10. Basic "A" size solenoid price is 86c each in 1000 lots.

The Hi-G "S" series solenoid was designed on a state-of-art project basis with over 50 years of solenoid engineering experience.

Send for the NEW Hi-G "S" solenoid catalog #S101 or call Hi-G direct for immediate service.

HI-G, INCORPORATED
Spring St. & Route 75, Windsor Locks, Conn. 06096
TEL: (203) 623-2481 TWX: 710-420-0592

SEVERAL NEW CUSTOMERS CALL OUR SOLENOID THE "PROBLEM SOLVER" AND "MONEY SAVER"

SPECIAL DESIGN ENGINEER'S SOLENOID KIT OFFERED @ $19.95

INTRODUCTORY OFFER

DESIGN, TEST AND CUSTOMIZE ON THE SPOT WITH SPECIAL DESIGN ENGINEER'S SOLENOID KIT.

$36.29 VALUE OFFERED AT $19.95.

SOLENOID KIT #SK2 INCLUDES:

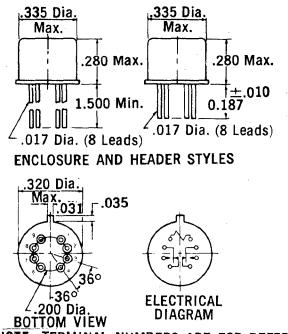
- 8 frame sizes with all coupling options.
- One of each of the 8 solenoid sizes providing continuous force-stroke coverage from 8 oz. to 14 lbs.
- Each unit is supplied with all standard options which may be added or deleted as design requirements change.
- All units rated 24VDC. Continuous duty.
- Unmatched reliability, performance and standard LOW COST options.
- Kit provides 192 solenoid combinations.

MA & MS TO-5 SERIES RELAY

Qualified MIL-R-5757

MA

DPDT CONTACTS

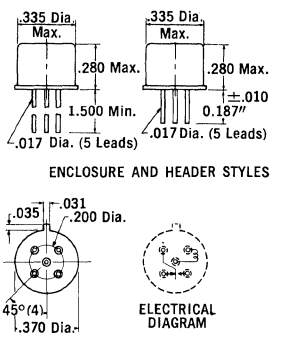


ENCLOSURE AND HEADER STYLES

NOTE: TERMINAL NUMBERS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.

1MA

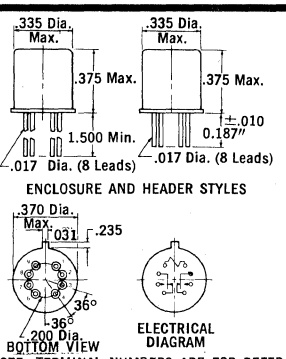
SPDT CONTACTS



ENCLOSURE AND HEADER STYLES

MS

DPDT CONTACTS

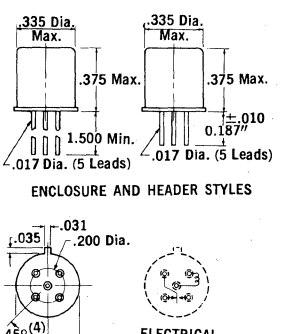


ENCLOSURE AND HEADER STYLES

NOTE: TERMINAL NUMBERS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON PART.

1MS

SPDT CONTACTS



ENCLOSURE AND HEADER STYLES

GENERAL SPECIFICATIONS

CONTACT CAPABILITIES

RATING
10,000,000 operations at low level. 1,000,000 operations at 0.5 amp, 28V d-c resistive load. 100,000 operations at 1.0 amp, 28V d-c resistive load.

CONTACT RESISTANCE
0.1 ohm maximum before life (measured 1/8" from header). 0.2 ohm maximum after life at maximum rated current (measured 1/8" from header).

CONTACT BOUNCE
1.5 milliseconds maximum

OVERLOAD
2 amps at 28V d-c for 100 operations minimum

INSULATION RESISTANCE
10,000 megohms minimum between mutually insulated terminals

ENCLOSURE
Hermetically sealed. All welded.

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE
— 65°C to + 125°C. (Higher temperature ratings on special order)

VIBRATION
.06" DA or 30G, 10-3000 cps.

SHOCK
80 G's

MILITARY SPECIFICATIONS

All Hi-G MA and MS Series relays are manufactured in accordance with Military Specification MIL-R-5757 and its applicable detail specification.

Authorized Hi-G dealers are located throughout the U.S. and Canada

HI-G, INC. ELECTRO-MECHANICAL DIVISION Spring Street and Route 75, Windsor Locks, Connecticut 06096
Attention: Relay Sales Engineering . . . or call us at (203) 623-2481. Your inquiry will receive our prompt attention.
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

Qualified

Sensitivity: 130 milliwatts

Operate Time: 3.0 milliseconds maximum at nom. coil voltage over temperature range.

Release Time: 2.5 milliseconds maximum at nom. coil voltage over temperature range.

Dielectric Strength: 500V RMS 60 cycles at sea level 125V RMS 60 cycles at 70,000 feet

Weight: 0.07 ounce with leads trimmed to ⅛". add 0.02 ounce for leads

Hi-G Part No.	Military Part No.	Coil Voltage (VDC) Nom.	Coil Voltage (VDC) Max.	DC Coil Resistance Ohms ±10% at 25° C	Pull In Voltage VDC Max. *	Drop Out Voltage VDC * Max.	Drop Out Voltage VDC * Min.
Wire Terminal							
MAW-6	M5757/40-001	6	8	98	4.5	3.2	.18
MAW-9	M5757/40-002	9	12	220	6.8	4.9	.35
MAW-12	M5757/40-003	12	16	390	9.0	6.5	.41
MAW-18	M5757/40-004	18	24	880	13.5	10.0	.59
MAW-26	M5757/40-005	26.5	32	1560	18.0	13.0	.89
Pin Terminal							
MAP-6	M5757/40-006	6	8	98	4.5	3.2	.18
MAP-9	M5757/40-007	9	12	220	6.8	4.9	.35
MAP-12	M5757/40-008	12	16	390	9.0	6.5	.41
MAP-18	M5757/40-009	18	24	880	13.5	10.0	.59
MAP-26	M5757/40-010	26.5	32	1560	18.0	13.0	.89

*Over temperature range

Qualified

Sensitivity: 100 milliwatts

Operate Time: 2.0 milliseconds maximum at nom. coil voltage over temperature range.

Release Time: 2.0 milliseconds maximum at nom. coil voltage over temperature range.

Dielectric Strength: 500V RMS 60 cycles at sea level 300V RMS 60 cycles at 70,000 feet

Weight: 0.06 ounce with leads trimmed at ⅛", add 0.02 ounce for leads

Hi-G Part No.	Military Part No.	Coil Voltage (VDC) Nom.	Coil Voltage (VDC) Max.	DC Coil Resistance Ohms ±10% at 25° C	Pull In Voltage VDC Max. *	Drop Out Voltage VDC * Max.	Drop Out Voltage VDC * Min.
Wire Terminal							
1MAW-6	M5757/38-003	6	8	125	4.5	3.2	.18
1MAW-9	M5757/38-004	9	12	280	6.8	4.9	.35
1MAW-12	M5757/38-002	12	16	500	9.0	6.5	.41
1MAW-18	M5757/38-001	18	24	1130	13.5	10.0	.59
1MAW-26	M5757/38-005	26.5	32	2000	18.0	13.0	.89
Pin Terminal							
1MAP-6	M5757/38-008	6	8	125	4.5	3.2	.18
1MAP-9	M5757/38-009	9	12	280	6.8	4.9	.35
1MAP-12	M5757/38-007	12	16	500	9.0	6.5	.41
1MAP-18	M5757/38-006	18	24	1130	13.5	10.0	.59
1MAP-26	M5757/38-010	26.5	32	2000	18.0	13.0	.89

*Over temperature range

Qualified

Sensitivity: 60 milliwatts

Operate Time: 4.5 milliseconds maximum at nom. coil voltage over temperature range.

Release Time: 2.5 milliseconds maximum at nom. coil voltage over temperature range.

Dielectric Strength: 500V RMS 60 cycles at sea level 125V RMS 60 cycles at 70,000 feet

Weight: 0.10 ounce with leads trimmed to ⅛", add 0.02 ounce for leads

Hi-G Part No.	Military Part No.	Coil Voltage (VDC) Nom.	Coil Voltage (VDC) Max.	DC Coil Resistance Ohms ±10% at 25° C	Pull In Current (Ma) Max.	Drop Out Current (MA) Max.	Drop Out Current (MA) Min.
Wire Terminal							
MSW-6	M5757/70-001	6	10	200	17.5	8.7	1.7
MSW-12	M5757/70-002	12	20	850	8.4	4.2	0.8
MSW-26	M5757/70-003	26	40	3300	4.2	2.1	0.4
MSW-36	M5757/70-004	36	57	6500	3.0	1.5	0.3
MSW-48	M5757/70-005	48	75	11000	2.4	1.2	0.2
Pin Terminal							
MSP-6	M5757/70-006	6	10	200	17.5	8.7	1.7
MSP-12	M5757/70-007	12	20	850	8.4	4.2	0.8
MSP-26	M5757/70-008	26	40	3300	4.2	2.1	0.4
MSP-36	M5757/70-009	36	57	6500	3.0	1.5	0.3
MSP-48	M5757/70-010	48	75	11000	2.4	1.2	0.2

Qualified

Sensitivity: 40 milliwatts

Operate Time: 4.0 milliseconds maximum at nom. coil voltage over temperature range

Release Time: 2.5 milliseconds maximum at nom. coil voltage over temperature range

Dielectric Strength: 500V RMS 60 cycles at sea level 300V RMS 60 cycles at 70,000 feet

Weight: .08 ounce with leads trimmed to ⅛", add 0.02 ounce for leads

Hi-G Part No.	Military Part No.	Coil Voltage (VDC) Nom.	Coil Voltage (VDC) Max.	DC Coil Resistance Ohms ±10% at 25° C	Pull In Current (Ma) Max.	Drop Out Current (MA) Max.	Drop Out Current (MA) Min.
Wire Terminal							
1MSW-6	M5757/69-001	6	11	255	12.5	6.25	1.2
1MSW-12	M5757/69-002	12	22	1025	6.25	3.12	0.6
1MSW-26	M5757/69-003	26	45	4000	3.16	1.58	0.3
1MSW-32	M5757/69-004	32	57	6500	2.47	1.23	0.2
1MSW-40	M5757/69-005	40	75	11000	1.91	0.96	0.15
Pin Terminal							
1MSP-6	M5757/69-006	6	11	255	12.5	6.25	1.2
1MSP-12	M5757/69-007	12	22	1025	6.25	3.12	0.6
1MSP-26	M5757/69-008	26	45	4000	3.16	1.58	0.3
1MSP-32	M5757/69-009	32	57	6500	2.47	1.23	0.2
1MSP-40	M5757/69-010	40	75	11000	1.91	0.96	0.15

Ordering Information: Standard items may be ordered by part number shown. For variation consult factory.

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FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

RELAYS WITH EXTRA DIMENSION

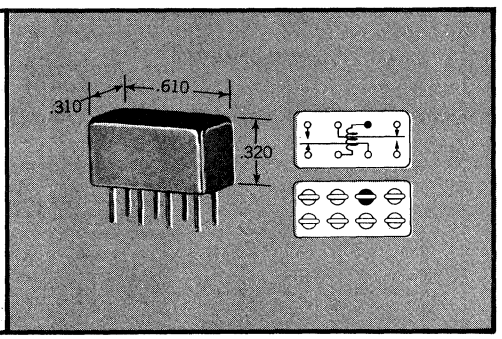
Qualified MIL-R-5757/37

the MINI- G®

150 GRID RELAY — SERIES G

Product Bulletin 95

All welded, DPDT relay manufactured in accordance with MIL-R-5757/37.



SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

SENSITIVITY AT 25°C: 135mW.

LIFE: 100,000 operations min. at rated load and 125°C.

OVERLOAD: 4 amps at 30VDC for 100 operations min.

CONTACT RESISTANCE:
(a) 50 milliohms initial at rated load.
(b) 150 milliohms after rated life.
(c) 3Ω max. during min. current life.
(d) 50Ω max. at 10mA and 30mV RMS.

CONTACT BOUNCE: 1.2ms max. at high level; 2.0ms max. at low level.

OPERATE TIME: 4.0ms max. at nom. coil voltage at 25°C.

RELEASE TIME: 4.0ms max. at 25°C.

DIELECTRIC STRENGTH: 500V RMS between all mutually insulated points at sea level; 750V RMS between contacts and case.

INSULATION RESISTANCE: 1000MΩ min. between mutually insulated terminals.

CONTACT RATING

- 1 ampere resistive at 30 volts DC max.
- 0.125 ampere resistive at 115 volts RMS, 400 Hz, case grounded.
- Low level 0 to 0.1 ampere at 50 mV DC or AC.
- Minimum Current per MIL-R-5757/37 (100,000 operations min.).
- 2 ampere resistive at 30 volts DC max. (50,000 operations min.).

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE: −65°C to +125°C.

VIBRATION: 0.5" DA from 5-34Hz, 30G from 34-3000Hz, 10μs max. contact opening.

SHOCK: 100G, 10μs max. contact opening.

ACCELERATION: 100G.

LEAKAGE RATE: 1×10^{-8} cc/sec max.

WEIGHT: 0.13 oz.

STANDARD CATALOG RELAYS

Voltage Code	Coil Voltage (Vdc)		DC Coil Resistance (ohms ±10% @ 25°C)	Max. Pull-In Voltage (Vdc)		Min. Drop-Out Voltage (Vdc)	
	Max.	Nom.		25°C	125°C	25°C	−65°C
106	8	6	56	2.7	3.6	0.30	0.17
112	16	12	210	5.4	7.2	0.60	0.35
126	32	26.5	1350	13.5	18.0	1.50	0.88

QUALIFIED TO THE REQUIREMENTS OF MIL-R-5757/37

Hi-G Part Number	MIL Part Number	Hi-G Part Number	MIL Part Number	Hi-G Part Number	MIL Part Number	Hi-G Part Number	MIL Part Number
2G-3407-1	M5757/37-001	2G-3407-15	M5757/37-015	2G-3407-29	M5757/37-029	2G-3407-43	M5757/37-043
2G-3407-2	M5757/37-002	2G-3407-16	M5757/37-016	2G-3407-30	M5757/37-030	2G-3407-44	M5757/37-044
2G-3407-3	M5757/37-003	2G-3407-17	M5757/37-017	2G-3407-31	M5757/37-031	2G-3407-45	M5757/37-045
2G-3407-4	M5757/37-004	2G-3407-18	M5757/37-018	2G-3407-32	M5757/37-032	2G-3407-46	M5757/37-046
2G-3407-5	M5757/37-005	2G-3407-19	M5757/37-019	2G-3407-33	M5757/37-033	2G-3407-47	M5757/37-047
2G-3407-6	M5757/37-006	2G-3407-20	M5757/37-020	2G-3407-34	M5757/37-034	2G-3407-48	M5757/37-048
2G-3407-7	M5757/37-007	2G-3407-21	M5757/37-021	2G-3407-35	M5757/37-035	2G-3407-49	M5757/37-049
2G-3407-8	M5757/37-008	2G-3407-22	M5757/37-022	2G-3407-36	M5757/37-036	2G-3407-50	M5757/37-050
2G-3407-9	M5757/37-009	2G-3407-23	M5757/37-023	2G-3407-37	M5757/37-037	2G-3407-51	M5757/37-051
2G-3407-10	M5757/37-010	2G-3407-24	M5757/37-024	2G-3407-38	M5757/37-038	2G-3407-52	M5757/37-052
2G-3407-11	M5757/37-011	2G-3407-25	M5757/37-025	2G-3407-39	M5757/37-039	2G-3407-53	M5757/37-053
2G-3407-12	M5757/37-012	2G-3407-26	M5757/37-026	2G-3407-40	M5757/37-040	2G-3407-54	M5757/37-054
2G-3401-13	M5757/37-013	2G-3407-27	M5757/37-027	2G-3407-41	M5757/37-041		
2G-3407-14	M5757/37-014	2G-3407-28	M5757/37-028	2G-3407-42	M5757/37-042		

® Trademark pending registration

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CRYSTAL CAN RELAYS

RADIO FREQUENCY RELAYS

Product Bulletin 155

RF contacts are terminated with RG-196/U Teflon insulated coaxial cable, 6" in length. Other lengths, types of cable, or coaxial connector terminations available on special order. These relays meet or exceed the applicable portions of MIL-R-5757 and MIL-R-3928.

RADIO FREQUENCY CHARACTERISTICS	
Frequency Range	0 - 500 MHz*
Voltage Standing Wave Ratio (VSWR)	<1.1:1 typical
Insertion Loss	0.16db typical
Characteristic Impedance	50 ohms†
Crosstalk	−50db typical

** Usable to 1000 MHz with reduced RF characteristics*
† Other impedances available on special order

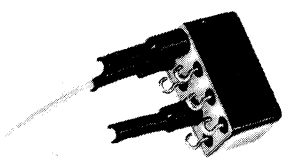
DICE CUBE RADIO FREQUENCY RELAY — SERIES RFC

Operate Power 150 mW

Relay Type	RFC
Size	0.5-inch cube
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.3 ounce (without terminations)

NOTE: Electrical characteristics same as series C

HALF SIZE CRYSTAL-CAN RADIO FREQUENCY RELAY — SERIES RFK

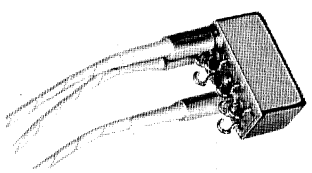


Operate Power 250 mW

Relay Type	RFK
Size	.4 x .8 x .4 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.37 ounce (without terminations)

NOTE: Electrical characteristics same as series K

LATCHING HALF SIZE CRYSTAL-CAN RADIO FREQUENCY RELAY — SERIES RFKL

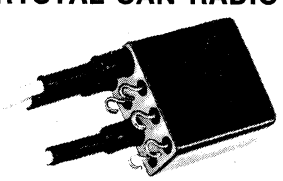


Operate Power 150 mW

Relay Type	RFKL
Size	.4 x .8 x .4 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.37 ounce (without terminations)

NOTE: Electrical characteristics same as series KL

CRYSTAL-CAN RADIO FREQUENCY RELAY — SERIES RFB

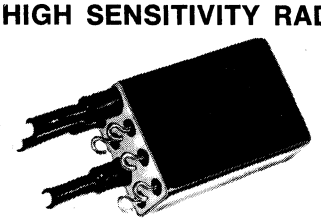


Operate Power 250 mW

Relay Type	RFB
Size	.875 x .800 x .400 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	0.95 ounce (without terminations)

NOTE: Electrical characteristics same as series B

HIGH SENSITIVITY RADIO FREQUENCY RELAY — SERIES RFBC



Operate Power 40 mW

Relay Type	RFBC
Size	1.275 x .800 x .400 inch
Contact Rating	200 watts RF cold switching 75 watts RF hot switching
Maximum Weight	1.0 ounce (without terminations)

NOTE: Electrical characteristics same as series BC

ENVIRONMENTAL CHARACTERISTICS FOR STANDARD CRYSTAL CAN SERIES

Life: 100,000 operations at 125°C and rated load.
Temperature: −65°C to +125°C, operating.
Vibration: 10 to 2000 Hz, 20G min.
Shock: 100 G
Sealing: Hermetic, to 80,000′

Insulation Resistance: 1000 megohms min., except coil-to-case at high temperature 500 megohms min.

Dielectric Strength: Contacts-to-case: 1000 volts rms, 60 Hz, mutually insulated terminals: 500 volts rms standard.

Authorized Hi-G dealers are located throughout the U.S. and Canada

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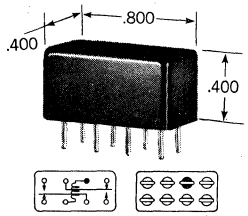
CRYSTAL CAN RELAYS

Qualified MIL-R-5757/9

HALF-SIZE CRYSTAL CAN RELAY — SERIES 2K Product Bulletin 102

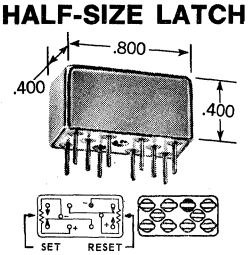


CONTACT RATING
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded and dry circuit.

ALL WELDED CONSTRUCTION

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.25	.35	40
112	12	14.4	6.5	.75	150
126	26.5	32	13.5	1.5	675

HALF-SIZE LATCHING RELAY — DUAL COIL — DPDT — SERIES KL Product Bulletin 103

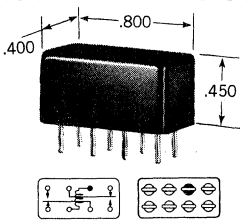


CONTACT RATING
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz case grounded and dry circuit.

ALL WELDED CONSTRUCTION

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Set/Reset Voltage @ + 25°C	DC Coil Resistance Ohms ±10% @ 25°C
112	12	14.4	6.5	250
126	26.5	32	13.5	1000

HALF-PINT® MINIATURE 4 AMP RELAY — SERIES 2HA Product Bulletin 100

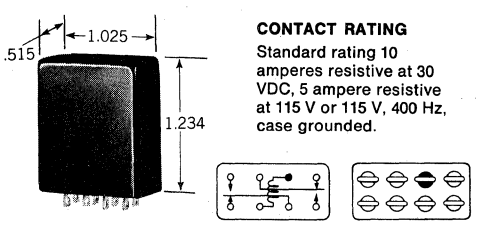


CONTACT RATING
4 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.4	.35	40
112	12	14.4	6.5	.75	150
126	26.5	32	13.0	1.5	600

10 AMP CRYSTAL CAN RELAY — SERIES T Product Bulletin 150

Qualified MIL-R-5757/23 & 28



CONTACT RATING
Standard rating 10 amperes resistive at 30 VDC, 5 ampere resistive at 115 V or 115 V, 400 Hz, case grounded.

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.3	.5	22
112	12	14.4	6.7	1.0	90
126	26.5	32	13.0	2.0	330
215	115	125	52.0	5	5500

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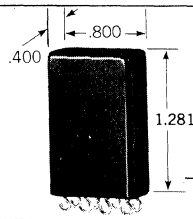
CRYSTAL CAN RELAYS

ENVIRONMENTAL CHARACTERISTICS FOR STANDARD CRYSTAL CAN SERIES

Life: 100,000 operations at 125°C and rated load.
Temperature: −65°C to +125°C, operating.
Vibration: 10 to 2000 Hz, 20G min.
Shock: 100 G
Sealing: Hermetic, to 80,000′

Insulation Resistance: 1000 megohms min., except coil-to-case at high temperature 500 megohms min.

Dielectric Strength: Contacts-to-case: 1000 volts rms, 60 Hz, mutually insulated terminals: 500 volts rms standard.



CURRENT SENSITIVE CRYSTAL CAN RELAY — 40 mW — SERIES BC

Product Bulletin 135

Qualified MIL-R-5757/13

CONTACT RATING

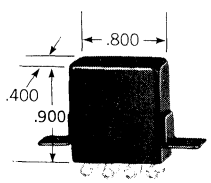
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded.

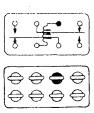
	2 BC RELAY — DPDT — 40 mW					1 BC RELAY —SPDT—25 mW			
Voltage Code	Coil Res. at 25°C	Nominal Coil Voltage (VDC)	Nominal Coil Current (mA)	Max P.I. Current (mA)	Min D.O. Current (mA)	Nominal Coil Voltage (VDC)	Nominal Coil Current (mA)	Max P.I. Current (mA)	Min D.O. Current (mA)
101	20	1.8	89.2	44.6	4.5	1.4	70.6	35.3	3.5
102	30	2.2	73.0	36.5	3.7	1.8	57.6	28.8	2.9
103	50	2.8	56.6	28.3	2.8	2.2	44.6	22.3	2.3
104	75	3.5	46.2	23.1	2.3	2.8	36.6	18.3	1.8
105	100	4.0	40.0	20.0	2.0	3.2	31.6	15.8	1.6
106	200	5.7	28.4	14.2	1.4	4.5	22.4	11.2	1.2
107	300	7.0	23.0	11.5	1.2	5.5	18.2	9.1	.90
109	500	9.0	17.8	8.9	.90	7.1	14.2	7.1	.70
112	875	12.0	13.5	6.75	.70	9.4	10.7	5.34	.54
113	1000	12.6	12.6	6.32	.64	10.0	10.0	5.0	.50
118	2000	18.0	8.9	4.45	.50	14.2	7.1	3.53	.36
120	2500	20.0	8.0	4.0	.40	15.8	6.3	3.2	.32
128	5000	28.0	5.6	2.8	.30	22.5	4.5	2.23	.23
135	8000	36.0	4.5	2.23	.23	29.0	3.6	1.77	.18
140	10000	40.0	4.0	2.0	.20	32.0	3.2	1.58	.16

2 AMP CRYSTAL CAN RELAY —SERIES 2B

Product Bulletin 120

Qualified MIL-R-5757/10





CONTACT RATING

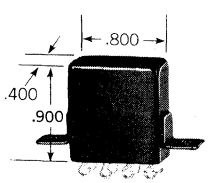
2 amperes resistive at 30 volts DC, 1 ampere resistive at 115 volts rms, 400 Hz, case grounded and dry circuit.

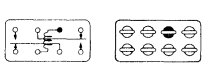
Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
2B (DC only, 2-Pole Only)					
106	6	7.2	3.1	.5	40
112	12	14.4	6.3	.75	160
126	26.5	32	13.0	1.5	675
148	48	58	25.0	2.5	2500
176	76	90	35.0	3.0	5000
2BR (AC Only, 2-Pole Only)					
126	26.5	32	15	2	600
148	48	58	28	3	2500
176	76	90	44	4	5000
215	115	125	66	5	10000

NOTE: BR types for operation at 60 to 400 Hz with specifications shown. Units may be used at higher frequencies, but individual values of voltage may change.
2-pole units only available as standard catalog item.

5 AMP CRYSTAL CAN RELAY — SERIES 2BN

Product Bulletin 120A





CONTACT RATING

5 amperes resistive at 30 volts DC; 3 ampere resistive at 115 volts rms, 400 Hz, case grounded; 2 ampere resistive at 115 volts rms, 60 Hz, case grounded.

NOTE: For AC operation BNR types are available on request.

ALL WELDED CONSTRUCTION

Voltage Code	Nominal DC Coil Voltage	Max Continuous Coil Voltage	Max Pull-in Voltage @ 25°C	Min Drop-out Voltage @ 25°C	DC Coil Resistance Ohms ±10% @ 25°C
106	6	7.2	3.1	.5	35
112	12	14.4	6.3	.75	140
126	26.5	32	13.0	1.5	600
148	48	58	25.0	2.5	2200
176	76	90	35.0	3.0	4400

Authorized Hi-G dealers are located throughout the U.S. and Canada

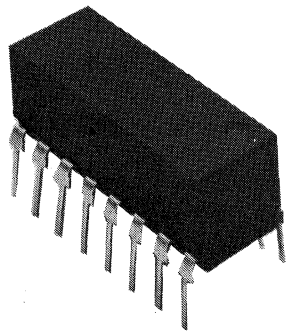
HI-G, INC. ELECTRO-MECHANICAL DIVISION Spring Street and Route 75, Windsor Locks, Connecticut 06096
Attention: Relay Sales Engineering . . . or call us at (203) 623-2481. Your inquiry will receive our prompt attention.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

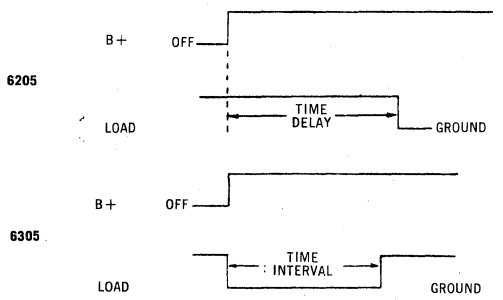
INDUSTRIAL-HYBRID THICK-FILM

TIMING MODULE

SERIES 6200
SERIES 6300



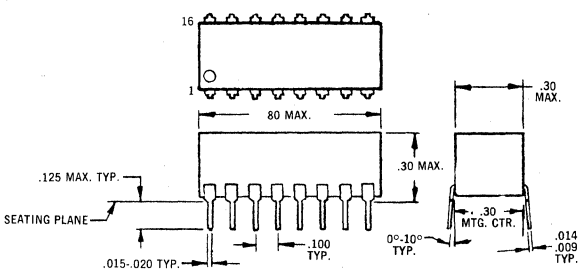
LOGIC DIAGRAMS



FEATURES

- **Delays fixed and adjustable to 30 sec.**
- **True 16 pin DIP package.**
- **TTL/DTL compatible.**
- **(2) logic models.**

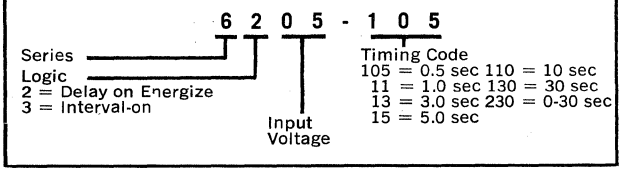
Physical



GENERAL SPECIFICATIONS

INPUT VOLTAGE:	5 VDC ±0.5 V.
CURRENT DRAIN:	25 ma max. plus load current.
SINK CURRENT:	20 ma max., transistor switch to ground.
FORWARD VOLTAGE DROP:	0.25 VDC maximum.
PULL-UP RESISTOR:	6000 ohms maximum.
ACCURACY:	±10% over temperature/ voltage range.
REPEATABILITY:	±2%.
RECYCLE TIME:	100 milliseconds maximum.
TEMPERATURE RANGE:	0°C to +71°C.
OVERVOLTAGE PROTECTION:	20 V/10 milliseconds maximum, no damage.

PART NUMBER DETERMINATION



DESCRIPTION

Module provides a path to ground at terminal designated "Load (−)", during the energized condition. The 6200 provides delay-on-energize. The 6300 provides an energized interval on. Removal of input resets unit.

PART SELECTION

There are 7 delay times available, 6 fixed and 1 adjustable. Select code which represents desired delay time, and prefix with series number. For example: 6205-11, equals delay-on-energize, 1 second fixed, timing module.

TERMINAL DESIGNATION

No.	Fixed	Adjustable
1	B+	B+
2	NC	Ext. Res.
3-7	NC	NC
8	Load (−)	Load (−)
9-14	NC	NC
15	NC	Ext. Res.
16	B−	B−

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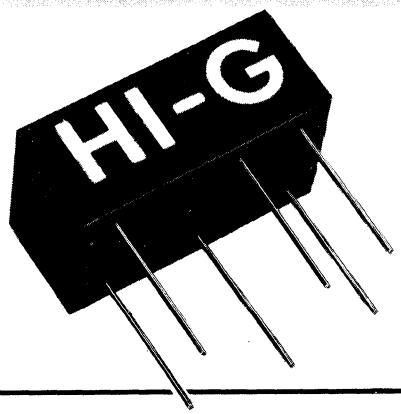
HYBRID INTEGRATED CIRCUIT TIMING MODULE

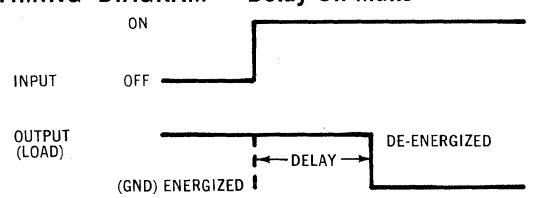
SERIES **6100**



FEATURES

- **Time delays from 50 ms to 60 sec.**
- **State-of-the-art reliability.**
- **Package less than ⅜" x ½" x ⅞".**
- **Delay-on-make-operation.**
- **Dual-in-line compatible.**
- **Life 1,000,000 operations minimum.**
- **External time adjustment possible.**

TIMING DIAGRAM — Delay-On-Make



PHYSICAL DATA

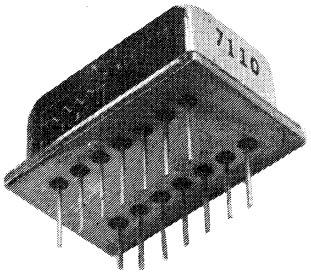
HEIGHT:	0.370 inches.
WIDTH:	0.460 inches.
LENGTH:	0.800 inches.
FOOTPRINT:	Dual -in-Line (0.3" wide x 0.1" grid).
CONNECTIONS:	Solder pins, ½" long.
ENCAPSULATION:	Epoxy.
WEIGHT:	Approx. 0.2 ounces.

DESCRIPTION

Hi-G Series 6100 are completely solid state delay-on-make timing devices. They use Hybrid thick film integrated circuits to provide state-of-the-art performance and reliability. The design of the 6100 Series offers smaller, lighter, low profile, dual-in-line compatible timers for direct mounting to printed circuit boards. This packaging enables these timers to be used over a wide range of applications.

OPERATION

Application of power to the input initiates the timing cycle. After the preset time delay, the output is energized and remains energized until the timer is reset by the removal of power at the input.



ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE:	18 to 32 volts DC, reverse polarity protection provided.
DELAY TIME:	50 milliseconds to 60 seconds. Factory set, fixed time.
DELAY TIME TOLERANCE:	±10%.
RESET TIME:	10 microseconds (max).
RECYCLE TIME:	0.5% (nominal delay time) = max. recycle time @ 25°C.
RECOVERY TIME:	100 milliseconds max.
OUTPUT SWITCH:	S.P.N.O. — solid state.
OUTPUT RATING:	.3 amp resistive at 28 VDC (25°C). .18 amp resistive at 28 VDC (85°C).
CURRENT DRAIN:	10 ma @ 28 VDC (25°C) plus load current.
OUTPUT LEAKAGE:	1 ma max. in non-conducting state
CONTACT DROP:	2.5 VDC max. in conducting state
TEMPERATURE RANGE:	−55°C to +85°C.

6150 — HERMETICALLY SEALED

TEMPERATURE RANGE:	−55°C +125°C
TIMING TOLERANCE:	±10%
SEALING:	72,000 feet
ENCLOSURE:	Base: .58 x .92
(DIMENSIONS MAX.)	Height: .42

Unless otherwise specified, characteristics are per 6100 model.

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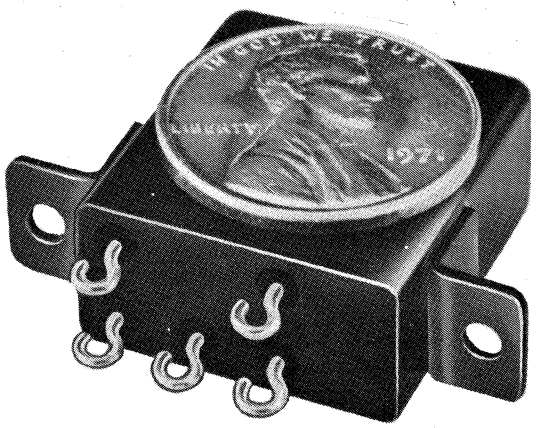
SOLID STATE TIMER

CRYSTAL CAN MOUNTING TIMING MODULE

SERIES **1800**
SERIES **1900**



FEATURES

The 1800 and 1900 Series are all Solid-State Timers that offer excellent reliability over a useful life well in excess of one million operations. They have a fast reset time, are remarkably stable over a wide temperature range, and can provide delays down to the millisecond range.

Each unit is hermetically sealed and encapsulated with a standard crystal-can header which results in an extremely rugged, high performance assembly. All units are available in a choice of standard mounting configurations. The 1860 version is directly interchangeable with a crystal can relay.

FIXED TIME DELAY

MINIATURE TIMING MODULE

SERIES **2400**

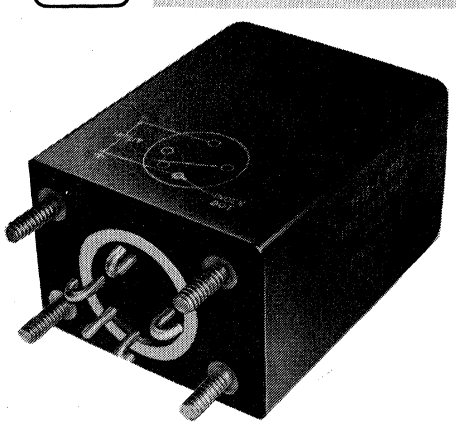
FEATURES

The Series 2400 Time Delay Relay combines a solid-state timing circuit and a Hi-G relay in a package only slightly longer than a standard crystal-case housing. This combination provides the current-carrying capacity and the environmental immunity of Hi-G's electromechanical relays with the long life and quick response of electronic circuits.

Delays from 50 milliseconds up to 120 seconds can be specified for this rugged DC timing module. The solid-state circuit has a voltage regulator circuit that permits the use of unregulated power sources.

ADJUSTABLE TIMING MODULE
FIXED TIMING MODULE

SERIES **1700**
SERIES **1600**



4 AND 10 AMPERES RATING CHART

Type	DC, 10 Amp	AC or DC, 4 Amp
Input Voltages	18 to 31 VDC, unregulated	DC Units, 18 to 31 volts, Unregulated AC Units, 105 to 125 volts, 400 Hz Unregulated
Delay Time	50 milliseconds to 180 seconds	50 milliseconds to 180 seconds
Contact Rating at 30 Volts DC	10 amperes, Resistive 5 amperes, Inductive	4 amperes, Resistive
Contact Configuration	1, 2 Poles, double-throw	1- 2- 3- and 4-pole, double-throw
Current Drain at 25°C at 28 volts DC	135 ma maximum	1-pole: 100 ma maximum; 2-pole: 150 ma maximum; 3 and 4 pole: 200 ma maximum

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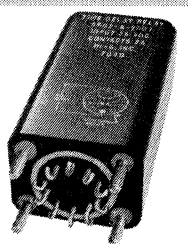
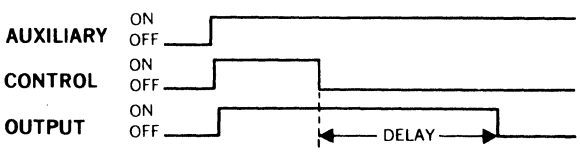
DELAY ON RELEASE TIMING MODULE

SERIES 5600
SERIES 5700



TIMING DIAGRAM — Delay-On-Release



FEATURES

- **All semiconductors are silicon devices**
- **PC board construction, completely encapsulated**
- **Hermetically sealed**

FUNCTION

Apply auxiliary power. Upon application of control power, the output will energize. Remove control power to initiate delay period.

OPERATION

The delay period is initiated by removing voltage from the control pin. The output de-energizes to mark the conclusion of the delay period. Electronic circuitry requires that auxiliary power be applied at all times.

Offered in a variety of enclosures, contact configurations and ratings, the fixed delay series is designated 5600 and the adjustable delay is series 5700.

Delay-on-release is often referred to as Delay-on-break, Delay-on-dropout or Delay-on-de-energization. The output logic remains the same, only the terms change.

Series	Timing
5600	Factory Set
5700	Adjustable

ELECTRICAL SPECIFICATIONS

INPUT: Units will not be damaged by reverse application of input voltage.
Auxiliary — 18-31V DC.
Control — 10-31V DC. Ground common to aux. power line.
10 volts minimum must be applied for a minimum duration of 20 milliseconds to energize output and arm the timing circuit.

DELAY TIMES: Overall, 50 msec to 300 seconds. Units rated 10 ampere, minimum delay 100 milliseconds. Units rated 125°C, maximum delay 180 seconds.

TIMING TOLERANCE: ±10%.

CURRENT DRAIN: (@ 25°C @ 28V DC)
Control line — 15 ma typical, 25 ma maximum.
Auxiliary — Deenergized (after completion of delay period) 25 ma. Energized. (See Tabulation)

Configuration	2 and 5 Amp	10 Amp
1 PDT	100 ma	150 ma
2 PDT	150 ma	240 ma

RESPONSE TIME:
Operate — Rated 2 and 5 amp, 10 msec maximum. 10 amp, 20 msec maximum.
Recycle — 0.5% maximum of specified delay.
Reset — 20 milliseconds maximum.

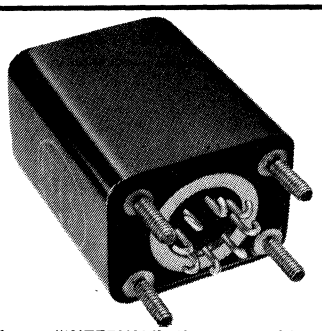
CONTACT RATINGS:

Specified Rating	Amperes @ 30V DC RES	Amperes @ 30V DC IND	Amperes @ 115V 400 Hz RES	Amperes @ 115V 400 Hz IND
2 amps	2	1	1	0.3
5 amps	5	1.5	3	1.0
10 amps	10	5	5	3

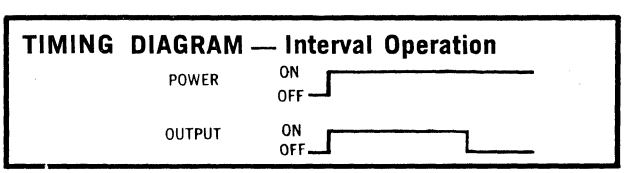
For A Complete List of Part Numbers and Ordering Information, Request Hi-G Bulletin 162.

INTERVAL TIMER

SERIES 4600
SERIES 4700
SERIES 4800



TIMING DIAGRAM — Interval Operation



The function of an "INTERVAL" timer, provides a defined time period. This time period or pulse is considered to be the conducting state of a solid state timing module or the energized state when utilizing an electromechanical relay for output.

The Hi-G approach uses precise circuit designs in compact simplicity to meet the need for a sound balance between reliability and economy. Standard devices include both solid state and electromechanical output configurations. The series 4800 represents the solid state timing module. For electromechanical relay output the 4600 series offers fixed delay times while the 4700 is an adjustable version.

FUNCTION

Apply power and the output will energize immediately. After time out, the output will revert to De-Energized State. Remove and Re-apply power to Recycle.

ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE: 18-31V DC. AC units 105-125V AC 400 Hz.DC units will not be damaged by reverse application of input voltage.

DELAY TIMES: 100 milliseconds to 180 sec.

TIMING TOLERANCE: ±10%.

OPERATE TIME: 4 amp. rated units: 7 ms maximum.
10 amp. rated units: 15 ms maximum.

RESET TIME: 10 ms maximum.

CURRENT DRAIN: De-Energized (after timeout and power still applied) 75 ma maximum @ 28V DC @ 25°C.

RECYCLE TIME: 0.5% maximum of the specified delay time.

CONTACT RATING: Choice of ratings.
10 amperes resistive, 5 amperes inductive @ 28V DC/ 115V AC 400 Hz; 4 amperes resistive 1 ampere Inductive @ 28V DC; 2 amperes resistive 1 ampere Inductive @ 115V AC 400 Hz.

For A Complete List of Part Numbers and Ordering Information, Request Hi-G Bulletin 161.

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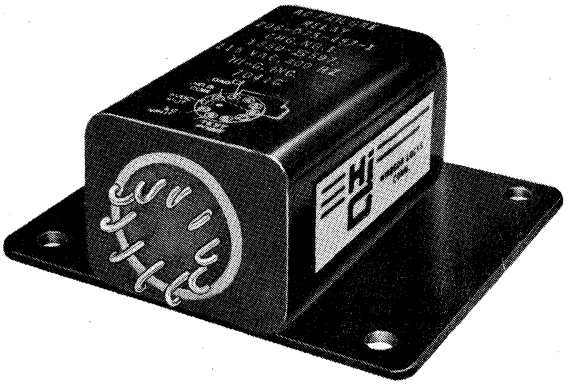
AC AND DC MONITORING
VOLTAGE LEVEL SENSOR
SERIES 1300



FEATURES

DC SENSOR — SERIES 1310

The Hi-G 1310 Series DC Voltage Sensor is essentially a voltage monitoring device operating on a snap-action transistor circuit with low drift and inherent temperature compensation. This device will either open or close a circuit when a predetermined voltage is present at the input.

By using a Hi-G electro-mechanical relay as the output of the voltage sensor, a positive switching action can be achieved with very close difference between pull-in and drop-out voltages.

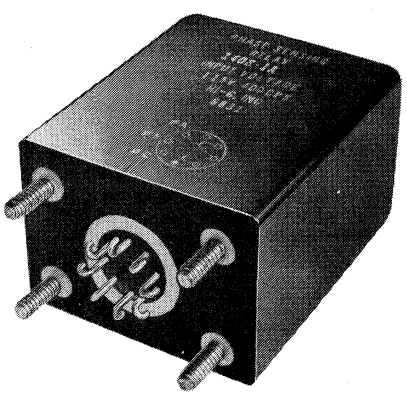
AC SENSOR — SERIES 1350

The Hi-G 1350 Series AC Voltage Sensor provides an output "signal" when the monitored power line voltage reaches a predetermined level. This rugged unit with reliable solid state design, provides precise, repeatable operation over a wide temperature extreme.

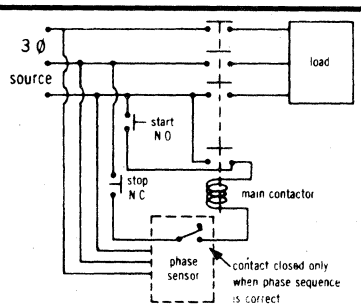
The input voltage is fed into a temperature compensated comparator circuit. When the input reaches the pre-set level, transistor amplifiers switch the output relay to provide a "signal." This output may control any external device, process, or warning system to protect expensive equipment.

The units for both series are potted and hermetically sealed and are designed to meet the environmental requirements of airborne applications.

3 φ POWER SYSTEM MONITOR
PHASE SENSOR
SERIES 1400



TYPICAL APPLICATION CONNECTIONS



FEATURES

Hi-G Phase Sensors monitor three-phase power systems and protect both the power source and the equipment being driven. They are complete units, ready to install, designed and manufactured to meet the most stringent of requirements of military electronics. Broad applications also exist in commercial and industrial fields.

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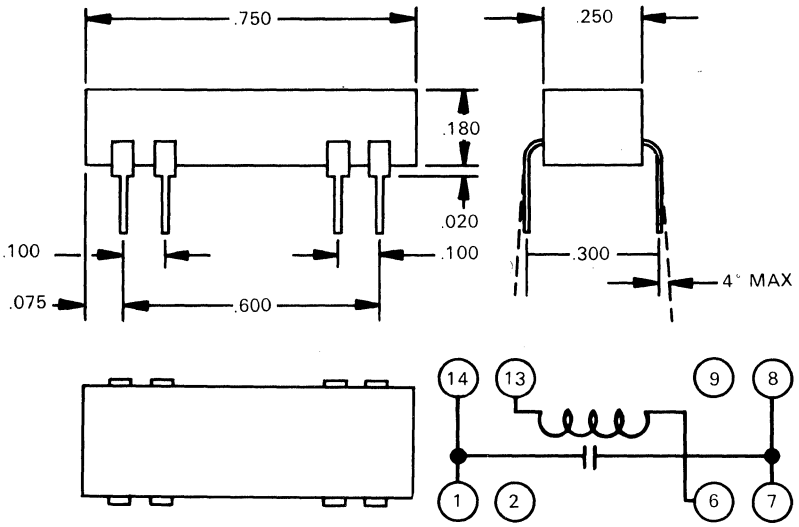
D.I.P. Reed Relay ("IDR" Series)

"IDR" Series Dual in-line Package (DIP)



SCHEMATIC
(Top view)

The Dual In-Line miniature unit is high density and automatically insertable. It can be mounted in the standard in line, 14 pin, IC layout and operated from standard 5 volt IC circuitry.

Mounting: Standard 14 pin, IC layout.

SPECIAL FEATURES AVAILABLE:
Diode between pins 6 and 9, cathode to pin 6. Electrostatic shield between coil and contacts, pin 2. Both diode and electrostatic shield.

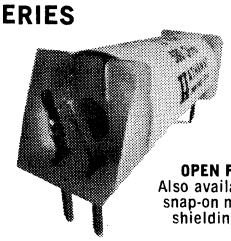
OPERATING SPECIFICATIONS:
Contact rating: Current; .250 Amps max.
Voltage; 50 Volts max.
Volt Amps; 5 max.
Carry load, 1 Amp max.
(non-switching)
Contact resistance: Initial; 200 milliohms max.
After life; 2 Ohms max.
Life expectancy: Low level; 100 X 10^6 operations.
12 V DC, .100 Amps; 5 X 10^6 operations.
Dielectric strength: 200 V AC, rms, 60 Hz.
Insulation resistance: 10^8 Ohms min. @ 25° C.
Operate time (including bounce): 500 microseconds max.
Release time (including bounce): 100 microseconds max.

ENVIRONMENTAL:
Temperature range: −40° C to +85° C.
Vibration: 20 G's @ 0-5K Hz.
Shock: 100 G's

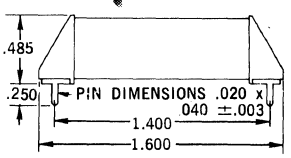
COIL CHARACTERISTICS @ 25° C

P/N	Nominal V DC	Must Oper.	Must Rel.	Res. Ohms ±10%
0565053	3.0	2.0	0.2	100
0565037	5.0	3.8	0.4	380
0565038	12.0	8.0	0.8	530
0565039	24.0	16.0	1.6	2000

"CR" SERIES



OPEN FRAME
Also available with snap-on magnetic shielding case.



OPERATING CHARACTERISTICS

Maximum Continuous Rating @ 25°C

6 volt coils	7.5 V d-c
12 volt coils	15.0 V d-c
26 volt coils	32.5 V d-c

Must Operate (Maximum) @ 25°C

6 volt coils	4.2 V d-c
12 volt coils	8.3 V d-c
26 volt coils	16.5 V d-c

Must Release (Minimum) @ 25°C

6 volt coils	0.4 V d-c
12 volt coils	0.8 V d-c
26 volt coils	1.5 V d-c

Environmental

AMBIENT TEMP. RANGE	VIBRATION 20 g's to 1000 Hz
Oper.: −55 to +75°C	SHOCK 35 g's
Storage: −65 to +85°C	ALTITUDE 0 to 50,000 feet

ELECTRICAL SPECIFICATIONS

Contact Resistance — 100 Milliohms max. initial
2 Ohms End of Life

Dielectric Strength
350 VRMS 60 Hz Open Contacts (Form A)
500 VRMS 60 Hz Between Mutually Isolated Members

Contact Life — Up to 5 x 10^9 Operations

Load Rating
Gold Alloy Form "A": Dry to 125mA, 4 watts max.
Gold Alloy Form "C": Dry to 125mA, 2 watts max.
Rhodium Form "A": 10mA to 1A, 10 watts max.

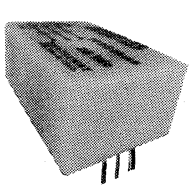
Operate Time (Including Bounce)
One Form A — 1.5 Millisecond

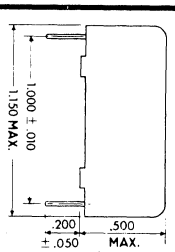
Insulation Resistance — 10^{10} Ohms Minimum @ 25°C

Contact Arrangement

1 Thru 4	Form A
1 Or 2	Form B
1	Form 1A 1B

"GP" SERIES





NOTE — COIL TERMINALS .028 ±.002 DIA.
SWITCH TERMINALS .018 x .028 MAX.

Nylon Case and Bobbin, Epoxy filled.
Printed Circuit mounting
Less than 1 ms switch time, 5 x 10^8 Ohms minimum insulation resistance.

OPERATING CHARACTERISTICS

Maximum Continuous Rating @ 25°C

6 volt coils	7.5 V d-c
12 volt coils	15.0 V d-c
26 volt coils	32.5 V d-c

Must Operate (Maximum) @ 25°C

6 volt coils	4.2 V d-c
12 volt coils	8.3 V d-c
26 volt coils	16.5 V d-c

Must Release (Minimum) @ 25°C

6 volt coils	0.4 V d-c
12 volt coils	0.8 V d-c
26 volt coils	1.5 V d-c

Environmental

AMBIENT TEMP. RANGE	VIBRATION 20 g's to 1000 Hz
Operating: 0 to +75C°	SHOCK 35 g's
Storage: −55 to +85C°	ALTITUDE 0 to 50,000 feet

ELECTRICAL SPECIFICATIONS

Contact Resistance — 200 Milliohms max. initial
2 Ohms End of Life

Dielectric Strength
250 VRMS 60 Hz Open Contacts (Form A)
200 VRMS 60 Hz Open Contacts (Form C)
500 VRMS 60 Hz Between Mutually Isolated Members

Contact Life — Up to 5 x 10^9 Operations

Load Rating
Gold Alloy Form "A": Dry to 125mA, 4 watts max.
Gold Alloy Form "C": Dry to 125mA, 2 watts max.
Rhodium Form "A": 10mA to 1A, 10 watts max.

Operate Time (Including Bounce)
One Form A — 1.0 Millisecond
One Form C — 1.5 Milliseconds

Insulation Resistance—5 x 10^8 Ohms Minimum @ 25°C

Contact Arrangement

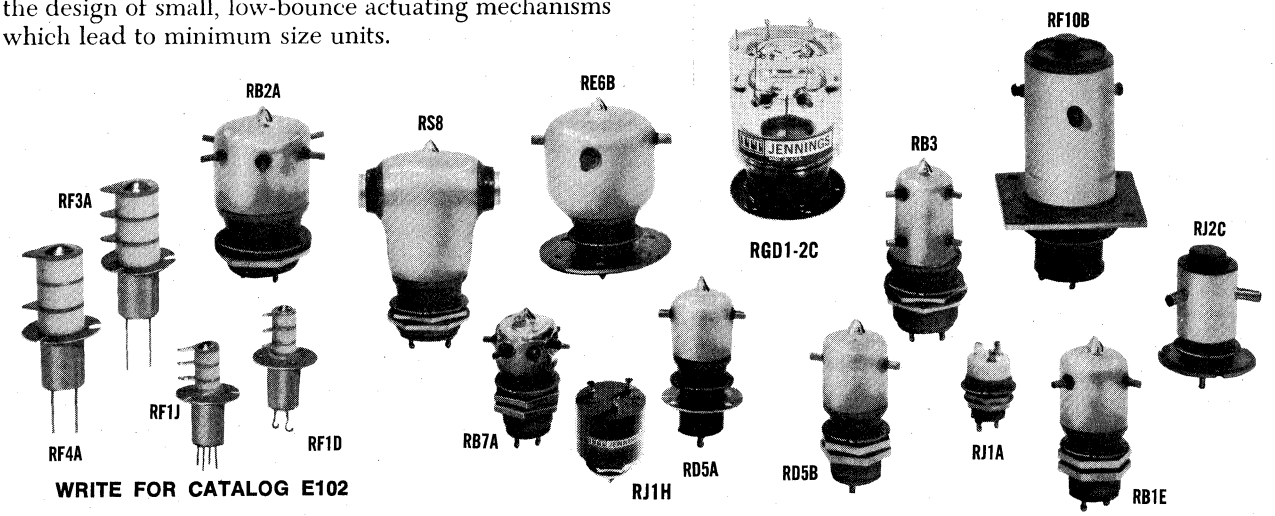
1 Thru 4	Form A
1 Or 2	Form B
1 Thru 3	Form C

vacuum relays

INTRODUCTION: Vacuum relays as manufactured by ITT Jennings are available for utilization in the control of high power equipment and circuits. Standard units are available for current ratings of 75 amps, peak voltage levels to 30 kv, and transferring power at frequencies through the VHF band.

ADVANTAGES: Because of the higher dielectric strength of the vacuum relay (1000 volts/mil working), small contact spacing and lower resultant travel allows the design of small, low-bounce actuating mechanisms which lead to minimum size units.

APPLICATIONS: The majority of applications of these units include the switching of antennas, frequency bands, transmit-receive modes, power circuits, and elements in pulse forming networks.



WRITE FOR CATALOG E102

RELAY TYPE	CONTACT ARRANGEMENT	RATED OPERATING VOLTAGE			CONTINUOUS CURRENT			CONTACT CAPACITY		CONTACT RESISTANCE	OPERATE TIME	RELEASE TIME	COIL RESISTANCE
		DC or 60 Hz (KV Peak)	2.5 MHz (KV Peak)	16 MHz (KV Peak)	DC or 60 Hz (Amps RMS)	2.5 MHz (Amps RMS)	16 MHz (Amps RMS)	Open Contact to Ground (pf)	Between Open Contacts (pf)	(Max. Ohms)	Max. (MS)	Max. (MS)	26.5 V +10% (Ohms)
RF1D	SPDT	2	2	2	8	6	4	2.0	2.0	.020	10	10	920
RF1J	SPDT Latching	2	2	2	8	6	4	2.0	2.0	.020	10	N/A	18.3
RF2A*	SPST N/C	7.5	N/A	N/A	5	N/A	N/A	N/A	N/A	.030	11	11	920
RF3A RF3B	SPDT SPDT Latch	6	6	6	N/A	25	15	4.0	4.0	.015	18 10	18 N/A	156 6.7
RF4A RF4B	SPST N/C SPST Latch	6	6	6	N/A	25	15	2.5	2.5	.015	18 10	18 N/A	156 6.7
RGD1-2C**	DPDT	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17	17	25 @ 12 Volts
RJ1A	SPDT	3.5	2.5	2.0	N/A	14	7	2.5	2.0	.010	8	8	335
RJ1H*	SPDT	10	N/A	N/A	25	N/A	N/A	N/A	N/A	.020	10	10	335
RJ2C	SPDT	12	10	8	50	22	15	1.0	0.7	.012	18	9	270
RF10B	SPDT	15	13	10	50	22	15	1.5	0.5	.012	35	10	225
RB7B	DPDT	7	4	3	14	9	4	2.0	1.0	.020	15	5	270
RB1E	SPDT	12	10	8	15	10	6	1.0	0.5	.012	18	9	265
RD6A	SPST N/C	12	10	8	15	10	6	1.0	0.5	.012	18	9	265
RD5B RD6B	SPST N/O SPST N/C	12	10	8	15	10	6	1.0	0.5	.012	18	8	265
RB3	DPDT	12	10	8	15	10	6	2.5	1.0	.010	20	8	120
RB2A	DPDT	20	15	10	20	12	6	2.5	1.0	.010	20	10	225
RB4	4PDT	15	12	10	20	10	6	2.5	1.0	.010	45	10	131
RE6B	SPDT	25	15	12	25	13	8	2.5	1.0	.010	25	10	120
RS8 RS10	SPST N/O SPST N/C	28	25	12	75	35	22	1.5	0.7	.003	30	10	120

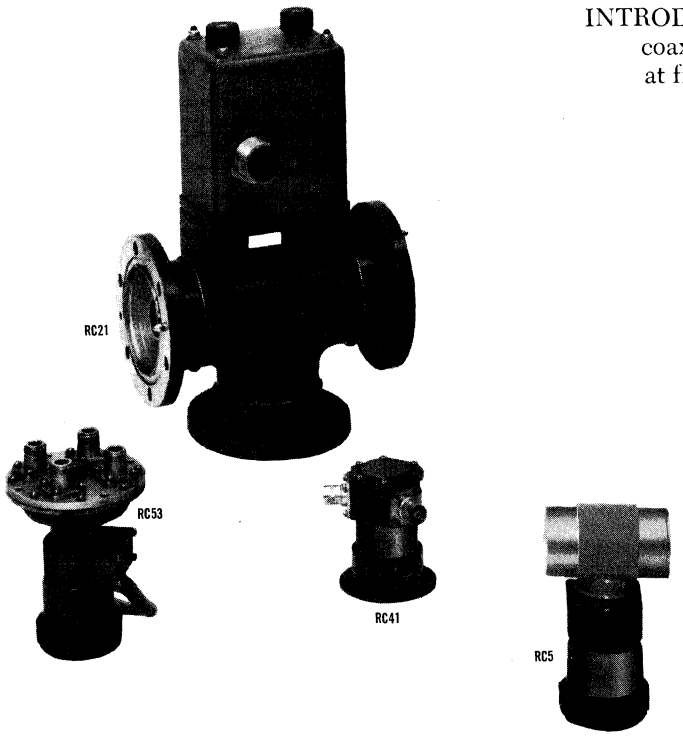
*For Load Switching **Defibrillator Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

ITT JENNINGS 970 McLaughlin Ave. • San Jose, Calif. 95116
Telephone: (408) 292-4025 • TWX: 910-338-0159

DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

vacuum coaxial relays



INTRODUCTION: The principal feature of the ITT Jennings coaxial vacuum relay is its high power handling capability at frequencies up to 1.7 ghz, where it is desired to contain circuit currents completely within a coax system.

ADVANTAGES: Coaxial relay advantages include low insertion VSWR, high rf power capability, high isolation, fast operation, low and stable contact resistance, and wide pass band characteristics.

APPLICATIONS: Typical applications for this type of unit include antenna and load switching external to a transmitter, crossbar switching matrices, and general coaxial instrumentation.

MODEL NUMBER	RC41	RC53	RC5	RC6	RC10	RC21	RC31
POWER RATING	3 KW CW at 30 MHz	4 KW CW at 30 MHz	25 KW CW at 30 MHz	25 KW CW at 30 MHz	90 KW CW at 30 MHz	90 KW CW at 30 MHz 3 MW Peak Spec. Order	325 KW CW at 30 MHz
FREQUENCY RANGE	0 to 500 MHz	0 to 600 MHz	0 to 100 MHz	0 to 400 MHz	0 to 100 MHz	0 to 500 MHz	0 to 150 MHz
VSWR WITH RESPECT TO 50 OHMS	1.1:1 Max.	1.1:1 Max.	1.02:1 Max. to 30 MHz 1.05:1 Max. to 60 MHz	1.1:1 Max. to 150 MHz	1.02:1 Max. to 30 MHz 1.05:1 Max. to 60 MHz	1.1:1 Max. to 400 MHz	1.1:1 Max.
CROSSTALK	Greater than 30 dB isolation at 300 MHz	Greater than 30 dB isolation at 30 MHz	Greater than 70 dB isolation at 30 MHz	Greater than 65 dB isolation at 30 MHz	Greater than 65 dB isolation at 30 MHz	Greater than 60 dB isolation at 30 MHz	Greater than 37 dB isolation at 30 MHz
INSERTION LOSS	0.1 dB Max.	0.1 dB Max.	0.02 dB Max.	0.01 dB Max.	0.02 dB Max.	0.05 dB Max.	0.01 dB Max.
COIL RESISTANCE ±10% 26.5 VDC COIL	265 Ohms	18 Ohms	18.8 Ohms	15.4 Ohms	8.3 Ohms	4.8 Ohms	7.8 Ohms
CONTACT CONFIGURATION	SPDT	2 pole, 2 position crossover transfer	SPST	SPDT	SPST	SPDT	SPDT
LINE/CONNECTOR SIZE	C	SC	1⅝"	1⅝"	3⅛"	3⅛"	6⅛"
ACTUATION	Non-latching continuous duty coil	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching	Permanent magnet latching
OPERATE TIME	25 Millisecs Max.	15 Millisecs Typ. 30 Millisecs Max.	15 Millisecs Typ. 30 Millisecs Max.	50 Millisecs Max.	15 millisecs Typ. 30 Millisecs Max.	40 Millisecs Max.	50 Millisecs Max.
WEIGHT	14.5 oz.	2 lbs., 12 oz.	1 lb., 13 oz.	8 lbs.	3 lbs., 12 oz.	14 lbs.	48 lbs., 8 oz.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

WRITE FOR CATALOG E1J201A

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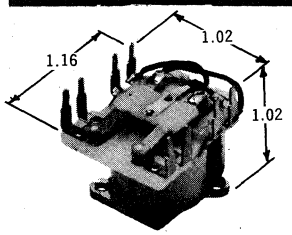
RELAYS

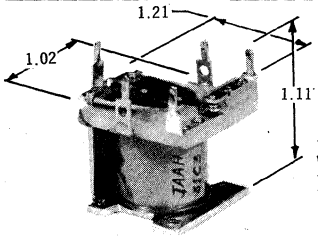
2 PDT / 1 & 3 AMPS / AC or DC COIL — SERIES JAA



A low cost, reliable general purpose AC or DC operated relay. For either printed circuit or chassis mounting. One inch height requires minimal amount of space. Excellent for a variety of control and signaling applications. 5 million operations mechanical life. Silver and Silver cadmium oxide contacts standard. Mounting by two 4-40 screws on .895 centers. Temperature range −60°C to +50°C. Weight 1.4 oz. Other coils and contacts available standard.

CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Pull-in Power	CONTACTS: Arrangement/mat'l	Rating (amps)	LIST PRICE
JAAD-32A1-120AP	120 AC	2100	.756 VA	2 Form C (DPDT) Silver	1.0	$3.80
JAAC-32A1-006DP	6 DC	75	258 MW	2 Form C (DPDT) Silver	1.0	3.35
JAAC-32A1-012DP	12 DC	350	236 MW			3.40
JAAC-32A1-024DP	24 DC	1500	238 MW			3.55

SPDT / 1 to 3 AMPS / DC COIL — TYPE JAAH



Power, sensitive, and high sensitive versions of single pole double throw relays. Miniature DC operated relay for low currents up to 3 amperes 28 VDC or 115 VAC. Printed circuit terminals, chassis mounting offers low cost, high reliability for a variety of control and signal applications. Temperature range, −60°C to +50°C. Weight 1.4 oz. (Special versions available from factory for spade solder lugs, reverse mounting holes, and silver cadmium oxide contacts.)

UL component recognized file 43220

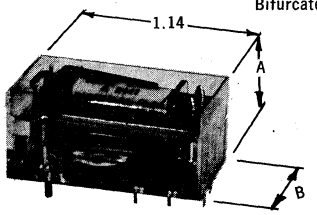
CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Pull-in Power	CONTACTS: Arrangement/mat'l	Rating (amps)	LIST PRICE
JAAH-31A1-006DPP	6 DC	110	176 MW	1 Form C (SPDT) Silver	3.0	$2.10
JAAH-31A1-012DPP	12 DC	410	176 MW			2.25
JAAH-31A1-024DPP	24 DC	1640	176 MW			2.30
JAAH-31A1-006DPS	6 DC	147	88 MW	1 Form C (SPDT) Silver	2.0	2.35
JAAH-31A1-012DPS	12 DC	620	88 MW			2.40
JAAH-31A1-024DPS	24 DC	2200	88 MW			2.45
JAAH-31A1-006DPH	6 DC	410	44 MW	1 Form C (SPDT) Silver	1.0	2.40
JAAH-31A1-012DPH	12 DC	1640	44 MW			2.45
JAAH-31A1-024DPH	24 DC	6150	44 MW			2.95
JAAH-31C3-006DPP	6 DC	110	176 MW	1 Form C (SPDT) AgCd oxide	3.0	2.35
JAAH-31C3-012DPP	12 DC	410	176 MW			2.40
JAAH-31C3-024DPP	24 DC	1640	176 MW			2.45
JAAH-31C9-006DPP	6 DC	110	176 MW	1 Form C (SPDT) AgCd oxide	10.0	2.40
JAAH-31C9-012DPP	12 DC	410	176 MW			2.45
JAAH-31C9-024DPP	24 DC	1640	176 MW			2.50

SOCKETS — TYPE JAKS

CATALOG NUMBER		LIST PRICE
	These sockets fit series JAKB relays with 2 Form C Contacts.	
	Chassis mounting (Retaining spring and grounding clip included)	
JAKS-1007	Socket silver plated contacts — 10 Pin	$.65
JAKS-1008	Socket gold plated contacts	.75
	Printed Circuit mounting	
JAKS-1009	Socket silver plated contacts — 10 Pin	.65
JAKS-1010	Socket gold plated contacts	.75
	These sockets fit series JAKG relays with 4 form C Contacts.	
	Chassis mounting	
JAKS-1000	Socket silver plated contacts — 16 Pin	.70
JAKS-1001	Socket gold plated contacts	.85
	Printed Circuit mounting	
JAKS-1002	Socket silver plated contacts — 16 Pin	.70
JAKS-1003	Socket gold plated contacts	.85

2, 4 & 6 PDT / 4 AMPS / DC COIL — SERIES JAE

TYPE	A	B
JAEB	.59	.95
JAEA	.55	.63
JAEC	.87	1.30

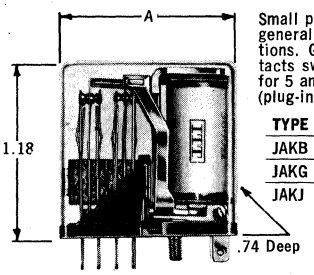


Our most compact relay for PC mounting. Extremely long life, twin contacts, and low profile. JAE ideally suited for many applications in logic, control, and communications equipment. Printed circuit board mounting. Bifurcated contacts. Plastic protective case. Mechanical life greater than 200 x 10^6 operations. Life at rated load 100 x 10^6 operations. Rated load 0.4 amperes. Max. current 1 amp. Temperature range −20°C to +65°C. Weight JAEA 0.5 oz., JAEB 0.7 oz. JAEC 1 oz. (Gold alloy contacts also available from factory.) Specify G4 instead of E4 in catalog number.

UL component recognized file 43220

CATALOG NUMBER	Ident. Number	COIL DATA: Nominal Volts	Ohms	CONTACTS: Arrangement/mat'l	Rating (amps)	LIST PRICE
JAEA-32E4-006DP	A2400	6 DC	60	2 Form C (DPDT) Silver-Pd Alloy	1	$4.70
JAEA-32E4-012DP	A2410	12 DC	210			4.70
JAEA-32E4-024DP	A2420	24 DC	850			4.70
JAEA-32E4-048DP	A2440	48 DC	3000			4.85
JAEB-34E4-006DP	A2640	6 DC	40	4 Form C (4PDT) Silver-Pd Alloy	1	5.05
JAEB-34E4-012DP	A2600	12 DC	210			5.05
JAEB-34E4-024DP	A2610	24 DC	850			5.05
JAEB-34E4-048DP	A2630	48 DC	3000			5.20
JAEC-36E4-006DP	A2800	6 DC	70	6 Form C (6PDT) Silver-Pd Alloy	1	6.90
JAEC-36E4-012DP	A2810	12 DC	270			6.90
JAEC-36E4-024DP	A2820	24 DC	900			6.90
JAEC-36E4-048DP	A2840	48 DC	3600			7.05
JAEA-32G4-006DP	A2405	6 DC	60	2 Form C (DPDT) Gold Alloy	1	5.30
JAEA-32G4-012DP	A2415	12 DC	210			5.30
JAEA-32G4-024DP	A2425	24 DC	850			5.30
JAEA-32G4-048DP	A2445	48 DC	3000			5.45
JAEB-34G4-006DP	A2645	6 DC	40	4 Form C (4PDT) Gold Alloy	1	6.25
JAEB-34G4-012DP	A2605	12 DC	210			6.25
JAEB-34G4-024DP	A2615	24 DC	850			6.25
JAEB-34G4-048DP	A2635	48 DC	3000			6.40
JAEC-36G4-006DP	A2805	6 DC	70	6 Form C (6PDT) Gold Alloy	1	8.10
JAEC-36G4-012DP	A2815	12 DC	270			8.10
JAEC-36G4-024DP	A2825	24 DC	900			8.10
JAEC-36G4-048DP	A2845	48 DC	3600			8.25

2 & 4 PDT / 2 & 5 AMPS / DC COIL — SERIES JAK



Small plug-in relay suitable for signal, logic, general purpose switching and control functions. Gold plated single or bifurcated contacts switch 2 amps at 28 VDC. Single silver for 5 amps 28 VDC. Spade terminals standard (plug-in or solder); printed circuit terminals available. The JAK relays have a stud for chassis mounting on spade terminal type only. Temperature range −40°C to +80°C. Weight: JAKB 0.8 oz., JAKG 0.9 oz. (Gold alloy or palladium contacts also available from factory.)

TYPE	DIM.
JAKB	.95
JAKG	1.17
JAKJ	1.40

UL component recognized file 43220

CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Pull-in Power	CONTACTS: Arrangement/mat'l	Rating (amps)	LIST PRICE
JAKB-32B1-006DG	6 DC	90	.40 W	2 Form C Single Silver	2	$4.40
JAKB-32B1-012DG	12 DC	430	.33 W			4.40
JAKB-32B1-024DG	24 DC	1250	.46 W			4.40
JAKB-32U1-006DG	6 DC	52	.69 W	2 Form C Bifurcated Silver	2	5.25
JAKB-32U1-012DG	12 DC	185	.77 W			5.25
JAKB-32U1-024DG	24 DC	700	.82 W			5.25
JAKB-32B3-006DG	6 DC	52	.69 W	2 Form C Single Silver	5	4.60
JAKB-32B3-012DG	12 DC	185	.77 W			4.60
JAKB-32B3-024DG	24 DC	700	.82 W			4.60
JAKG-34B1-006DG	6 DC	52	.69 W	4 Form C Single Silver	2	4.90
JAKG-34B1-012DG	12 DC	185	.77 W			4.90
JAKG-34B1-024DG	24 DC	700	.82 W			4.90
JAKG-34U1-006DG	6 DC	41	.87 W	4 Form C Bifurcated Silver	2	6.30
JAKG-34U1-012DG	12 DC	130	1.16 W			6.30
JAKG-34U1-024DG	24 DC	600	.96 W			6.30
JAKJ-36B1-006DG	6 DC	45	.45 W	6 Form C Single Silver	2	6.90
JAKJ-36B1-012DG	12 DC	230	.45 W			6.90
JAKJ-36B1-024DG	24 DC	930	.45 W			6.90

All available with other coil voltages.
Also available with 10 amp AG-CD oxide contacts.

RELAYS

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INDUSTRIAL PRODUCTS
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PHONE: (408) 292-4025 TWX: 910-338-0159, TELEX: 34-6311

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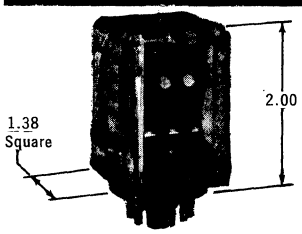
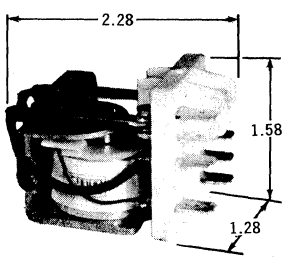
1, 2 & 3 PDT / 5 & 10 AMPS / AC or DC COIL — TYPE JBGA



Economical tube base plug-in multipole relay for switching light power loads such as motors, solenoids and other relays and general automation equipment. Mechanical life expectation 30 million operations. Solid square laminated contacts of silver for 5 amps or silver cadmium oxide for 10 amp rating. Enclosed in high impact plastic dust cover. Temperature range AC version −20°C to +45°C. DC version −20°C to +50°C. Weight 2.6 oz.
UL component recognized file 43220

CATALOG NUMBER	COIL DATA Nominal Volts	COIL DATA Ohms	CONTACTS Arrangement/ material	CONTACTS Rating (amps)	LIST PRICE
JBGA-32A5-120AJ	120 AC	2300	2 Form C	5	$7.15
JBGA-33A5-120AK	120 AC	2300	3 Form C	5	8.00
JBGA-32A5-024DJ	24 DC	460	2 Form C	5	7.15
JBGA-33A5-024DK	24 DC	460	3 Form C	5	8.00
JBGA-32C1-120AJ	120 AC	2300	2 Form C	10	7.40
JBGA-32C1-024DJ	24 DC	460	2 Form C	10	7.40
JBGA-33C1-006AK	6 AC	6	3 Form C		8.25
JBGA-33C1-012AK	12 AC	29	(3PDT)		8.25
JBGA-33C1-024AK	24 AC	120	Silver cad.	10	8.25
JBGA-33C1-120AK	120 AC	2300	oxide		8.25
JBGA-33C1-240AK	240 AC	8400			9.75
JBGA-33C1-006DK	6 DC	34	3 Form C		8.25
JBGA-33C1-012DK	12 DC	135	(3PDT)		8.25
JBGA-33C1-024DK	24 DC	460	Silver cad.	10	8.25
JBGA-33C1-110DK	110 DC	8400	oxide		9.25

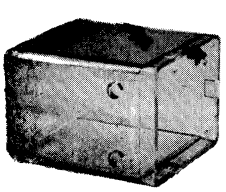
1, 2 & 3 PDT / 15 AMPS / AC or DC COIL — TYPE JBNG



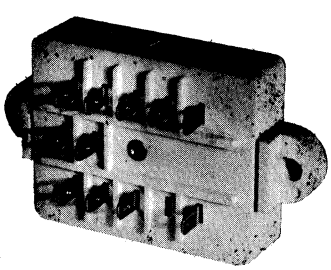
Open version 15 amp relay with AC or DC operated coil. .250 quick connect terminals for easy maintenance. Specially designed to meet the needs of the appliance industry and ideally suited for harness wiring. Large arc barriers isolate contacts which extends voltage carrying capability to 240 Volts AC. Silver cadmium oxide contacts provide heavy load capability. AC or DC actuated coils as desired. Mounting by 6-32 stud and .150 locating tab on .437 centers. Transparent non-inflammable plastic protective cover available separately. Temperature range −35°C to +50°C. Weight 3.2 oz.
UL component recognized file 43220

CATALOG NUMBER	COIL DATA Nominal Volts	COIL DATA Ohms	CONTACTS Arrangement/ material	CONTACTS Rating (amps)	LIST PRICE
JBNG-32C1-012AA	12 AC	5	2 Form C		$5.35
JBNG-32C1-024AA	24 AC	19	(DPDT)	15	5.35
JBNG-32C1-120AA	120 AC	457	Silver cad.		5.35
JBNG-32C1-240AA	240 AC	1745	oxide		5.75
JBNG-33C1-012AA	12 AC	5	3 Form C	15	5.95
JBNG-33C1-240AA	240 AC	1745	Silver cad.		6.35
JBNG-32C1-006DA	6 DC	16	2 Form C		5.25
JBNG-32C1-012DA	12 DC	58	(DPDT)	15	5.25
JBNG-32C1-024DA	24 DC	250	Silver cad.		5.25
JBNG-33C1-006DA	6 DC	16	3 Form C	15	5.90
JBNG-33C1-012DA	12 DC	58	(3PDT)	15	5.90
JBNG-33C1-024DA	24 DC	250	Silver cad.		5.90

Plastic cover for JBN Relays

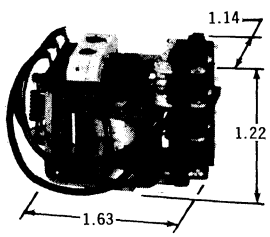


JBNS-1001 35¢



Socket for JBNH JBNS-1002 95¢

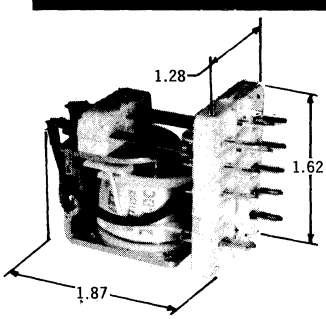
1, 2 & 3 PDT / 5 & 10 AMPS / AC or DC COIL — TYPE JBGC



Open version, low cost, multipole relay. Highly efficient general purpose relay for switching industrial loads of 5 and 10 amperes or actuating small solenoids or other relays. Mounted by single 6-32 NC stud and ⅛ locating tab on .437 centers. Temperature range AC version −20°C to +50°C. DC version −20°C to +55°C. Weight 2.5 oz.
UL component recognized file 43220

CATALOG NUMBER	COIL DATA Nominal Volts	COIL DATA Ohms	CONTACTS Arrangement/ material	CONTACTS Rating (amps)	LIST PRICE
JBGC-32A5-120AGS	120 AC	2300	2 Form C	5	$5.95
JBGC-32A5-240AGS	240 AC	8400	(DPDT)		5.95
JBGC-33A5-120AGS	120 AC	2300	3 Form C	5	6.20
JBGC-32A5-024DGS	24 DC	460	2 Form C	5	5.95
JBGC-33A5-024DGS	24 DC	460	3 Form C	5	6.20
JBGC-32C1-120AGS	120 AC	2300	2 Form C	10	6.15
JBGC-33C1-006AGS	6 AC	6	3 Form C		6.50
JBGC-33C1-012AGS	12 AC	29	(3PDT)		6.50
JBGC-33C1-024AGS	24 AC	120	Silver cad.	10	6.50
JBGC-33C1-120AGS	120 AC	2300	oxide		6.50
JBGC-33C1-240AGS	240 AC	8400			6.50
JBGC-31C1-006DGS	6 DC	34	1 Form C	10	6.00
JBGC-32C1-006DGS	6 DC	34	2 Form C	10	6.15
JBGC-33C1-006DGS	6 DC	34	3 Form C		6.50
JBGC-33C1-012DGS	12 DC	135	(3PDT)		6.50
JBGC-33C1-024DGS	24 DC	460	Silver cad.	10	6.50
JBGC-33C1-110DGS	110 DC	8400	oxide		6.80

2 & 3 PDT / 10 AMPS / AC or DC COIL — TYPE JBNH



True heavy duty 10 amp relay with long leaf springs. Terminals permit direct wire soldering, accept .110 Faston quick connects or plug into a socket. Recommend for high reliability control systems and high repetition duty cycles. Open construction mounted by 6-32 stud and .150 locating tab on .437 center. Temperature range −35°C to +50°C, weight 3.9 oz. Covers recommended when relay mounted into socket.

UL component recognized file 43220

CATALOG NUMBER	COIL DATA Nominal Volts	COIL DATA Ohms	CONTACTS Arrangement/ material	CONTACTS Rating (amps)	LIST PRICE
JBNH-32A1-012AF	12 AC	5	2 Form C	10	$5.35
JBNH-32A1-240AF	240 AC	1745	Silver		5.70
JBNH-33A1-012AF	12 AC	5	3 Form C		5.95
JBNH-33A1-024AF	24 AC	19	(3PDT)	10	5.95
JBNH-33A1-120AF	120 AC	457	Silver		5.95
JBNH-33A1-240AF	240 AC	1745			6.30
JBNH-32A1-006DF	6 DC	16	2 Form C	10	5.35
JBNH-32A1-110DF	110 DC	5600	Silver		5.70
JBNH-33A1-006DF	6 DC	16	3 Form C		5.95
JBNH-33A1-012DF	12 DC	58	(3PDT)	10	5.95
JBNH-33A1-024DF	24 DC	250	Silver		5.95
JBNH-33A1-110DF	110 DC	5600			6.30

ITT

JENNINGS

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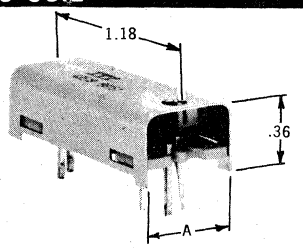
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

RELAYS

1 & 2 PST / 10 WATT / DC COIL — TYPE JDCD

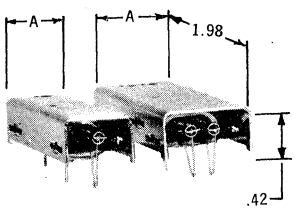


Small reed relay constructed with rigid magnetic iron shield. Semi-rigid mounting pins permit easy insertion into PC board without permitting any change in reed characteristics. Rhodium plated reed. 0.6 amp max. switched current 10 W or 12 VA max. power. 220 Volts max.

JDCD	A
1 Form A	.39
2 Form A	.50

CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Nominal Power	CONTACTS: Arrangement/mat'l	Rating	LIST PRICE
JDCD-01R6-003	3 DC	50	.18 W	1 Form A	10 W	$2.61
JDCD-01R6-006	6 DC	230	.18 W	SPST-NO	or	2.69
JDCD-01R6-012	12 DC	760	.18 W	Rhodium	12 VA	2.74
JDCD-01R6-024	24 DC	2800	.18 W			2.89
JDCD-02R6-003	3 DC	36	.23 W	2 Form A	10 W	3.97
JDCD-02R6-006	6 DC	150	.23 W	DPST-NO	or	4.05
JDCD-02R6-012	12 DC	610	.23 W	Rhodium	12 VA	4.09
JDCD-02R6-024	24 DC	2350	.23 W			4.33

1 & 2 PST / 25 WATT / DC COIL — TYPE JDDD

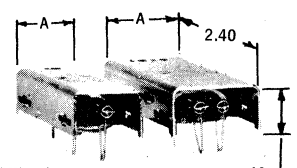


Economical, dependable, magnetic shielded reed relay. Sturdy construction proven by years of use in telephone circuits. Flexible pins prevent damage of reed capsule distortion during mounting. Employs the JDAA-50 standard capsule. 25 watt normal rating. Temperature range of −30°C to +85°C. Weight 1 Form .45 oz., Form .60 oz.

JDDD	A	JDDD	A
1 Form A	.60	3 Form A	1.00
2 Form A	.80	4 Form A	1.20

CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Nominal Power	CONTACTS: Arrangement/mat'l	Rating (amps)	LIST PRICE
JDDD-01G5-006	6 DC	130	.33 W	1 Form A		$2.17
JDDD-01G5-012	12 DC	430	.33 W	(SPST-NO)	1	2.17
JDDD-01G5-024	24 DC	1900	.33 W	Gold		2.25
JDDD-02G5-006	6 DC	70	.55 W	2 Form A		3.06
JDDD-02G5-012	12 DC	260	.55 W	(DPST-NO)	1	3.13
JDDD-02G5-024	24 DC	1000	.55 W	Gold		3.25
JDDD-03G5-006	6 DC	45	.80 W			3.93
JDDD-03G5-012	12 DC	170	.80 W	3 Form A	1	4.09
JDDD-03G5-024	24 DC	650	.80 W			4.13
JDDD-04G5-006	6 DC	43	.95 W			4.70
JDDD-04G5-012	12 DC	150	.95 W	4 Form A	1	4.78
JDDD-04G5-024	24 DC	600	.95 W			4.85

1 & 2 PST-NO / 50 WATT / DC COIL — TYPE JDHL

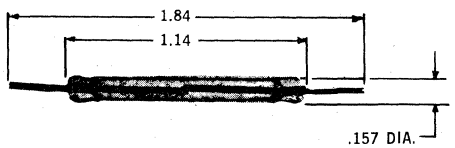


Economical standard size reed relay. Magnetically shielded construction gives higher efficiency while shielding stray flux fields from adjacent parts. Flexible pin connection provides protection when mounting and prevents changes in the reed relay operating characteristics. .200 grid spacing makes this relay desirable for PC mounting. Uses standard switch capsule JDAA-80. Temperature range −20°C to +70°C. Weight: 1 Form .6 oz.; 2 Form .88 oz.

JDHL	A
1 Form A	.86
2 Form A	.96

CATALOG NUMBER	COIL DATA: Nominal Volts	Ohms	Nominal Power	CONTACTS: Arrangement/mat'l	Rating	LIST PRICE
JDHL-01G8-006	6 DC	60	.60 W	1 Form A	50 W	$2.37
JDHL-01G8-012	12 DC	275	.52 W	SPST-NO	or	2.41
JDHL-01G8-024	24 DC	1050	.55 W	Gold	60 VA	2.53
JDHL-02G8-006	6 DC	35	1.02 W	2 Form A	50 W	3.33
JDHL-02G8-012	12 DC	140	1.02 W	DPST-NO	or	3.33
JDHL-02G8-024	24 DC	500	1.15 W	Gold	60 VA	3.41

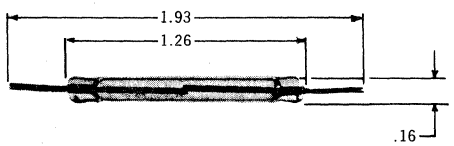
20 WATT — TYPE JDAA-40



Standard 20 watt single pole single throw reed relay proven superior for telephone crosspoint service both in ferreed and normal type crosspoint relays. Form A contact. Diffused gold contact surface. 20 VA switching capability. Operation by DC coil or permanent magnet. Minimum recommended load 10^{-8} VA. 700 volt flashover between contacts. Maximum switching current 1 amp, AC or DC. Maximum switching voltage 90 VDC, 250 VAC. Maximum switching power, 20 VA; mechanical life, 40 x 10^9 ops. minimum. Temperature range −25°C to +85°C.

CATALOG NUMBER	Contact Material	AMPERE TURNS: Close	Release	LIST PRICE
JDAA-40G1-AA	GOLD	60	12	$.55

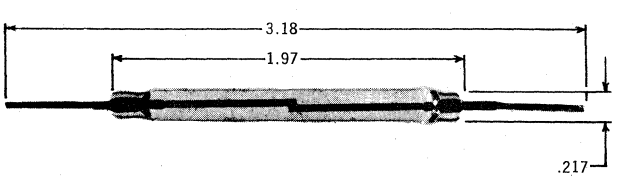
25 WATT — TYPE JDAA-50



Standard 25 watt single pole single throw reed proven superior for telephone crosspoint service both in ferreed and normal type crosspoint relays. Form A contact. Diffused gold contact surface. 24 VA switching capability. Operation by DC coil or permanent magnet. Minimum recommended load 10^{-8} VA. 650 volt flashover between contacts. Maximum switching current 1 amp, AC or DC. Maximum switching voltage 90 VDC, 250 VAC. Maximum switching power, 24 VA; mechanical life, 2 x 10^9 ops. minimum. Temperature range −25°C to +85°C.

CATALOG NUMBER	Contact Material	AMPERE TURNS: Close	Release	LIST PRICE
JDAA-50G1-AA	GOLD	51 to 69	17 to 27	$.80

50 WATT — TYPE JDAA-80



A heavy duty reed relay with gold diffused contacts. Excellent life characteristics as proven over years of reliable switching in telephone industry. Load can be reliably switched from 10^{-8} VA to 1 ampere. Flashover 800 VDC min. between contacts. Max. switching current: 1 amp AC or DC; max. switching voltage 150 VDC, 220 VAC; min. load 10^{-8} VA; max. switching power 60 VA, 50 W; mechanical life 6 x 10^9 ops. min. Temperature range −25°C to +85°C.

CATALOG NUMBER	Contact Material	AMPERE TURNS: Close	Release	LIST PRICE
JDAA-80G1-AA		78 to 102	26 to 42	$.95
JDAA-80G1-BA	GOLD	72 to 110	22 to 46	.95

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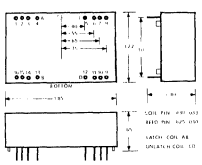
RELAYS SCANNERS/MATRICES LED DISPLAYS

ITI specializes in solving signal switching problems using many different switching devices and systems. Shown here are three product lines developed to solve difficult problems. If you have a switching problem contact our engineering staff.

MAGNETIC LATCHING RELAYS

The Model OLR Magnetic Latching Relay is a proprietary device for difficult switching and control problems where circuits, or preset data patterns must be maintained during primary power failure. The relay consumed **no** power during the holding time. Employing advanced technology to close and open the magnetic reed switches, no prebiasing permanent magnets are used in the design. There is no requirement to reduce the residual magnetic field to zero to open the reed switches. A very high residual magnetic field is generated by the latch pulse resulting in a relay which will withstand severe shock and vibration.



OPERATING PARAMETERS

Operate Voltage: 24 VDC (−10%, +100%)
Release Voltage: 24 VDC (−10%, +100%)
Pulse Duration: 500 μsec. Min. (Recommended pulse 1 ms.).
Coil Dissipation: 1 Watt Max. (Combined for both latch and unlatch coil).
Arc Suppression: None Included (1N4001 or equiv. recommended).
Operate Coil Resistance: 85 Ohms, Min.
Release Coil Resistance: 100 Ohms, Min.
Operate Current: 300 ma. Max.
Instantaneous Power: 7.2 Watts
Average Power: 7.2 Milli-Watts for 1 ms. Pulse

REED SWITCH PARAMETERS (Standard Relay)

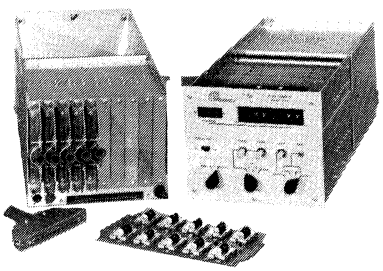
Voltage Breakdown: 300 VDC
Insulation Resistance: 10^{12} Ohms
Contact Resistance*: .2 Ohms
Switching Current: .5 Amp.
Switching Voltage: 200 VAC RMS / 200 VDC
Switched Power: 12 VA Max.
Current Carry: 1.0 Amp.
Operate Time: 500 μsec.
Contact Material: Rhodium
Life: 50 x 10^6 operations
Capacity Across Contact: .2 pf
* End of Life Resistance

STANDARD REED PRICES

Price	2A	4A	6A
1-9	$16.82	$18.40	$19.95
10-24	14.29	15.69	17.09
25-49**	13.45	14.77	16.09

** Consult Factory for Prices above 50.

SCANNERS / MATRICES



The Model 7100 family of switching products lets you design your own switching system for data acquisition, test instrumentation, or signal distribution. Designed to be compatible with all DTL and TTL logic blocks, remote control from other equipment is straight forward.

The SCAN CONTROL contains the necessary power supplies and control circuitry to permit scanning from one to one-thousand channels of information. Plug-in SCAN CARDS (1, 2, 3 or 4 pole) have a ten channel capacity and up to ten cards may be installed in a half-rack width either behind the SCAN CONTROL or separate SCAN EXPANDER modules (also half-rack). Expanding the number of signals to be scanned is simply a matter of adding SCAN CARDS for ten-channel increments and SCAN EXPANDERS for one-hundred channel increments.

All scanning functions may be controlled from the front panel but for applications where remote control is required, the EXT control mode disables the front panel to prevent conflicts in the operation of the unit.

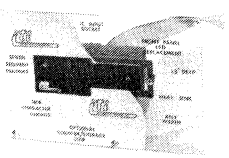
Leads are provided for remote selection of FIRST and LAST channels, remote START, STDBY and ADV, and remote readout of the channel identification digits, "closure complete", "scan complete", and "on last channel".

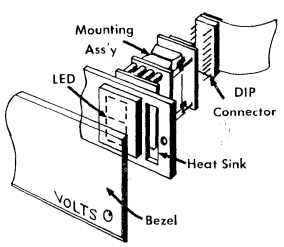
PRICE LIST

Scan Control*	$1,250
Scan Expander*	$ 210
Scan Cards, each	
1 Pole	$ 75
2 Pole	80
3 Pole	87
4 Pole	99
Low thermal contacts add 20% per card.	
Enclosure	$ 95

LED DISPLAYS

FRONT REPLACEABLE MODULAR ACCEPTS EITHER .27 OR .60 HIGH CHARACTERS





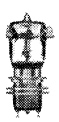
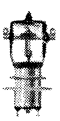
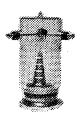
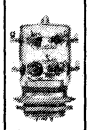
Model 7108, VERSADISPLAY, is a prepackaged LED (light emitting diode) display assembly which will accept either a standard DIP integrated circuit light package for character heights of .275 inches or the new enlarged display packages with .6 inch high characters. The LED display plug into I.C. sockets permitting easy replacement from the front of the assembly. The assembly is not prepackaged into a given chassis but is provided in a form for custom installation.

The assembly is formed as a series of circuit cards mounted one over the other to minimize the amount of panel space occupied. The first two layers contain the I.C. socket for the display and a seven segment decoder package. The third layer can be supplied with a number of different options. The unit can be provided with only a I.C. socket for connecting positive logic inputs to drive the seven segment decoder, or a I.C. chip can be mounted which can store the input information and drive the seven segment decoder directly. This I.C. chip can be a quad latch or a counting module. The stored information can also be extended to other circuits from the quad latch or the counting circuit. In this manner, the display module can be used as a counter with attached display directly.

The connection to the display is thru a I.C. socket mounted on the back of the third layer of the assembly. A 16 pin DIP socket is provided. Pre-assembled cables are available for the unit. A panel mounted filter is provided which can be engraved or screened with the desired nomenclature. This cover is designed for application directly to the front panel. The digital displays are riveted to a special heat dissipating assembly which also is the mounting structure for attaching the unit to a panel or chassis.

vacuum relays mean reliability ...reliability means KILOVAC

ki'lo·vac *n.* (F. *kilo*, thousand. L. *vacuus*)
1. That technology which offers reliable performance in high voltage relays resulting from operation at kilovolt levels in a vacuum dielectric.
2. *adj.*, pertaining to short contact travel, low contact mass, contacts free of oxides/pitting, and minimum contact bounce.

												
KILOVAC TYPE	**H-8**	**H-9**	**H-11/S2**	**H-12**	**H-14**	**H-16**	**H-17**	**H-18**	**H-19**	**H-23#**	**H-25/S10**	**H-26**
Contact arrangement	SPDT	SPST, N.C.	SPST, N.O.	SPDT	DPDT	DPDT	SPDT	DPDT	DPDT	SPST, N.C.	SPDT	4PDT
Rated operating voltage (KV DC or 60 Hz peak)	15	15	9	8	12	12	25	8	20	30	50	15
Test voltage (KVDC)	20	20	12	12	15	15	30	10	25	35	60	17
Continuous current, contacts closed, max. (amps DC or 60 Hz RMS)	15	15	15	15	30	30	30	10	30	30	30	30
*Max. current at rated voltage switching under load (amps DC)	0.5	0.5	0.1	0.1	0.3	0.5	0.1	0.1	0.1	0.1	0.1	0.1
Contact resistance, max. (ohms)	0.015	0.015	0.015	0.015	0.015	0.030	0.015	0.020	0.015	0.015	0.015	0.02
Operating time, max. (ms)	15	15	18	18	20	20	25	15	40	30	60	30
Coil resistance (ohms ±10% @ 25°C)	265	265	250	250	120	120	120	265	225	120	120	120
Coil voltage (VDC, nominal)	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
Nominal dimensions (inches)	1D x 3H	1¼D x 2¾H	1D x 1⅝H	1D x 1¾H	1¼D x 2¾H	1D x 3¼H	2D x 3½H	1D x 2H	2D x 3¼H	2D x 3¾H	3D x 7½H	2D x 4H
Nominal weight (oz)	3	3	2	2	8	5	5	4	7	7	30	16
Mounting style**	threaded base	solder flange	threaded base	threaded base	threaded base	threaded base	flange base	threaded base	threaded base	threaded base	threaded base	threaded base
Approximate unit price (1-9 pcs)	$98	$98	$98	$98	$128	$128	$128	$135	$135	$135	factory quote	$195

* All ratings are for pure resistive circuits. Contact factory for other circuits vs. ratings. ** Other styles available.
# H-24, same spec as H-23, except H-24 is SPST, N.O.

KILOVAC vacuum relays (ceramic or glass) are specified by design engineers for performance and reliability not available in conventional relays:

HIGH VOLTAGE ISOLATION: 2000 volts per mil of contact gap with predictable, repeatable isolation well in excess of rated values.

LOW AND STABLE CONTACT RESISTANCE: 0.015 ohms typical, with no contact oxidation or maintenance.

FAST SWITCHING TIME: 10 ms typical, due to small contact gap and short armature travel.

LONG LIFE: Millions of cycles with minimum degradation in electrical performance.

Any one of these standard features will justify your selection of KILOVAC vacuum relays. KILOVAC design and years of production experience permits immediate off-the-shelf delivery from a broad product line with voltages up to 100 KV. Special modifications provided in extremely short order.

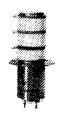
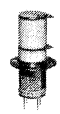
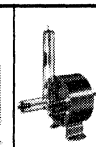
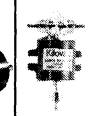
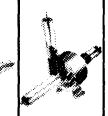
High vacuum technology has made high voltage switching practical with considerable savings in space and weight. KILOVAC uses the latest in vacuum pumping techniques, utilizing the "ion" type pump and achieving, in production, hard vacuums to 10^{-8} mm of mercury or better. Special manufacturing techniques include kovar-to-glass seals, final assembly in a dust and contaminant free area, specially selected glass and specially developed KILOVAC high voltage aging techniques.

KILOVAC relays are widely used in ECM, communications, sonar, radar, pulse-forming networks, medical electronics, and other high voltage equipment, or low voltage equipment where extreme reliability is a must. Many KILOVAC models are interchangeable with other manufacturers' types.

KILOVAC's broad line and "Quick Reaction Time" is geared to your most critical delivery schedule.

For complete technical information call your nearest KILOVAC sales-engineering representative or write directly to us.

KILOVAC, a company small enough to be responsive, large enough to be responsible.

												
KILOVAC TYPE	**HC-1†**	**KC-2†**	**KC-3†**	**KC-4†**	**KC-10†**	**KC-20†**	**KM-15**	**HVS-1**	**HVS-10**	**H-4**	**H-5#**	**H-35**
Contact arrangement	SPDT	SPDT	SPDT	SPST-Latching	SPDT	SPST, N.O.	DPDT	SPDT	SPDT	SPDT	SPST, N.O.	SPDT
Rated operating voltage (KV DC or 60 Hz peak)*	2.5	15	8	10	15	28	8	17	17	5	5	35
Test voltage (KVDC)	5	18	11	12	20	30	18	22	25	7.5	7.5	40
Continuous current, contacts closed, max. (amps DC or 60 Hz RMS)	18	50	25	28	75	110	10	7	8	10	4	10
*Max. current at rated voltage switching under load (amps DC)	0.5	0.5	0.1	0.5	0.1	0.1	5.0	3.0	4.0	5.0	2.0	5.0
Contact resistance, max. (ohms)	0.010	0.012	0.015	0.015	0.012	0.005	0.100	0.015	0.015	0.02	0.035	0.015
Operating time, max. (ms)	6	18	18	3	35	30	25	25	20	10	10	30
Coil resistance (ohms ±10% @ 25°C)	335	265	220	6	225	120	65	128	65	250	250	50
Coil voltage (VDC, nominal)	26.5	26.5	26.5	26.5	26.5	26.5	40	26.5	40	26.5	26.5	26.5
Nominal dimensions (inches)	¾D x 1½H	1⅝D x 2⅜H	¾D x 2¾H	¾D x 2¾H	1⅝D x 4⅝H	1⅝D x 3¾H	2½D x 3⅝H	4¾L x 5H	5L x 3¼H	1⅞L x ⅞H	2L x ¾H	8¼L x 5¼H
Nominal weight (oz)	1	3	2.5	2	16	10	12	15	14	1	1	15
Mounting style**	threaded base	flange base	flange base	flange base	flange	threaded	flanged	foot bracket	foot bracket	flange	foot bracket	foot bracket
Approximate unit price (1-9 pcs)	$54	$98	$75	factory quote	$175	$225	$125	$60	$60	$55	$65	$120

* All ratings are for pure resistive circuits. Contact factory for other circuits vs. ratings. ** Other styles available.
# H-6, Same Spec as H-5, Except H-6 is SPST, N.C. † Ceramic envelope.

Kilovac® CORPORATION

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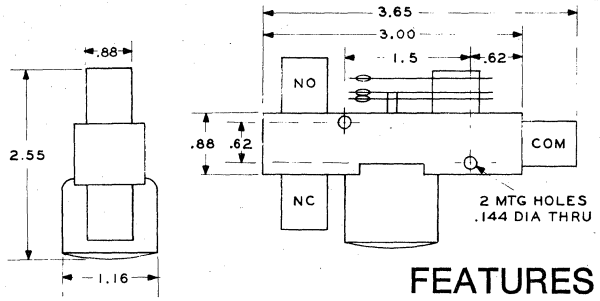
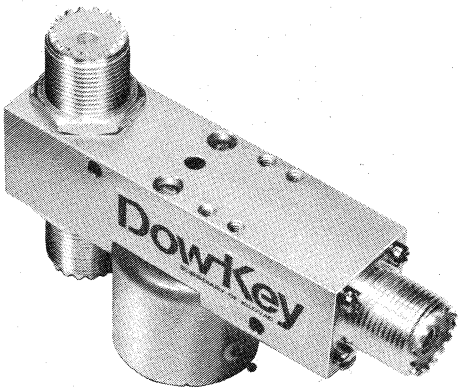
SERIES 60 SPDT Remote Coaxial Relay





FEATURES

The Series 60 are remotely operated, ruggedly constructed, SPDT coaxial relays designed for operation to one Kw. They are available with or without two Form C auxiliary contacts. For transmit-receive applications, they are available with a special high-isolation "G" connector at the NC or receive position. The "G" connector increases the isolation to greater than −100 dB at frequencies up to 500 MHz, but reduces the power rating of the normally-closed connector to 20 watts. "G" connectors will increase VSWR above 400 MHz. Data given for the Series 60 is applicable when used in a 50-ohm transmission line. UHF connectors are not recommended above 400 MHz. Standard coils are 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time ..... 25 ms. max.
Auxiliary Contact Rating ..... 5 Amps., 115 Vac

MECHANICAL DATA

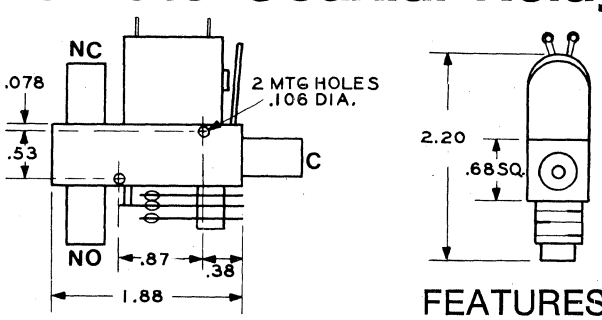
Life Expectancy ..... 1,000,000 cycles
Weight ..... 10 oz. Approx.
Finish
R.F. Contacts ..... Gold Plated Fine Silver
Auxiliary Contacts ..... Gold Plated Fine Silver

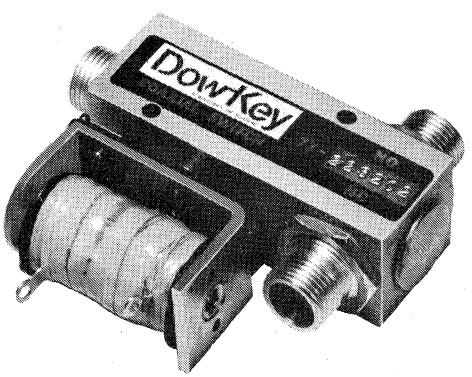
CONNECTORS & PART NUMBERS

Connector Type	Std. SPDT	With 2C Aux. Contacts	With NC "G" Conn.	With 2C Aux. & NC "G"
UHF	60-XX04	60-XX0442	60-XX28	60-XX2842
50 ohm N	60-XX01	60-XX0142	60-XX25	60-XX2542

See ordering information for coil data.

SERIES 77 SPDT Remote Coaxial Relay





FEATURES

The Series 77 are medium size, light-weight coaxial relays for industrial and less critical military applications. The "T" shaped connector configuration has the common connector at one end and the NO and NC connectors 180° apart at the other end. Available with or without one set of Form C auxiliary contacts. Coils are available in 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time ..... 15 ms. max.

MECHANICAL DATA

Weight ..... 3 Oz.
Life Expectancy ..... 1,000,000 cycles
Finish
Connectors ..... Silver Plated
Body ..... Irridite
R.F. Contacts ..... Gold Plated Fine Silver

CONNECTORS & PART NUMBERS

Connector Type	Standard SPDT	With IC Aux. Contacts
BNC	77-XX02	77-XX0232
"F"	77-XX32	77-XX3232

See ordering information for coil data.

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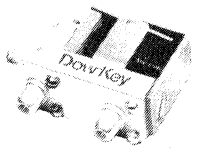
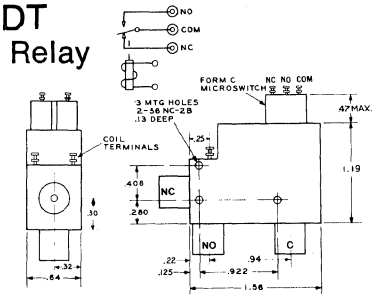
SERIES 61 SPDT
Remote Coaxial Relay





FEATURES

The Series 61 are small SPDT relays for military and severe-environment applications. The balanced armature actuator prevents contact chatter under high-frequency vibration and severe shock. They are offered with one or two Form C microswitch auxiliary contacts. Gold-finished R.F. contacts provide reliable operation at low levels. Coils are available for 12 Vdc (60 ohms), 26 Vdc (275 ohms) and 110 Vdc (5000 ohms).

SPECIFICATIONS

Operating Time ..... 15 ms. max.
Auxiliary Contact Rating ..... 5 amps, 115 Vac

MECHANICAL DATA

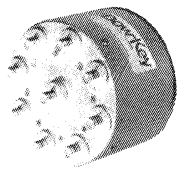
Life Expectancy ..... 1,000,000 cycles
Weight ..... 4½ Oz., max.
Finish
Connectors ..... Silver Plated
Magnetic Parts ..... Nickel Plated

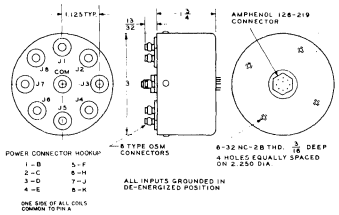
CONNECTORS AND PART NUMBERS

Connector Type	SPDT	With 1C Microswitch	With 2C Microswitch
BNC	61-XX02	61-XX212	61-XX0222

See ordering information for coil data.

SERIES 74 SP8T
Remote Coaxial Relay





FEATURES

The Series 74 are small, 8-position, single-pole coaxial relays intended for use in 50-ohm circuits at frequencies up to 2 GHz, where multiple sources are to be switched to a common output. All unused relay terminals are grounded to provide maximum isolation. Coils are available for 12 Vdc (60 ohms), 26 Vdc (275 ohms) and 110 Vdc (5000 ohms).

SPECIFICATIONS

Operating Time ..... 15 ms. max.

MECHANICAL DATA

Life Expectancy ..... 1,000,000 cycles
Weight ..... 15 Oz.
Finish
Connectors ..... Silver Plated
Contacts ..... Gold Plated Fine Silver

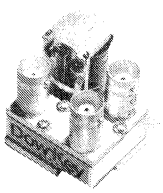
CONNECTORS AND PART NUMBERS

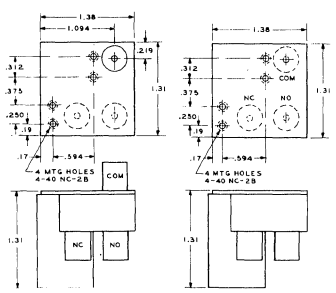
Connector Type*	Part Number
BNC	74-XX02
TNC	74-XX03
OSM	74-XX08

* Others on request, contact factory.

See ordering information for coil data.

SERIES 163/164 SPDT
Remote Coaxial Relay





FEATURES

These are general purpose coaxial relays for use up to 1 GHz, and are intended for military and other applications where reliability is important. The Series 163 has the common connector passing through the mounting surface, while the Series 164 has all connectors opposite the mounting surface. Gold plated contacts are used for reliability at low signal levels. Standard coil voltages are 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time ..... 10 ms. max.

MECHANICAL DATA

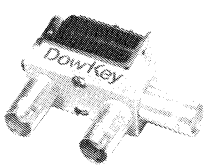
Life Expectancy ..... 1,000,000 cycles
Weight ..... 4 Oz. Approx.
Finish
R.F. Surfaces ..... Siver Plated
Magnetic Parts ..... Nickel Plated
R.F. Contacts ..... Gold Plated Fine Silver

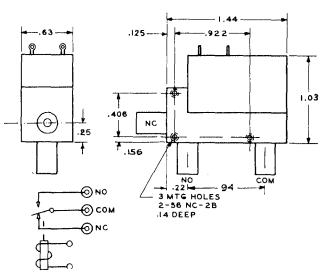
CONNECTORS AND PART NUMBERS

Connector Type	Series 163	Series 164
BNC	163-XX02	164-XX02

See ordering information for coil data.

SERIES 169 SPDT
Remote Coaxial Relay





FEATURES

The Series 169 are small relays for use up to 1 GHz. Gold-finished contacts provide reliable operation at low levels. Coils are available in 12 Vdc (70 ohms), 26 Vdc (290 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time ..... 12 ms. max.

MECHANICAL DATA

Life Expectancy ..... 1,000,000 cycles
Weight ..... 3.5 Oz., max.
Finish
Body and Connectors ..... Silver Plated
Magnetic Parts ..... Nickel Plated

CONNECTORS AND PART NUMBERS

Connector Type	Part Number
BNC	169-XX02
F	169-XX32

See ordering information for coil data.

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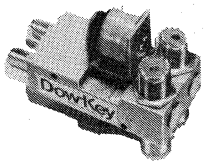
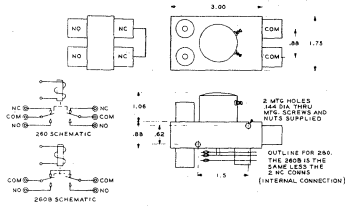
DOWKEY DIVISION OF KILOVAC CORPORATION

SERIES 260/260B DPDT
Remote Coaxial Relay





FEATURES

These are remote operation, ruggedly constructed coaxial relays designed for use from low level to one KW. There are two basic types: The 260 is a standard DPDT switch with six connectors. The 260B is similar, except for an internal connection between the NC contacts, leaving only four connectors. The 260B is widely used for inserting a circuit element, such as a power amplifier, between two normally connected elements, such as an exciter and antenna. Both types are available with or without Form 2C auxiliary contacts. Coils are available in 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time ..... 25 ms.
Auxiliary Contact Rating ..... 5 amps, 115 Vac

MECHANICAL DATA

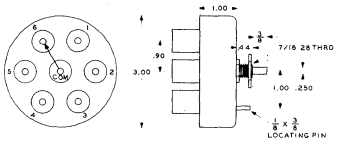
Life Expectancy ..... 1,000,000 cycles
Weight ..... 12 Oz. approx.
Finish
R.F. Contacts ..... Gold Plated Fine Silver
Auxiliary Contacts ..... Gold Plated Fine Silver

CONNECTORS AND PART NUMBERS

Connector Type	Series 260		Series 260B	
	Standard	With Aux. Contacts	Standard	With Aux. Contacts
UHF	260-XX04	260-XX0442	260B-XX04	260B-XX0442
BNC	260-XX02	260-XX0242	260B-XX02	260B-XX0242

See ordering information for coil data.

SERIES 78
Multi-Position Coaxial Switch



FEATURES

Series 78 are manually operated switches using coaxial switching members rather than wafer switches. They are offered in SPDT, DPDT, 3, 4, and 6 position types. The unused connectors are of the open, non-shorting type.

MECHANICAL DATA

Life Expectancy ..... 100,000 cycles, min.
Weight ..... 10 Oz.
Finish
Connectors ..... Silver Plated
Cover ..... Clear Irridite
Contacts ..... Gold Plated Fine Silver

Mounting: Clearance hole for 7/16 thread and 7/64 hole for locating pin. Supplied with mounting nut, lock washer, knob and escutcheon plate.

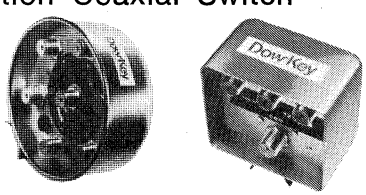
CONNECTOR LOCATIONS VS. FUNCTION

Function	Connector Location
SPDT	1, 6, & C
1P3T	1, 3, 5 & C
1P4T	1, 2, 3, 6 & C
1P6T	1, 2, 3, 4, 5, 6 & C
DPDT	1, 2, 3, 4, 5 & 6

CONNECTORS AND PART NUMBERS

Connector Type	SPDT	1P3T	1P4T	1P6T	DPDT
UHF	78-0204	78-0304	79-0404	78-0604	———
BNC	———	78-0302	———	78-0602	78-0702

SERIES 71/72
Multi-Position Coaxial Switch



FEATURES

The Series 71 and 72 are high power, multi-position relays commonly used for switching antennas, transmitters or receivers at frequencies up to 500 MHz. They are available with shorting or non-shorting contacts, and have a separate actuating coil for each position. Any one or more inputs or outputs may be connected to the common. Coils are available in 12 Vdc (48 ohms), 26 Vdc (245 ohms) and 115 Vac (5000 ohms).

SPECIFICATIONS

Operating Time ..... 25 ms.

MECHANICAL DATA

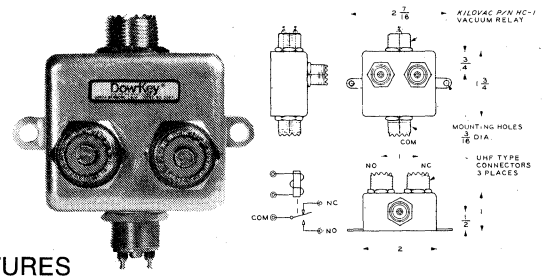
Life Expectancy ..... 500,000 cycles per position
Weight ..... Series 72, 1.5 lbs.; Series 71, 3 lbs.

CONNECTORS AND PART NUMBERS

Connector Type	3 Position		6 Position	
	Shorting	Non-Shorting	Shorting	Non-Shorting
UHF	72-XX0401	72-XX0402	71-XX0401	71-XX0402

See ordering information for coil data.

MODEL 220-2304 SPDT
Vacuum Coaxial Relay



FEATURES

This compact relay, which incorporates a Kilovac HC-1 ceramic vacuum relay as the switching element, is intended for use in antenna, transmitter, and receiver switching applications. It is capable of carrying two KW of R.F. power at 30 MHz and one KW at 250 MHz. The relay is fitted with UHF connectors, and is designed for continuous operation. R.F. impedance is 50 ohms. Standard coil voltage is 26 Vdc (335 ohms), but other coil voltages are available on special order.

SPECIFICATIONS

Switching Time ..... 6 ms. max.

MECHANICAL DATA

Life Expectancy ..... 1,000,000 cycles
Weight ..... 4 Oz.
Finish
Body ..... Nickel Plated
R.F. Connectors ..... Silver Plated

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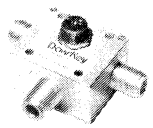
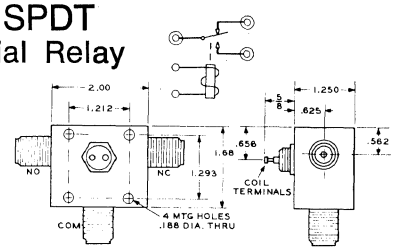
SERIES 310 SPDT
Vacuum Coaxial Relay





FEATURES

Series 310 relays have high power capability in a small package, with continuous rating of 3000 watts at frequencies up to 30 MHz. At 400 MHz, the relay will carry 1000 watts. Reliable vacuum-enclosed contacts minimize noise and losses. Standard coils are 12 Vdc (120 ohms), 26 Vdc (340 ohms), 48 Vdc (900 ohms), 110 Vdc (6000 ohms) and 115 Vac (6000 ohms).

SPECIFICATIONS

Operating Time ..... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz ..... 1500 V
At 400 MHz ..... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz ..... 40 amps
At 400 MHz ..... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight ..... 8 Oz.

Finish
Connectors .. Silver Plated
Block ..... Silver Plated

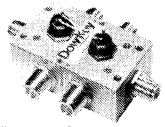
CONNECTORS AND PART NUMBERS

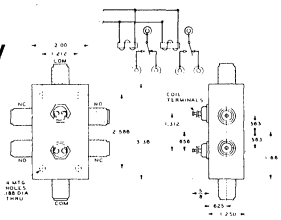
Connector Types	Part Numbers	Connector Types	Part Numbers
N	310-XX01	SC	310-XX53
HN	310-XX51	BNC*	310-XX02
C	310-XX05	TNC*	310-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 311 DPDT
Vacuum Coaxial Relay





FEATURES

Series 311 relays are capable of handling three KW of R.F. power at 30 MHz and one KW at 400 MHz. The use of vacuum-enclosed contacts provides reliable, low contact resistance operation. Typical applications for the Series 311 relays include switching R.F. power and radar pulse-forming networks. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). (Resistance values are for parallel-connected coils.)

SPECIFICATIONS

Operating Time ..... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz ..... 1500 V
At 400 MHz ..... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz ..... 40 amps
At 400 MHz ..... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight ..... 12 Oz.

Finish
Connectors .. Silver Plated
Block ..... Silver Plated

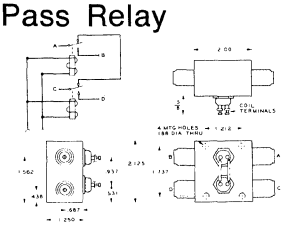
CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	311-XX01	SC	311-XX53
HN	311-XX51	BNC*	311-XX02
C	311-XX05	TNC*	311-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 312
Vacuum Coaxial By-Pass Relay



FEATURES

Series 312 relays are intended for use in circuits where it is desired to by-pass an RF power amplifier and connect the driving source directly to the amplifier load. Reliable, low contact resistance is provided by the vacuum-enclosed contacts. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). Resistance values are for parallel-connected coils.)

SPECIFICATIONS

Operating Time ..... 6 ms. max.

ELECTRICAL DATA

Peak Voltage
At 30 MHz ..... 1500 V
At 400 MHz ..... 1000 V

Peak Current - 1 μsec. Pulse
At 30 MHz ..... 40 amps
At 400 MHz ..... 10 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight ..... 12 Oz.

Finish
Connectors .. Silver Plated
Block ..... Silver Plated

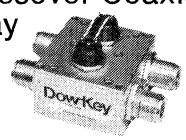
CONNECTORS AND PART NUMBERS

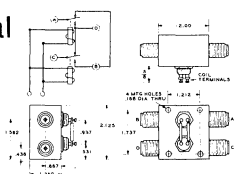
Connector Types	Part Numbers	Connector Types	Part Numbers
N	312-XX01	SC	312-XX53
HN	312-XX51	BNC*	312-XX02
C	312-XX05	TNC*	312-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

SERIES 313
Transfer/Crossover Coaxial Vacuum Relay





FEATURES

These remotely operated, ruggedly constructed transfer relays are designed for high-power, high voltage use. The Series 313 also features Kilovac vacuum-enclosed contacts for high reliability, low contact resistance and long life. Applications include interchanging two transmitters between an antenna and a dummy load, reversing feed phase for directional antenna, and similar applications. Standard coils are 12 Vdc (60 ohms), 26 Vdc (170 ohms), 48 Vdc (450 ohms), 110 Vdc (3000 ohms), and 115 Vac (3000 ohms). (Resistance values are for parallel-connected coils.)

SPECIFICATIONS

Operating Time ..... 6 ms. max.

ELECTRICAL DATA

Isolation Loss (at 30 MHz)..35 db min.
Insertion Loss ..... 0.2 db max.
R.F. Power Rating ..... 3 KW

Peak Voltage .. 1500 V
Peak Current (1 μsec. Pulse) ..... 40 amps

MECHANICAL DATA

Life Expectancy
1,000,000 cycles
Weight ..... 12 Oz.

Finish
Connectors .. Silver Plated
Block ..... Silver Plated

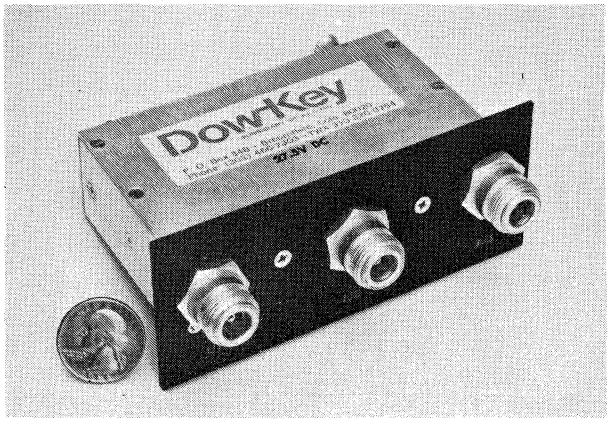
CONNECTORS AND PART NUMBERS

Connector Types	Part Numbers	Connector Types	Part Numbers
N	313-XX01	SC	313-XX53
HN	313-XX51	BNC*	313-XX02
C	313-XX05	TNC*	313-XX03

* Reduced power rating with these connectors

See ordering information for coil data.

OEM SPECIALS

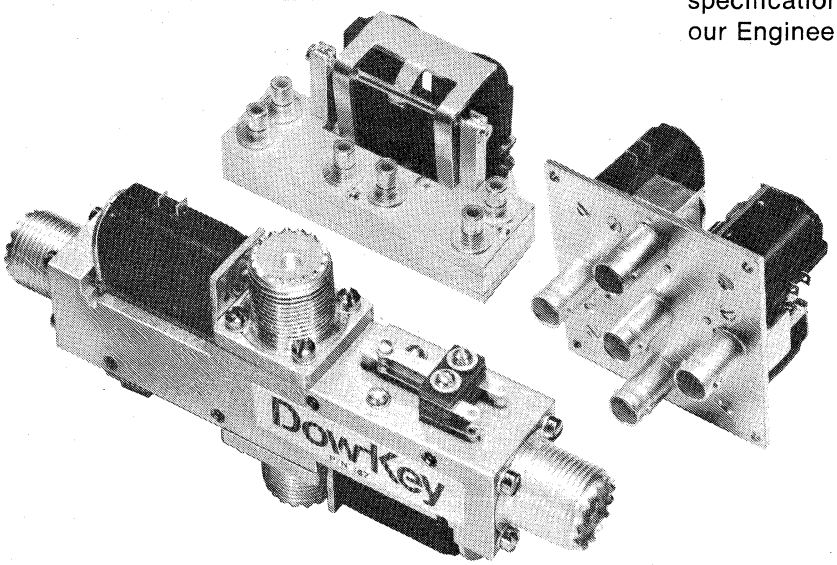


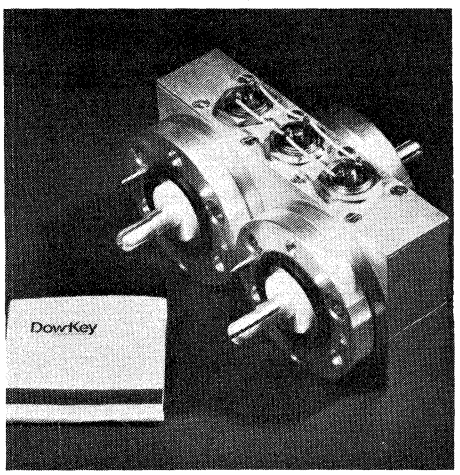
This catalog covers only the standard, most popular Dow-Key relays. We manufacture many more products than shown, and invite your inquiries.

Dow-Key offers the original equipment manufacturer a diverse background of designing and producing special relays to exacting specifications.

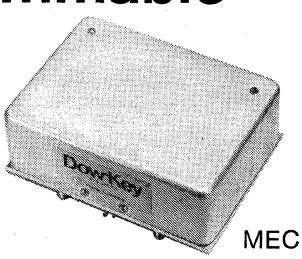
Latching relays, hermetically sealed relays and a wide variety of switching arrangements, non-standard connectors, attached cables of various types (with or without connectors) and special coils are available.

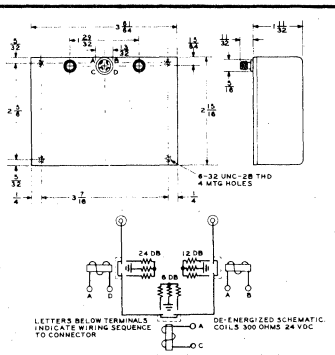
Your inquiries regarding relays designed to your specifications will receive prompt attention from our Engineering and Marketing Departments.





SERIES 175 Remote Programmable Attenuator





FEATURES

The Series 175 is a remotely controlled 50 ohm programmable attenuator providing three attenuator networks that are arranged to be inserted in an R.F. circuit to provide attenuation from 0 to 42 dB in 6 dB steps. Other attenuator steps, R.F. connectors and coils can be supplied on special order. Standard coils are 12 Vdc (120 ohms), 26 Vdc (340 ohms) and 110 Vdc (5000 ohms).

SPECIFICATIONS

Operating Time ..... 15 ms. max.

MECHANICAL DATA

Life Expectancy ..... 1,000,000 cycles
Weight ..... 1 lb.
Power Connector ..... 4 solder-pin header
Finish
Cover ..... Nickel Plated
Connectors ..... Silver Plated

CONNECTORS AND PART NUMBERS

Connector Type	0-250 MHz	250-500 MHz	500-1200 MHz
BNC	175-XX02A	175-XX02B	175-XX02C
TNC	175-XX03A	175-XX03B	175-XX03C

See ordering information for coil data.

DowKey
DIVISION OF KILOVAC CORPORATION
P.O. BOX 4422 • SANTA BARBARA, CALIF. 93103 • (805) 684-4560 • TWX 910/336-1141
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

Ordering Information

In the data given for each Dow-Key relay series, the first two or three digits denote the series or basic relay type. The "XX" following the hyphen represents the coil voltage; refer to the coil data table and replace XX with the appropriate coil number. The next two digits designate the type of connector. The final two digits, when used, indicate auxiliary contacts or special terminations.

Using the Series 60 SPDT remote coaxial relay as an example, assume a relay with UHF connectors and 2C auxiliary contacts, with a 12 Vdc coil is wanted. The numbers shown in the Connectors and Part Numbers table are 60-XX0442. Referring to the Coil Data, the coil number is found to be 22. Thus, the part number would be 60-220442.

Various other coils and connectors, as well as certain other modifications, are available in addition to the standard series shown in this catalog. Please contact the factory for your special requirements.

Coil Data

Standard coil voltages are 12 Vdc, 26 Vdc, and 115 Vac, except for vacuum coaxial relays, which are also available at 48 Vdc and 110 Vdc in standard models. Other voltages listed in the table below are available on special order at a slight premium price or in minimum-order quantities.

Part No. Digits	Nominal Volts	Part No. Digits	Nominal Volts
21	6 Vdc	25**	110 Vdc
22*	12 Vdc	26*†	115 Vac
23*	26 Vdc	64††	220 Vac
24**	48 Vdc		

* Standard Coils

** Also standard for vacuum coaxial relays only.

† External diode rectifier supplied with vacuum coaxial relays (not required with other models).

†† Not available on vacuum coaxial relays.
(Within normal temperature and voltage ranges, all the listed coils are rated for continuous duty.)

Connector Data

Connectors are 50-ohm female jack type, unless otherwise specified. The dimensions, materials and finishes are in accordance with applicable military specifications. In many cases, standard 50-ohm relays and switches may be used without introducing significant discontinuities in 75 and 90-ohm impedance circuits at the frequencies where the higher impedance cables are normally employed.

Only the most popular connector types are listed with each coaxial relay or switch described in this catalogue. Within available space limitations, a number of other connectors are available on special order. These include types TNC, HN, C, SC, OSM, and others. Contact the factory for your special connector requirements.

Environmental Data

Design characteristics of Dow-Key relays and switches are generally based on the requirements of specification MIL-S-3928 and the test procedures of MIL-STD-202. In general, the criteria for shock and vibration resistance are operational requirements of no contact opening in excess of 10 microseconds. Non-operating tests may be performed at much higher acceleration levels with no subsequent electrical or mechanical impairment. Shock capability ranges from 15 to 50 g, and vibration capability from 10 g at 55 Hz to 10 g at 2000 Hz. Temperature tolerances are from −55° to +125°C, with most relays bracketed between −55° and +85°C. Complete, detailed information for individual relays and switches is available on request.

VSWR and Isolation Data

Listed below are typical VSWR and isolation values for Dow-Key coaxial relays and switches. The VSWR figures indicate the discontinuity introduced by the addition of the relay or switch in a matched system. Isolation data are in decibels, and indicate the magnitude of leakage to an open terminal when that terminal is terminated in a resistive load equal to characteristic impedance of the system. Type UHF connectors are not recommended for use at frequencies above 400 MHz. Their use above that frequency may cause a substantial increase in VSWR.

VSWR

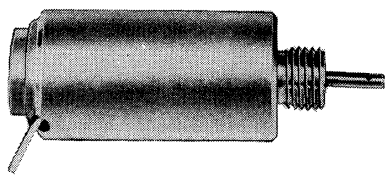
Frequency, MHz	Series 60	Series 61	Series 71/72	Series 74	Series 77	Series 78	Series 163/164	Series 169	Series 220	Series 260/260B	Series 310	Series 311	Series 312	Series 313
50	1.05	1.03	1.06	1.03	1.03	1.05	1.03	1.05	1.1	1.05	1.05	1.05	1.05	1.05
200	1.08	1.06	1.18	1.06	1.07	1.08	1.07	1.08	1.15	1.08	1.08	1.08	1.08	1.08
400	1.12	1.12	1.2	1.12	1.1	1.15	1.12	1.15	—	1.12	1.1	1.1	1.1	1.1
1000	1.3	1.2	—	1.2	1.25	1.3	1.25	1.3	—	1.3	—	—	—	—

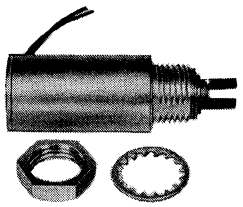
Isolation, dB

50	45	60	58	65	55	60	60	55	35	45	35	35	35	35
200	37	42	42	60	45	50	45	48	25	37	28	28	28	28
400	30	32	32	55	40	45	40	42	—	30	20	20	20	20
1000	25	—	—	50	33	30	30	32	—	25	—	—	—	—

LIBERTY CONTROLS INC.

TUBULAR SOLENOIDS



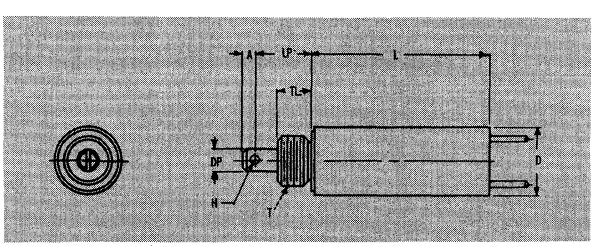


CHARACTERISTICS	½" Dia. T-2			¾" Dia. T-3	1" Dia. T-4		1½" Dia. T-5	
Mounting:	⅜-32 Threaded Bushing (hex nut and lockwasher supplied)			15/32 Threaded Bushing (9/16" x 3/32" hex nut and lockwasher supplied)	¾-24 Threaded Bushing (7/8" x 1/8" hex nut and lockwasher supplied)		1-27 Threaded Bushing (1⅛" x 1/8" hex nut and lockwasher supplied)	
Plunger:	3/16" dia., 60° taper, phenolic plunger sleeve			¼" dia., 60° taper, phenolic plunger sleeve	7/16" dia., 60° taper, phenolic plunger sleeve		½" dia., 60° taper, phenolic plunger sleeve	
Coil Voltages:	6, 12, 24, 110 VDC			6, 12, 24, 110 VDC	6, 12, 24, 110 VDC		6, 12, 24, 100 VDC	
Part Number	T-21	T-24	T-26	T-34	T-43	T-46	T-55	T-57
Length:	7/8"	1½"	2"	1½"	1⅛"	2"	1⅝"	2⅜"
Power Requirements:								
a. Continuous	2.4W	3.5W	4W	3.5W	4W	5.5W	7W	10W
b. Intermittent (25%) (one min. max. on time)	7W	15W	20W	22W	19W	38W	40W	60W
Voltage Breakdown:	500 V RMS 60 Hz.			1000 V RMS 60 Hz.	1000 V RMS 60 Hz.		1000 V RMS 60 Hz.	
Termination:	6" leads			6" leads	6" leads		6" leads	
Push or Pull Available:	Yes			Yes	Yes		Yes	

PUSH/PULL CHARACTERISTICS

DISTANCE FROM STOP IN INCHES (PUSH/PULL IN OZ.)

PART NO.	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	1"	1¼"	1½"
CONTINUOUS DUTY										
T-21	2	0.5	—	—	—	—	—	—	—	—
T-24	6	3	1.5	0.5	—	—	—	—	—	—
T-26	6	3	1.5	1	0.8	0.6	0.5	—	—	—
T-34	16	8	3.5	2	1.5	1	—	—	—	—
T-43	13	10	3.5	1	—	—	—	—	—	—
T-46	26	18	9	6	3	2	1	—	—	—
T-55	100	48	18	8	4	2	1	—	—	—
T-57	150	80	42	25	17	10	6	2	1	—
INTERMITTENT (25%)										
T-21	7	3.5	1	—	—	—	—	—	—	—
T-24	9	6	4	3.5	3	2	1	—	—	—
T-26	12	8	5.5	4.5	4	3.8	3.5	3	—	—
T-34	30	22	13	10	7	5	3	1	—	—
T-43	50	35	16	7	3	1	—	—	—	—
T-46	72	58	40	28	24	19	16	9	3	—
T-55	200	150	92	56	33	20	10	3	—	—
T-57	220	160	120	95	78	62	50	30	15	7



TUBULAR SOLENOID DIMENSIONS

TYPE	D	L	DP	LP	A	HD	T	TL
T-21	½"	7/8"	.195"	17/32"	3/32"	1/16"	3/8-32NEF	¼"
T-24	½"	1½"	.195"	17/32"	3/32"	1/16"	3/8-32NEF	¼"
T-26	½"	2"	.195"	17/32"	3/32"	1/16"	3/8-32NEF	¼"
T-34	¾"	1½"	¼"	23/32"	⅛"	3/32"	15/32-32NEF	3/8"
T-43	1"	1⅛"	7/16"	25/32"	5/32"	⅛"	¾-24NS	3/8"
T-46	1"	2"	7/16"	25/32"	5/32"	⅛"	¾-24NS	3/8"
T-55	1½"	1⅝"	½"	23/32"	5/32"	⅛"	1 -27NS	3/8"
T-57	1½"	2⅜"	½"	25/32"	5/32"	⅛"	1 -27NS	3/8"

HOW TO ORDER TUBULAR SOLENOIDS

When ordering any of the above tubular solenoids, the part number should be specified as follows:

TYPE NO.	DUTY	VOLTAGE
T-21 thru T-57	C — Continuous 25 — 25% Intermittent (% of "on Time" compared to 4 min. duty cycle)	6VDC 12VDC 24VDC 110VDC

Specify if intended use is for pull or push application.

Example: T-3425110 Pull
This is a tubular solenoid; dia. — ¾"; length — 1½"; 25% intermittent duty, 110 VDC, and pull type.

If you require any special tubular solenoids other than those listed, please contact us for design assistance.

500 BROOKFOREST AVENUE, SHOREWOOD, ILLINOIS 60431 • PHONE (815) 725-2241

LIBERTY CONTROLS INC.

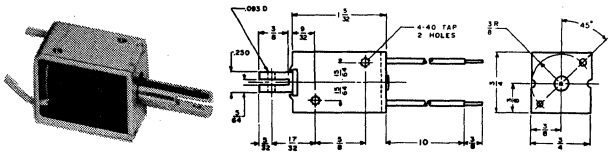
SOLID FRAME SOLENOIDS

Liberty Controls, Inc. has a complete line of solid frame solenoids which can be tailored to fit your needs. These shown below are the standard line which cover a variety of applications. Each of the below pull solenoids are complimented by a push type with similar characteristics. Plungers and plunger stops are made from a special steel annealed after all machining for maximum efficiency.

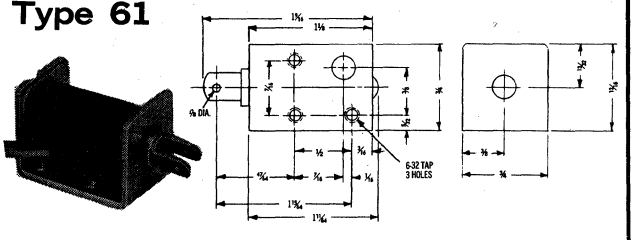
Continuous rated units should be used whenever possible. When the mechanical push/pull required exceeds the capabilities of a continuous rated coil, it is important to give us complete information regarding the intended duty cycle so that we may design and supply the best coil for your application. When one of these units will be energized for a period of four (4) minutes or longer, a continuous duty coil **must** be used. Where intermittent coils are to be used the per cent of "on time" is related to this four (4) minute period.

We have designed and built many **special solenoids** including push and pull, very large, and very small units. We are interested in looking at your special requirements.

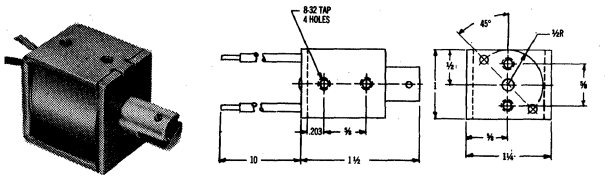
Type 60



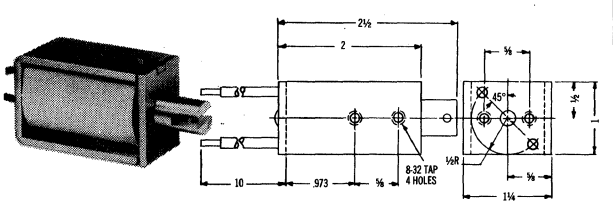
Type 61



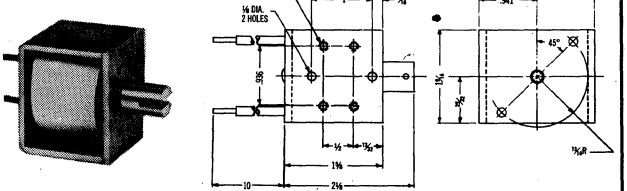
Type 81



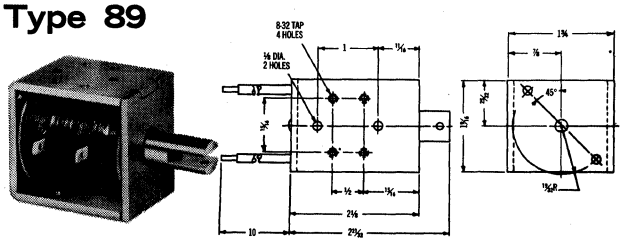
Type 82



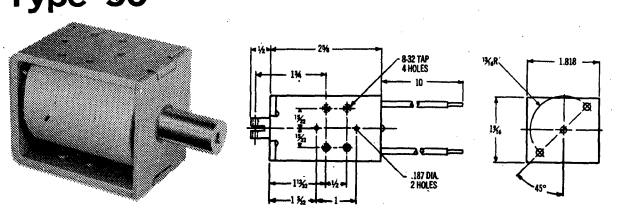
Type 88



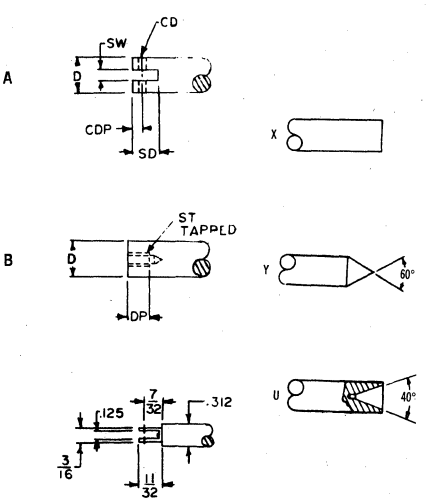
Type 89



Type 90



Plunger Details



DIMENSIONS (Refer to Drawings Above)

TYPE	A					B		
	D	SW	SD	CD	CDP	D	ST	DP
60	1/4"	5/64"	3/8"	3/32"	5/32"	1/4"	6-32	1/4"
81 & 82	7/16"	9/64"	3/8"	3/32"	5/32"	7/16"	10-32	1/4"
88, 89 & 90	1/2"	9/64"	3/8"	3/32"	5/32"	1/2"	10-32	1/4"

LIBERTY CONTROLS INC.

SOLID FRAME SOLENOIDS

PUSH/PULL CHARACTERISTICS OF SOLID FRAME SOLENOIDS

DISTANCE FROM STOP IN INCHES (PUSH/PULL IN OZ.)

TYPE	1/16"	1/8"	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"
CONTINUOUS DUTY									
AC 60	8	4	2	1	.5	—	—	—	—
61	8	6	4	3	2.5	—	—	—	—
81	6	4	2	1	—	—	—	—	—
82	20	6	3	2	1	—	—	—	—
88	17	14	9	4	3	—	—	—	—
89	16	8	6	5	5	5	—	—	—
90	14	7	4	3	3	2	2	2	—
DC 60	10	3	.5	—	—	—	—	—	—
61	7	2	1	—	—	—	—	—	—
81	6	4	2	1	—	—	—	—	—
82	30	20	10	6	4	2	2	—	—
88	96	40	14	7	3	—	—	—	—
89	80	40	12	4	2	1	—	—	—
90	110	64	27	12	6	3	2.	1	—
INTERMITTENT DUTY									
AC 60	12	6	3.5	2	1	—	—	—	—
61	16	11	8	6	5	—	—	—	—
81	20	16	8	4	2	—	—	—	—
82	33	21	12	9	7	6	4	—	—
88	54	40	24	16	12	—	—	—	—
89	58	40	28	24	20	20	—	—	—
90	50	40	24	18	17	17	17	17	17
DC 60	15	6	2	1.5	.5	—	—	—	—
61	20	12	9	7	6	—	—	—	—
81	27	18	10	5	3	—	—	—	—
82	67	48	32	20	11	6	3	—	—
88	190	140	70	40	20	10	—	—	—
89	184	140	100	60	40	26	16	—	—
90	190	140	96	65	45	30	20	—	—

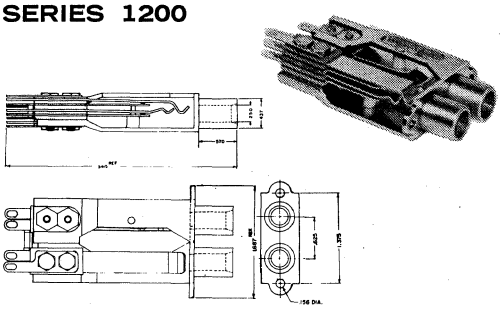
HOW TO ORDER

When ordering any of the above solid frame solenoids, the part number should be specified as follows:

TYPE	DUTY	VOLTAGE	PLUNGER Front	PLUNGER Back
60	C — Continuous	6VDC or AC	A	U
61	25 — 25%	12VDC or AC	B	X
81	Intermittent	24VDC or AC	C	Y
82	(% of "on time" compared to	48VDC or AC	D	
88	4 min. continuous duty cycle)	115VDC or AC	E	
89		230VDC or AC		
90				

TELEPHONE TWIN JACKS

SERIES 1200



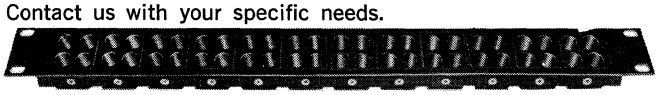
The twin jacks are assembled in a die cast frame for long life characteristics. Designs similar to the Western Electric No. 482A. It is arranged for a No. 338 or similar type jack plug.

Spring pile-up can be tailored to your specifications.

Available in both solder terminal and wire wrap terminals.

We also supply mounting strips for the twin jacks as shown. These can be tailored to fit your needs on 19" or 23" equipment racks providing 24 or 28 sets of twin jacks for equipment testing.

Contact us with your specific needs.



500 BROOKFOREST AVENUE, SHOREWOOD, ILLINOIS 60431 • PHONE (815) 725-2241

LIBERTY CONTROLS INC.

TELEPHONE TYPE RELAYS

Liberty Controls makes high quality telephone type relays for many special applications as indicated below. Contact materials of the finest quality are used to make any of the contact form arrangements. Special engineering is available for any type of telephone relay application.

Coil characteristics are tailored to meet your needs and are available as single wound, double wound, concentric wound, and high resistance wound. Copper slugs and sleeves can be used to meet your special operate and release timing needs.

Specially annealed heelpieces and armatures are used to give the most efficient magnetic properties available and bearing pins are used throughout our entire line of telephone relays.

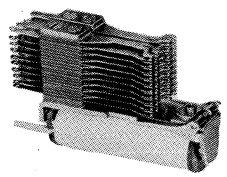
HOW TO ORDER TELEPHONE TYPE RELAYS

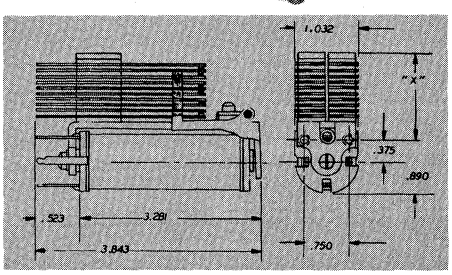
The following information should be provided when ordering telephone type relays:

TYPE	OPERATION	COIL VOLTAGE
B	QA — Quick Acting — Available on DC units only	6VDC or AC
C	SO — Slow Operate — Available on DC units only	12VDC or AC
F	SR — Slow Release — Available on DC units only	24VDC or AC
G		48VDC or AC
M	AC — Alternating Current in quick acting only	110VDC or AC
S		230VDC or AC

Specify pileup information as to contact forms (A, B, C, D, & E) and number of each.
Also indicate whether one or two pileups are required.

SERIES B RELAY

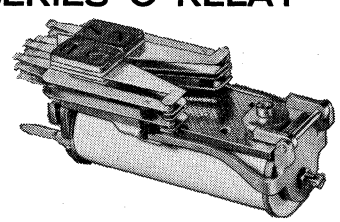


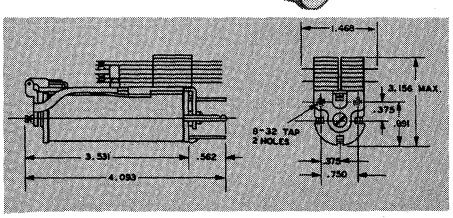


The Series B Telephone type relay is very similar to the Series C with the following exceptions. It is narrower than the "C" and is therefore better for applications where many relays are needed mounted close together. It also has bifurcated twin contacts which give a surer "make" contact. The Series B is the quality leader of the telephone type relays. This relay is ideal for computers, fire control, pulsing, or switching functions.

- **ELECTRICAL CHARACTERISTICS:**
  - **Contacts:** Bifurcated contacts standard but single contacts available. Specify the electrical characteristics you desire.
  - **Pileups:** Maximum of 20 springs in each pileup (one or two pileups)
  - **Operating Voltages:** Up to 230 V AC or DC
  - **Voltage Breakdown:** 1500 V RMS 60 Hz. (higher is required)
  - **Terminals:** Solder Type
  - **Mounting:** Heelpiece drilled and tapped for two 8-32 screws.
  - **Special:** Mounting hardware and cover are available. Can be provided as a socket plug-in relay. Also available hermetically sealed. See special applications.

SERIES C RELAY





The Series C Telephone type relay is recommended for applications which require rapid opening and closing of circuits. It is the most sensitive relay because of its length. It is available in the quick acting, slow operate, and slow release configurations, and thus can be designed to fit many applications. It is also available for AC application.

- **ELECTRICAL CHARACTERISTICS:**
  - **Contacts:** Many contact materials are available. Please specify your rating needs.
  - **Pileups:** Maximum of 20 springs in each pileup (one or two pileups) Micro-switch available.
  - **Operating Voltages:** CQA up to 230 VDC, CSO & CSR up to 135 VDC, CAC up to 220 VAC
  - **Voltage Breakdown:** 1500 V RMS 60 Hz (higher if required)
  - **Terminals:** Solder Type
  - **Mounting:** Heelpiece drilled and tapped for two 8-32 screws
  - **Special:** Mounting hardware and cover are available. Can be provided as a socket plug-in relay. Also available hermetically sealed. See special applications.

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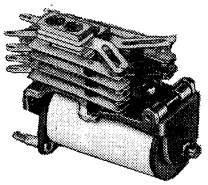
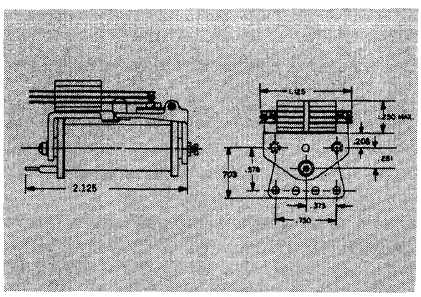
LIBERTY CONTROLS INC.

TELEPHONE TYPE RELAYS

SERIES G RELAY





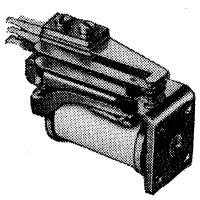
The Series G relay combines the best features of the conventional telephone type relay, such as, the Series C and the special advantages of extremely small size, lightweight, and unusual resistance to vibration.

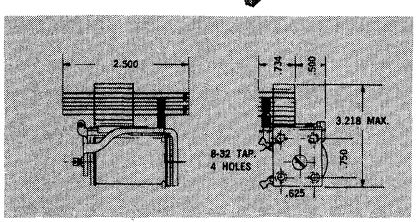
It has the same sturdy construction, large contact-spring capacity, sensitivity, and adaptability to a wide range of specifications that has made the Type "C" so popular.

It has the feature of independent twin contacts. The long flexible contact fingers of the bifurcated stationary springs allow the twin contacts to operate independently of each other. This assures that one will close even when the other is blocked by dirt or grit.

- **ELECTRICAL CHARACTERISTICS:**
  - **Contacts:** Standard contacts are bifurcated, but many materials are available to meet your specifications.
  - **Pileups:** Maximum of 20 springs in each pileup (one or two pileups)
  - **Operating Voltage:** GQA up to 150 VDC; GSO and GSR up to 110 VDC; GAC up to 220 VAC
  - **Terminals:** Solder Type, printed circuit type, or GQIN insertable terminals for socket mounting.
  - **Mounting:** Heelpiece drilled and tapped for two 6-32 screws.
  - **Special:** Available in 16 pin or 28 pin cover and socket arrangement. See special applications. Hermetically sealed relays also available.

SERIES M RELAY

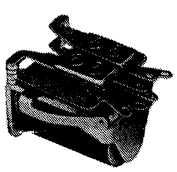


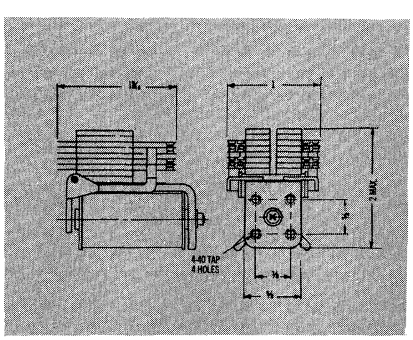


The Series M has all the features of the Type "C", except that is employs a shorter heelpiece and coil. The sensitivity of the M relay is not as great and the time delay is smaller when the coil is equipped with a copper slug.

- **ELECTRICAL CHARACTERISTICS:**
  - **Contacts:** Many contact materials are available. Please specify your rating needs.
  - **Pileup:** Maximum of 12 springs in pileup (single pileup only) Micro-switch available.
  - **Operating Voltage:** MQA up to 135 VDC; MSO and MSR up to 115 VDC; MAC up to 220 VAC
  - **Voltage Breakdown:** 1500 V RMS 60 Hz. (higher if required)
  - **Terminals:** Solder type.
  - **Mounting:** Heelpiece is drilled and tapped for four 8-32 screws.
  - **Special:** Hermetically sealed relays also available.

SERIES S RELAY





The Series S relay is ideally suited to aircraft and applications requiring high resistance to vibration, humidity, and temperature extremes.

- **ELECTRICAL CHARACTERISTICS:**
  - **Contacts:** Many contact materials available. Please specify your rating needs.
  - **Pileups:** Maximum of 6 springs in each pileup (one or two pileups)
  - **Operating Voltages:** Up to 150 VDC
  - **Voltage Breakdown:** 1500 V RMS 60 Hz. (higher if required)
  - **Terminals:** Solder Type
  - **Mounting:** Heelpiece drilled and tapped for four 4-40 screws
  - **Special:** Also available with oversized coil for greater sensitivity. Also available hermetically sealed. See special applications.

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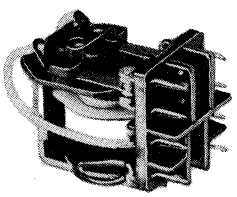
LIBERTY CONTROLS INC.

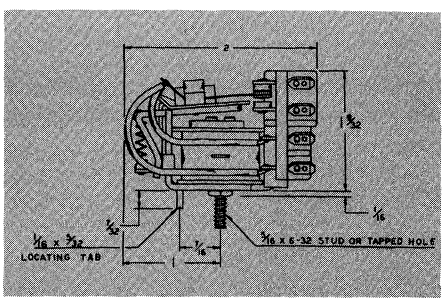
GENERAL PURPOSE TYPE RELAYS

Liberty Controls has an outstanding reputation for its line of General Purpose Relays. These relays perform dependably in many diverse applications including light to medium switching and plate circuit operations, in process controls and communication equipment. More recently many of these types of relays have been used as safety features on power equipment, such as, line monitoring for stray currents, discharging voltage on shutdown, and equipment shutdown through fault detection.

A wide variety of contact arrangements and ratings are available in our general purpose relay family. Minimum contact pressures of 25 grams are maintained on the smaller relays while the larger power relays perform at upwards of 200 grams contact pressure. Standard contacts are made of Silver Cadmium Oxide for low resistance qualities and then gold flashed to prevent corrosion and retard pitting which generally occurs with inductive loads.

SERIES 210 RELAY





- **ELECTRICAL CHARACTERISTICS:**

Contacts: Rated at 5 or 10 amps using silver cadmium oxide as standard. U/L approved.

Action: SPDT thru 3PDT.

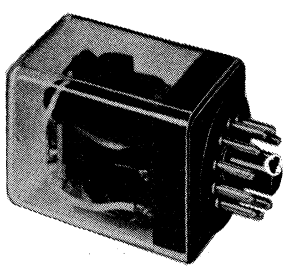
Operating Voltages: 6, 12, 24, 115, 230 VAC; 6, 12, 24, 110 VDC.

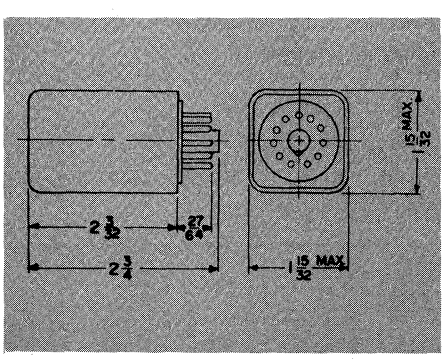
Terminals: Tab, solder, or printed circuit type.

Mounting: Frame drilled and tapped for one (1) 6-32 screw and locating tab. Optional with 5/16" x 6-32 stud and w/o locating tab.

Special: Available with SPST normally open or normally closed action. Also available as a manual reset or latching relay. Special plate circuit coils can be provided. See special applications.

SERIES 220 RELAY





- **ELECTRICAL CHARACTERISTICS:**

Contacts: Rated 5 or 10 amps using silver cadmium oxide - gold flashed as standard.

Action: SPDT thru 3PDT.

Operating Voltages: 6, 12, 24, 115, 230 VAC; 6, 12, 24, 110 VDC.

Terminals: Plug-in type for standard 8 or 11 pin socket.

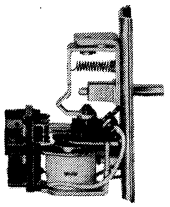
Mounting: In standard 8 or 11 pin socket.

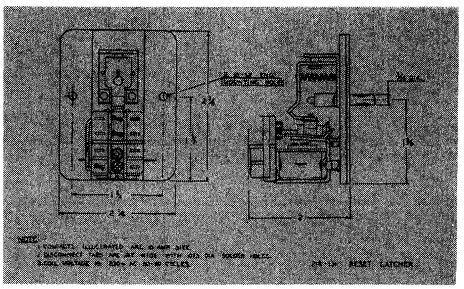
Special: Plate circuit coils available. This relay also available with printed circuit terminals and combination solder lug as 3/16" quick connect with cover. See special applications.

LIBERTY CONTROLS INC.

GENERAL PURPOSE TYPE RELAYS

SERIES 218 RELAY





The 218 manual reset relay is UL recognized and is uniquely adaptable to safety circuits.

It allows for electrical operation of the contact arrangement and then holds the operated position until manually released. Pulse to relay coil will set the relay and mechanically hold it in the operated position. Relay can be reset manually by a button on the front of the unit.

- **ELECTRICAL CHARACTERISTICS:**

Contacts: Rated at 5 or 10 amps using silver cadmium oxide as standard. UL recognized.

Action: SPDT thru 3PDT.

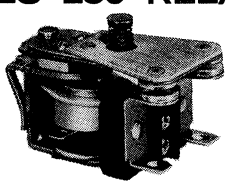
Operating Voltages: 6, 12, 24, 115, 230 VAC; 5, 6, 12, 24, 110 VDC.

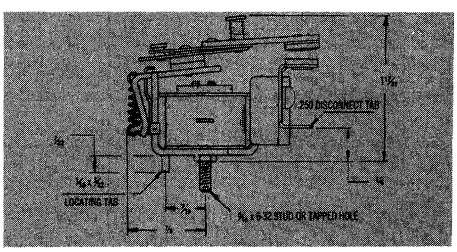
Terminals: Tab, solder, or printed circuit type.

Mounting: Mounted with two (2) 10-32 screws through base plate as shown in line drawing. Modify for front mounting.

Special: Available with single throw normally open or normally closed action. Special plate circuit coils available.

SERIES 250 RELAY





- **ELECTRICAL CHARACTERISTICS:**

Contacts: Rated at 25 amps @ 120-240 VAC resistive and 1 HP @ 120-240 VAC

Action: SPST Normally open, double break

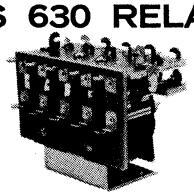
Operating Voltages: 6, 12, 24, 115, 230 VAC; 6, 12, 24, 110 VDC

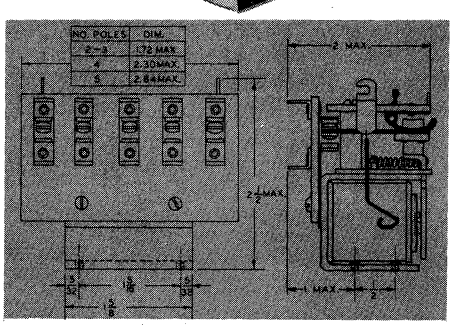
Terminals: ¼" quick connect for contacts, 3/16" quick connect for coil.

Mounting: Frame drilled and tapped for one (1) 6-32 screw and locating tab. Optional with 5/16" x 6-32 stud and w/o locating tab.

Special: Available with 5 amps SPDT auxiliary switch.

SERIES 630 RELAY





- **ELECTRICAL CHARACTERISTICS:**

Contacts: Rated at 15 amps. 120V 60 Hz. resistive using gold plated silver contacts as standard.

Action: DPDT thru 5PDT

Operating Voltages: 6, 12, 24, 48, 115, 230 VAC; 5, 6, 12, 24, 48, 110 VDC

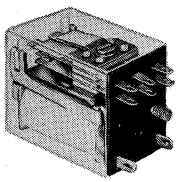
Terminals: Solder or screw type

Mounting: Frame drilled and tapped for four (4) 6-32 screws

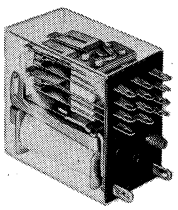
Special: Available in ST normally open or normally closed action. Also provided in 8, 12, & 18 pin Jones Plug or 8, 12, and 20 pin octal type plug.

Magnecraft® *miniature industrial relays*

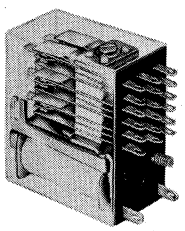
class 67 miniature industrial relays DPDT — 4PDT — 6PDT — 8PDT / enclosed plug-in relays 3 or 5 amp contacts



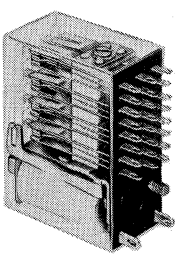
2 FORM C
1.188" x .938" x .734"



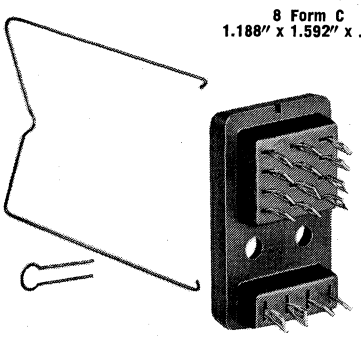
4 Form C
1.188" x 1.156" x .734"



6 Form C
1.188" x 1.375" x .734"



8 Form C
1.188" x 1.592" x .734"



MOUNTING HARDWARE
.745" x L

Magnecraft VersaPac Class 67 Miniature Industrial Relays are designed for applications requiring 2 to 8 form C contacts where space, weight and low cost are of prime importance. Ideal for use in business machines, communication equipment, vending machines and all applications requiring long life and reliable performance.

Single and bifurcated, crossbar contacts of silver alloy gold flashed rated 3 or 5 amps at 28 VDC or 115 VAC resistive load. All Class 67 relays feature plastic dust covers and combination solder/plug-in terminals (sockets listed below) with 3-48 NC stud. Voltage specified versions operate at 75% of nominal coil voltage or less with a coil dissipation of 1.8 watts max.

Sensitive versions are also available in 2 or 4 form C contacts rated 3 amps at 28 VDC or 115 VAC resistive load.

IN STOCK FOR IMMEDIATE DELIVERY

STANDARD ADJUSTMENT 2 FORM C

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-1	3 Amps	6	52	3.30
W67CSX-2		12	185	3.30
W67CSX-3		24	700	3.30
W67CSX-4		48	2,500	3.30
W67CSX-5		115	15,000	5.00
W67RCSX-1	5 Amps	6	52	3.40
W67RCSX-2		12	185	3.40
W67RCSX-3		24	700	3.40
W67RCSX-4		48	2,500	3.40
W67RCSX-5		115	15,000	5.10
W67TCSX-1	3* Amps	6	52	3.50
W67TCSX-2		12	185	3.50
W67TCSX-3		24	700	3.50
W67TCSX-4		48	2,500	3.50
W67TCSX-5		115	15,000	5.20
W67TRCSX-1	5* Amps	6	52	3.50
W67TRCSX-2		12	185	3.50
W67TRCSX-3		24	700	3.50
W67TRCSX-4		48	2,500	3.50
W67TRCSX-5		115	15,000	5.20

* Denotes Bifurcated Contacts.

STANDARD ADJUSTMENT 4 FORM C

Stock Part No.	Contact Rating	Coil Volts	Coil Ohms	Prices 1-24
W67CSX-6	3 Amps	6	52	3.65
W67CSX-7		12	185	3.65
W67CSX-8		24	700	3.65
W67CSX-9		48	2,500	3.65
W67CSX-10		115	15,000	5.35
W67RCSX-6	5 Amps	6	52	3.90
W67RCSX-7		12	185	3.90
W67RCSX-8		24	700	3.90
W67RCSX-9		48	2,500	3.90
W67RCSX-10		115	15,000	5.60
W67TCSX-6	3* Amps	6	52	4.05
W67TCSX-7		12	185	4.05
W67TCSX-8		24	700	4.05
W67TCSX-9		48	2,500	4.05
W67TCSX-10		115	15,000	5.75
W67TRCSX-6	5* Amps	6	52	4.05
W67TRCSX-7		12	185	4.05
W67TRCSX-8		24	700	4.05
W67TRCSX-9		48	2,500	4.05
W67TRCSX-10		115	15,000	5.75

* Denotes Bifurcated Contacts.

STANDARD ADJUSTMENT 6 FORM C

W67CSX-11	3 Amps	6	25	4.70
W67CSX-12		12	90	4.70
W67CSX-13		24	420	4.70
W67CSX-14		48	1,550	4.70
W67CSX-15		115	9,000	5.60
W67RCSX-11	5 Amps	6	25	5.10
W67RCSX-12		12	90	5.10
W67RCSX-13		24	430	5.10
W67RCSX-14		48	1,550	5.10
W67RCSX-15		115	9,000	6.00
W67TCSX-11	3* Amps	6	25	5.35
W67TCSX-12		12	90	5.35
W67TCSX-13		24	430	5.35
W67TCSX-14		48	1,550	5.35
W67TCSX-15		115	9,000	6.25
W67TRCSX-11	5* Amps	6	25	5.50
W67TRCSX-12		12	90	5.50
W67TRCSX-13		24	430	5.50
W67TRCSX-14		48	1,550	5.50
W67TRCSX-15		115	9,000	6.40

* Denotes Bifurcated Contacts.

STANDARD ADJUSTMENT 8 FORM C

W67CSX-16	3 Amps	6	20	7.30
W67CSX-17		12	72	7.30
W67CSX-18		24	350	7.30
W67CSX-19		48	1,250	7.30
W67CSX-20		115	8,000	8.20
W67RCSX-16	5 Amps	6	20	7.70
W67RCSX-17		12	72	7.70
W67RCSX-18		24	350	7.70
W67RCSX-19		48	1,250	7.70
W67RCSX-20		115	8,000	8.60
W67TCSX-16	3* Amps	6	20	8.05
W67TCSX-17		12	72	8.05
W67TCSX-18		24	350	8.05
W67TCSX-19		48	1,250	8.05
W67TCSX-20		115	8,000	8.95
W67TRCSX-16	5* Amps	6	20	8.25
W67TRCSX-17		12	72	8.25
W67TRCSX-18		24	350	8.25
W67TRCSX-19		48	1,250	8.25
W67TRCSX-20		115	8,000	9.15

* Denotes Bifurcated Contacts.

SENSITIVE ADJUSTMENT

Stock Part No.	2 Amp Contacts	Coil Current	Coil Ohms	Prices 1-24
W67SCSX-1	DPDT	8.5 MA	1,000	3.60
W67SCSX-2		5.8 MA	2,500	3.60
W67SCSX-3		4.1 MA	5,000	4.10
W67SCSX-4		3.1 MA	10,000	4.50
W67SCSX-5		2.6 MA	15,000	4.80
W67SCSX-6	4PDT	13.0 MA	1,000	4.00
W67SCSX-7		8.4 MA	2,500	4.00
W67SCSX-8		6.2 MA	5,000	4.50
W67SCSX-9		4.2 MA	10,000	4.90
W67SCSX-10		3.5 MA	15,000	5.20

SOCKETS AND MOUNTING HARDWARE

Stock Part No.	Description	Dim. "L"	Prices 1-24
70-303	2 Pole Solder Terminal	.970	.55
70-304	2 Pole PC Terminal	.970	.55
70-305	4 Pole Solder Terminal	1.188	.70
70-306	4 Pole PC Terminal	1.188	.70
70-307	6 Pole Solder Terminal	1.406	.95
70-308	6 Pole PC Terminal	1.406	.95
70-309	8 Pole Solder Terminal	1.625	1.72
70-310	8 Pole PC Terminal	1.625	1.72

CLASS 77CS

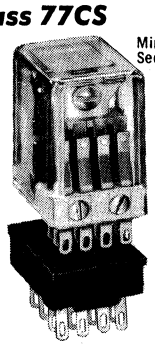
77CS Socket Terminal					
W77CSX-1‡	4PDT 5 Amps	6VDC	40	1.0W	5.30
W77CSX-2‡		12VDC	160		5.30
W77CSX-3‡		24VDC	600		5.40
W77CSX-4‡		48VDC	2500		5.55
W77CSX-5‡		110VDC	10000		5.97
W77ACSX-1‡		115VAC	—	3VA	5.96

CLASS 77PC

Stock Part No.**	†Nom. Coil Volt.	*Coil Ohms	Prices 1-9
W77PCX-12	6VDC	40	5.60
W77PCX-13	12VDC	160	5.60
W77PCX-14	24VDC	600	5.69
W77PCX-15	48VDC	2500	5.84
W77PCX-16	110VDC	10000	6.25

** Do not order this part no. when socket is required.
‡ When relays are required to plug into sockets 70-161-1, 70-161-3, order from this table only. Sockets ordered separately.
* Resistance Values ±10% at 25VDC.
† Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.

class 77CS

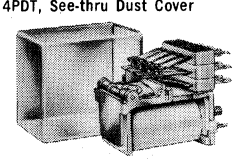


Miniature 5 amp 4PDT
See-thru Dust Cover and Sockets

- Size: 55/64" x 1 7/64" x 1 9/32"
- 70-161-1 solder terminal socket with retainer .58¢.
- 70-161-3 printed circuit terminal socket .58¢.

class 77PC

Miniature Printed Circuit Mtg.
5 amp 4PDT, See-thru Dust Cover



- Size: 55/64" x 1 7/64" x 1 9/32"
- Telephone type relays having greater contact forces, precision hinge-pin armature and unitized design assuring stabilized operation over very long life. Printed circuit type is assembled directly to P.C. board. Solder type can be soldered to directly, or used with either solder or P.C. socket.

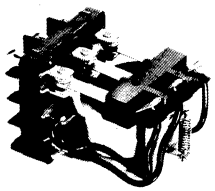
Magnecraft® general purpose relays

IN STOCK FOR IMMEDIATE DELIVERY

class 388 — open type

SPDT, DPDT, 3PDT — 10 Amps
AC or DC operation

- Small Size: 2 1/64 x 1 29/64 x 1 9/32".
- Silver Alloy, gold flashed contacts; rated 10 Amps at 115 VAC or 28 VDC resistive load.
- Three way terminals: Plug-in; Solder; Quick connect.
- Easy Mounting: One #6-32 tapped mounting hole with locating boss.
- Weight: 2.3 oz. approx.



U/L RECOGNIZED
(File No. E55458)

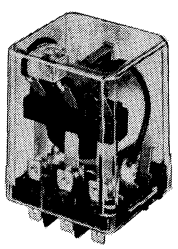
Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9	Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9
AC VOLTAGE SPECIFIED						**DC VOLTAGE SPECIFIED**					
W388AX-1	SPDT	6VAC	—	2.5VA Prox.	3.60	W388X-1	SPDT	6VDC	32	1.2W	3.45
W388AX-2		12VAC	—		3.60	W388X-2		12VDC	120		3.45
W388AX-3		24VAC	—		3.60	W388X-3		24VDC	470		3.45
W388AX-4		120VAC	—		3.60	W388X-4		110VDC	10000		4.10
W388AX-5		240VAC	—		4.05						
W388AX-6	DPDT	6VAC	—	2.5VA Prox.	4.50	W388X-5	DPDT	6VDC	32	1.2W	4.00
W388AX-7		12VAC	—		4.50	W388X-6		12VDC	120		4.00
W388AX-8		24VAC	—		4.50	W388X-7		24VDC	470		4.00
W388AX-9		120VAC	—		4.50	W388X-8		110VDC	10000		4.70
W388AX-10		240VAC	—		4.95						
W388AX-11	3PDT	6VAC	—	2.5VA Prox.	5.10	W388-9	3PDT	6VDC	32	1.2W	4.65
W388AX-12		12VAC	—		5.10	W388-10		12VDC	120		4.65
W388AX-13		24VAC	—		5.10	W388-11		24VDC	470		4.65
W388AX-14		120VAC	—		5.10	W388-12		110VAC	10000		5.10
W388AX-15		240VAC	—		5.55						

*Resistance values ±10% at 25°C
†Voltage specified relays pull in at 75% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.

class 388CP — plug-in

SPDT, DPDT, 3PDT — 10 Amps
AC or DC Operation
Crackproof, see through plastic dust cover.

- Sizes: 2 3/16 x 1 17/32 x 1 13/32.
- Silver Alloy, gold flashed contacts; rated 10 Amps at 115 VAC or 28 VDC resistive load.
- Easy plug-in mounting.
- Weight: 3 oz. approx.



U/L RECOGNIZED
(File No. E55458)

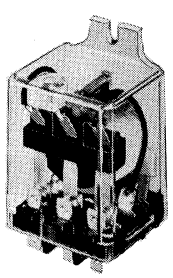
Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9	Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9
AC VOLTAGE SPECIFIED						**DC VOLTAGE SPECIFIED**					
W388ACPX-1	SPDT	6VAC	—	2.5VA Prox.	3.85	W388CPX-1	SPDT	6VDC	32	1.2W	3.70
W388ACPX-2		12VAC	—		3.85	W388CPX-2		12VDC	120		3.70
W388ACPX-3		24VAC	—		3.85	W388CPX-3		24VDC	470		3.70
W388ACPX-4		120VAC	—		3.85	W388CPX-4		110VDC	10000		4.35
W388ACPX-5		240VAC	—		4.30						
W388ACPX-6	DPDT	6VAC	—	2.5VA Prox.	4.75	W388CPX-5	DPDT	6VDC	32	1.2W	4.25
W388ACPX-7		12VAC	—		4.75	W388CPX-6		12VDC	120		4.25
W388ACPX-8		24VAC	—		4.75	W388CPX-7		24VDC	470		4.25
W388ACPX-9		120VAC	—		4.75	W388CPX-8		110VDC	10000		4.95
W388ACPX-10		240VAC	—		5.20						
W388ACPX-11	3PDT	6VAC	—	2.5VA Prox.	5.35	W388CPX-9	3PDT	6VDC	32	1.2W	4.90
W388ACPX-12		12VAC	—		5.35	W388CPX-10		12VDC	120		4.90
W388ACPX-13		24VAC	—		5.35	W388CPX-11		24VDC	470		4.90
W388ACPX-14		120VAC	—		5.35	W388CPX-12		110VAC	10000		5.35
W388ACPX-15		240VAC	—		5.80						

*Resistance values ±10% at 25°C
†Voltage specified relays pull in at 75% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.

class 388CQ—flange mount

SPDT, DPDT, 3PDT — 10 Amps
AC or DC Operation
Crackproof, see through plastic dust cover.

- Size: 2 29/32 x 1 17/32 x 1 13/32
- Silver alloy, gold flashed contacts; rated 10 Amps at 115 VAC or 28 VDC resistive load.
- Easy flange mount.
- Weight: 3 oz. approx.

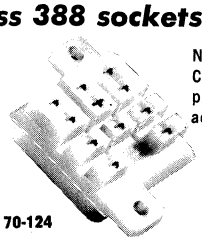


U/L RECOGNIZED
(File No. E55458)

Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9	Stock Part No.	Contacts 10A	COIL Volts†	COIL Ohms*	Nominal Power	Prices 1-9
AC VOLTAGE SPECIFIED						**DC VOLTAGE SPECIFIED**					
W388ACQX-1	SPDT	6VAC	—	2.5VA Prox.	3.85	W388CQX-1	SPDT	6VDC	32	1.2W	3.70
W388ACQX-2		12VAC	—		3.85	W388CQX-2		12VDC	120		3.70
W388ACQX-3		24VAC	—		3.85	W388CQX-3		24VDC	470		3.70
W388ACQX-4		120VAC	—		3.85	W388CQX-4		110VDC	10000		4.35
W388ACQX-5		240VAC	—		4.30						
W388ACQX-6	DPDT	6VAC	—	2.5VA Prox.	4.75	W388CQX-5	DPDT	6VDC	32	1.2W	4.25
W388ACQX-7		12VAC	—		4.75	W388CQX-6		12VDC	120		4.25
W388ACQX-8		24VAC	—		4.75	W388CQX-7		24VDC	470		4.25
W388ACQX-9		120VAC	—		4.75	W388CQX-8		110VDC	10000		4.95
W388ACQX-10		240VAC	—		5.20						
W388ACQX-11	3PDT	6VAC	—	2.5VA Prox.	5.35	W388CQX-9	3PDT	6VDC	32	1.2W	4.90
W388ACQX-12		12VAC	—		5.35	W388CQX-10		12VDC	120		4.90
W388ACQX-13		24VAC	—		5.35	W388CQX-11		24VDC	470		4.90
W388ACQX-14		120VAC	—		5.35	W388CQX-12		110VAC	10000		5.35
W388ACQX-15		240VAC	—		5.80						

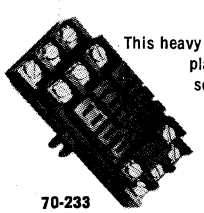
*Resistance values ±10% at 25°C
†Voltage specified relays pull in at 75% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.

class 388 sockets



70-124

Nylon sockets rated at 10 Amps. Choice of solder, quick-connect, or printed circuit terminals. Will accept all class 388 type relays.



70-233

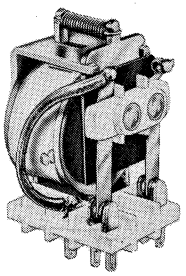
This heavy duty molded thermo plastic screw terminal socket is rated for 10 Amps. Closed back construction requires no insulation.

Stock Part No.	Type	Prices 1-9
70-124-1	Solder Terminal	.80
70-124-2	Quick-Connect	.90
70-178-1	Printed Circuit	.90
70-233	11 pin screw terminal	3.50

Magnecraft® general purpose relays

class 588 / open type relays / SPDT — DPDT — 3PDT / 5 or 10 amps / ac or dc operation

U/L RECOGNIZED



1 49/64" x 1 1/64" x 1 1/64"

IN STOCK FOR IMMEDIATE DELIVERY

Class 588 low cost UL recognized continuous duty general purpose relays. Engineered for maximum efficiency and reliable performance at lowest cost. These relays are ideal for use in test equipment, business machines, automation and communication equipment and all applications requiring a multi-pole general purpose relay. Contacts are silver alloy, gold flashed rated 5 or 10 amps at 28 VDC or 115 VAC resistive load.

Open types have axial type solder lugs for easy wiring. Single 6-32 tapped mounting hole with locating boss for ease of mounting.

Voltage specified relays operate at 75% of nominal coil power (1.2 watts or less for DC versions and 85% of nominal coil power (2 VA) for AC versions.

DC Voltage Specified

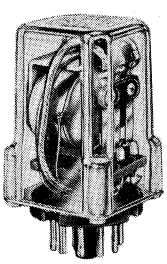
Stock Part No.	Contacts	Coil Volts	Coil Ohms	Prices 1-24
W588X-1	5 Amp SPDT	6 VDC	30	3.40
W588X-2		12 VDC	120	3.40
W588X-3		24 VDC	480	3.40
W588X-4		110 VDC	10,080	4.00
W588X-5	5 Amp DPDT	6 VDC	30	3.85
W588X-6		12 VDC	120	3.85
W588X-7		24 VDC	480	3.85
W588X-8		110 VDC	10,080	4.55
W588X-9	5 Amp 3PDT	6 VDC	30	4.40
W588X-10		12 VDC	120	4.40
W588X-11		24 VDC	480	4.40
W588X-12		110 VDC	10,080	4.90
W588X-13	10 Amp SPDT	6 VDC	30	3.45
W588X-14		12 VDC	120	3.45
W588X-15		24 VDC	480	3.45
W588X-16		110 VDC	10,080	4.05
W588X-17	10 Amp DPDT	6 VDC	30	3.90
W588X-18		12 VDC	120	3.90
W588X-19		24 VDC	480	3.90
W588X-20		110 VDC	10,080	4.60
W588X-21	10 Amp 3PDT	6 VDC	30	4.50
W588X-22		12 VDC	120	4.50
W588X-23		24 VDC	480	4.50
W588X-24		110 VDC	10,080	5.00

AC Voltage Specified

Stock Part No.	Contacts	Coil Volts	Coil Ohms	Prices 1-24
W588AX-1	5 Amp SPDT	6 VAC	6	3.50
W588AX-2		12 VAC	24	3.50
W588AX-3		24 VAC	96	3.50
W588AX-4		115 VAC	2,200	3.50
W588AX-5	5 Amp DPDT	6 VAC	6	4.35
W588AX-6		12 VAC	24	4.35
W588AX-7		24 VAC	96	4.35
W588AX-8		115 VAC	2,200	4.35
W588AX-9	5 Amp 3PDT	6 VAC	6	4.85
W588AX-10		12 VAC	24	4.85
W588AX-11		24 VAC	96	4.85
W588AX-12		115 VAC	2,200	4.85
W588AX-13	10 Amp SPDT	6 VAC	6	3.55
W588AX-14		12 VAC	24	3.55
W588AX-15		24 VAC	96	3.55
W588AX-16		115 VAC	2,200	3.55
W588AX-17	10 Amp DPDT	6 VAC	6	4.40
W588AX-18		12 VAC	24	4.40
W588AX-19		24 VAC	96	4.40
W588AX-20		115 VAC	2,200	4.40
W588AX-21	10 Amp 3PDT	6 VAC	6	5.00
W588AX-22		12 VAC	24	5.00
W588AX-23		24 VAC	96	5.00
W588AX-24		115 VAC	2,200	5.00

class 588CP / enclosed plug-in relays / SPDT — DPDT — 3PDT / 5 or 10 amps

U/L RECOGNIZED



2 1/8" x 1 13/32" x 1 13/32

IN STOCK FOR IMMEDIATE DELIVERY

Class 588CP low cost UL recognized continuous duty general purpose relays are similar to types shown above but utilize plastic dust cover and plug-in base. SPDT and DPDT contacts have 8-pin octal plug-in bases while the 3PDT types use 11-pin plug-in bases. Voltage specified relays operate at 75% of nominal coil power (1.2 watts or less for DC versions and 85% of nominal coil power (2 VA) for AC versions.

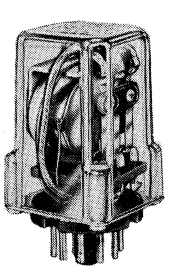
(U.L. RATED TO 8.5 AMP)
DC Voltage Specified

Stock Part No.	Contacts	Coil Volts	Coil Ohms	Prices 1-24
W588CPX-1	5 Amp SPDT	6 VDC	30	6.00
W588CPX-2		12 VDC	120	6.00
W588CPX-3		24 VDC	480	6.00
W588CPX-4		110 VDC	10,080	6.60
W588CPX-5	5 Amp DPDT	6 VDC	30	6.60
W588CPX-6		12 VDC	120	6.60
W588CPX-7		24 VDC	480	6.60
W588CPX-8		110 VDC	10,080	7.25
W588CPX-9	5 Amp 3PDT	6 VDC	30	8.30
W588CPX-10		12 VDC	120	8.30
W588CPX-11		24 VDC	480	8.30
W588CPX-12		110 VDC	10,080	8.90
W588CPX-13	10 Amp SPDT	6 VDC	30	6.10
W588CPX-14		12 VDC	120	6.10
W588CPX-15		24 VDC	480	6.10
W588CPX-16		110 VDC	10,080	6.70
W588CPX-17	10 Amp DPDT	6 VDC	30	6.70
W588CPX-18		12 VDC	120	6.70
W588CPX-19		24 VDC	480	6.70
W588CPX-20		110 VDC	10,080	7.35
W588CPX-21	10 Amp 3PDT	6 VDC	30	8.40
W588CPX-22		12 VDC	120	8.40
W588CPX-23		24 VDC	480	8.40
W588CPX-24		110 VDC	10,080	9.00

AC Voltage Specified

Stock Part No.	Contacts	Coil Volts	Coil Ohms	Prices 1-24
W588ACPX-1	5 Amp SPDT	6 VAC	6	6.20
W588ACPX-2		12 VAC	24	6.20
W588ACPX-3		24 VAC	96	6.20
W588ACPX-4		115 VAC	2,200	6.20
W588ACPX-5	5 Amp DPDT	6 VAC	6	6.95
W588ACPX-6		12 VAC	24	6.95
W588ACPX-7		24 VAC	96	6.95
W588ACPX-8		115 VAC	2,200	6.95
W588ACPX-9	5 Amp 3PDT	6 VAC	6	8.55
W588ACPX-10		12 VAC	24	8.55
W588ACPX-11		24 VAC	96	8.55
W588ACPX-12		115 VAC	2,200	8.55
W588ACPX-13	10 Amp SPDT	6 VAC	6	6.30
W588ACPX-14		12 VAC	24	6.30
W588ACPX-15		24 VAC	96	6.30
W588ACPX-16		115 VAC	2,200	6.30
W588ACPX-17	10 Amp DPDT	6 VAC	6	7.05
W588ACPX-18		12 VAC	24	7.05
W588ACPX-19		24 VAC	96	7.05
W588ACPX-20		115 VAC	2,200	7.05
W588ACPX-21	10 Amp 3PDT	6 VAC	6	8.65
W588ACPX-22		12 VAC	24	8.65
W588ACPX-23		24 VAC	96	8.65
W588ACPX-24		115 VAC	2,200	8.65

class 488CP / current operated enclosed plug-in relays



2 1/8" x 1 13/32" x 1 13/32

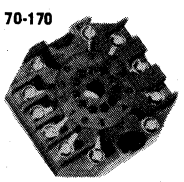
Class 488CP is a plate circuit current operated general purpose relay having extremely good sensitivity. Enclosed in dust cover with either an 8-pin or 11-pin plug-in base. Nominal power of 125 milliwatts per single pole is required.
Available with SPDT, DPDT, or 3PDT silver alloy, gold flashed contacts rated 5 amps at 28 VDC or 115 VAC resistive load.

Stock Part No.	5 Amp Contacts	Coil Current	Coil Ohms	Prices 1-24
W488CPX-19	SPDT	7.2 MA	2,500	6.90
W488CPX-20	SPDT	5.0 MA	5,000	7.00
W488CPX-21	SPDT	3.6 MA	10,000	7.45
W488CPX-22	DPDT	10.0 MA	2,500	7.35
W488CPX-23	DPDT	7.2 MA	5,000	7.45
W488CPX-24	DPDT	5.0 MA	10,000	7.90
W488CPX-25	3PDT	12.3 MA	2,500	9.05
W488CPX-26	3PDT	8.7 MA	5,000	9.15
W488CPX-27	3PDT	6.1 MA	10,000	9.60

industrial screw terminal sockets

70-169

70-170



These heavy duty molded thermo plastic screw terminal sockets are rated at 10 amperes. Closed back construction requires no insulation.

Part No.	Type	List Price
70-170	Screw Terminal 11 pin Octal	3.50
70-169	Screw Terminal 8 pin Octal	1.75

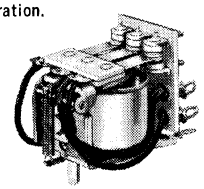
IN STOCK FOR IMMEDIATE DELIVERY

Magnecraft® general purpose relays

IN STOCK FOR IMMEDIATE DELIVERY

class 88 open type

SPDT, DPDT, 3PDT — 10 amps.
AC or DC operation.

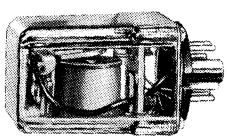


- Small Size: 1 13/16" x 1 3/16" x 1 1/4"
- Silver alloy, gold-flashed, contacts rated at 10 amps at 115 VAC or 28 VDC resistive load.
- Solder terminals for easy wiring.
- Easy mounting: One #6-32 tapped mounting hole with locating boss.
- Rugged hinge-pin armature for long life and stability of operation.
- Weight: 2 oz. approx.

Stock Part No.	Contacts 10 Amps.	COIL †Volt or ††Curr.	COIL *Res. Ohms	Nominal Power	Prices 1-9
AC Voltage Specified					
W88AX-1	SPDT	6VAC	—	3 VA	4.02
W88AX-2		12VAC	—		4.02
W88AX-3		24VAC	—		4.02
W88AX-4		115VAC	—		4.02
W88AX-34		230VAC	—		4.54
W88AX-5	DPDT	6VAC	—	3 VA	4.70
W88AX-6		12VAC	—		4.70
W88AX-7		24VAC	—		4.70
W88AX-8		115VAC	—		4.70
W88AX-32		230VAC	—		5.22
W88AX-9	3PDT	6VAC	—	3 VA	5.24
W88AX-10		12VAC	—		5.24
W88AX-11		24VAC	—		5.24
W88AX-12		115VAC	—		5.24
W88AX-36		230VAC	—		5.78
DC Voltage Specified					
W88X-2	SPDT	6VDC	25	1.5W	3.60
W88X-3		12VDC	100		3.60
W88X-4		24VDC	400		3.60
W88X-5	SPDT	110VDC	8000	1.5W	4.24
W88X-6	DPDT	6VDC	25	1.5W	4.16
W88X-7		12VDC	100		4.16
W88X-8		24VDC	400		4.16
W88X-9		110VDC	8000		4.80
W88X-10	3PDT	6VDC	25	1.5W	4.64
W88X-11		12VDC	100		4.64
W88X-12		24VDC	400		4.64
W88X-13		110VDC	8000		5.24
DC Current Specified For Electronic Operation					
W88X-14	SPDT	7.2 MA	2500	125MW	4.12
W88X-15		5.0 MA	5000		4.22
W88X-16		3.6 MA	10000		4.68
W88X-17	DPDT	10 MA	2500	250MW	4.42
W88X-18		7.2 MA	5000		4.52
W88X-19		5.0 MA	10000		4.96
W88X-20	3PDT	12.3 MA	2500	375MW	4.88
W88X-21		8.7 MA	5000		5.00
W88X-22		6.1 MA	10000		5.44

class 88CP plug in

AC or DC operation.
Crackproof, see through plastic dust cover.
SPDT, DPDT, 3PDT — 10 amps.



- Size: 1 3/8" x 1 3/8" x 2 1/16" above socket.
- Silver alloy, gold-flashed, contacts rated 10 amps at 115 volts AC or 28 volts DC, resistive load.
- Furnished with 8 or 11 pin std. octal plug.
- Rugged hinge-pin armature for long life and stability of operation.
- Weight: 3 oz. approx.

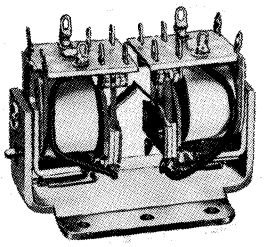
Stock Part No.	Contacts 10 Amps.	COIL †Volt or Crnt.	COIL *Res. Ohms	COIL Nominal Pwr.	Plug	Prices 1-9
AC Voltage Specified						
W88ACPX-1	SPDT	6VAC	—	3 VA	8-pin	6.48
W88ACPX-2		12VAC	—			6.48
W88ACPX-3		24VAC	—			6.48
W88ACPX-4		115VAC	—			6.48
W88ACPX-76		230VAC	—			7.29
W88ACPX-5	DPDT	6VAC	—	3 VA	8-pin	7.26
W88ACPX-6		12VAC	—			7.26
W88ACPX-7		24VAC	—			7.26
W88ACPX-8		115VAC	—			7.26
W88ACPX-32		230VAC	—			8.07
W88ACPX-9	3PDT	6VAC	—	3 VA	11-pin	9.02
W88ACPX-10		12VAC	—			9.02
W88ACPX-11		24VAC	—			9.02
W88ACPX-12		115VAC	—			9.02
W88ACPX-39		230VAC	—			9.83
DC Voltage Specified						
W88CPX-1	SPDT	6VDC	25	1.5W	8-pin	6.24
W88CPX-2		12VDC	100			6.24
W88CPX-3		24VDC	400			6.24
W88CPX-4	SPDT	110VDC	8000	1.5W	8-pin	6.88
W88CPX-5	DPDT	6VDC	25	1.5W	8-pin	6.88
W88CPX-6		12VDC	100			6.88
W88CPX-7		24VDC	400			6.88
W88CPX-8		110VDC	8000			7.52
W88CPX-9	3PDT	6VDC	25	1.5W	11-pin	8.53
W88CPX-10		12VDC	100			8.53
W88CPX-11		24VDC	400			8.53
W88CPX-12		110VDC	8000			9.19
DC Current Specified for Electronic Operation						
W88CPX-13	SPDT	7.2MA	2500	125MW	8-pin	6.81
W88CPX-14		5.0MA	5000			6.93
W88CPX-15		3.6MA	10000			7.39
W88CPX-16	DPDT	10MA	2500	250MW	8-pin	7.28
W88CPX-17		7.2MA	5000			7.39
W88CPX-18		5.0MA	10000			7.85
W88CPX-19	3PDT	12.3MA	2500	375MW	11-pin	8.89
W88CPX-20		8.7MA	5000			9.01
W88CPX-21		6.1MA	10000			9.47

Stronger magnetic system designed for intermittant actuation.

class 88L latching relay

AC or DC operation — 4PDT and 6PDT — 10 amps.

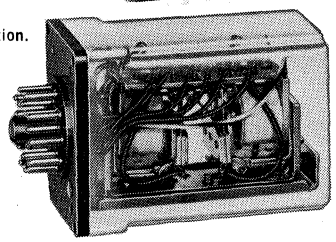
- Size: 3" x 1 3/4" x 1 15/16"
- Combination of two Class 88 Relays with interlocking latch-in levers mounted on a common base.
- Each armature latches when pulled in. Energizing one armature releases or resets the other.
- Silver alloy, gold-flashed, contacts rated 10 amps at 115 volts AC or 28 VDC resistive load.
- Easy mounting with clearance holes for six #6-32 screws.
- Rugged hinge pin armature for long life and stability of operation.
- Weight: 6½ oz. approx.



class 88LCP enclosed plug-in latching relays — 4 PDT 10 amp

AC or DC operation.

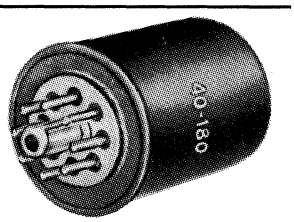
- Size: 2 3/8" x 1 3/4" x 3 3/16" above socket
- Enclosure: Crackproof, see-through plastic dust cover.
- Mounting: 20-pin octal style plug mates with std. amphenol 77-MIP-20 socket.
- Weight: 8 oz. approx.



class 88HP hermetically sealed plug-in relay

AC or DC operation — DPDT or 3PDT — 10 amps.

- Size: 1 11/16", dia. x 2 1/32" above socket.
- Hermetically sealed to afford maximum protection against severe ambient conditions.
- Silver alloy contacts, gold-flashed, rated 10 amps at 115 volts AC or 28 volts DC, resistive load.
- Mounting: Standard 8 or 11-pin octal style plug.
- Weight: 5 oz. approx.

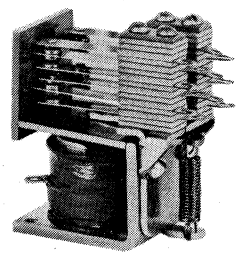


Stock Part No.	Contacts 10 Amps	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
CLASS 88L					
W88ALX-2	4PDT	6VAC	—	6VA prox.	12.22
W88ALX-3		24VAC	—		12.22
W88ALX-4		115VAC	—		12.22
W88ALX-5	6PDT	6VAC	—	6VA prox.	14.75
W88ALX-6		24VAC	—		14.75
W88ALX-7		115VAC	—		14.75
W88LX-1	4PDT	6VDC	12	3W	11.13
W88LX-2		12VDC	50		11.13
W88LX-3		24VDC	200		11.13
W88LX-4		110VDC	4000		12.51
W88LX-5	6PDT	6VDC	12	3W	13.55
W88LX-6		12VDC	50		13.55
W88LX-7		24VDC	200		13.55
W88LX-8		110VDC	4000		14.92
CLASS 88LCP					
W88ALCPX-10	4PDT (20 Pins)	6VAC	—	6VA prox.	17.26
W88ALCPX-11		24VAC	—		17.26
W88ALCPX-12		115VAC	—		17.26
W88LCPX-9	4PDT (20 Pins)	6VDC	12	3W	15.99
W88LCPX-10		12VDC	50		15.99
W88LCPX-11		24VDC	200		15.99
W88LCPX-12		110VDC	4000		16.26
CLASS 88HP					
W88AHPX-21	DPDT (8 Pins)	6VAC	—	3VA	11.87
W88AHPX-22		12VAC	—		11.87
W88AHPX-23		24VAC	—		11.87
W88AHPX-24		115VAC	—		11.87
W88HPX-32	DPDT (8 Pins)	6VDC	25	1.5W	11.31
W88HPX-33		12VDC	100		11.31
W88HPX-34		24VDC	400		11.31
W88HPX-35		110VDC	8000		12.52
W88AHPX-36	3PDT (11 Pins)	115VAC	—	3VA	14.10
W88HPX-51		24VDC	400	1.5W	13.52

*Resistance Values ±10% at 25°C.
†Voltage Specified Relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.
††Current Specified Relays pull in at Specified Value or less.

Magnecraft® general purpose and power relays

class 12 low cost multi-pole general purpose DPDT-3PDT-4PDT-6PDT ac or dc operation - 10 amps



1 23/32" x 1" x L

Class 12 low cost general purpose relay with multiple contacts. Used widely in commercial applications such as industrial controls, communications equipment, and automatic vending machines. Coil dissipation, 3 watts maximum.

Mounting: 4 6-32 tapped holes on 3/4" x 7/8" centers. Standard Contacts: 3/16" silver. Rated 10 amperes resistive at 115 VAC.

IN STOCK FOR IMMEDIATE DELIVERY

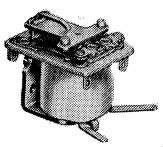
DC Voltage Specified

Stock Part No.	10 Amp Contacts	Coil Volts	Coil Ohms	Dim. "L"	Prices 1-24
W12X-1	DPDT	6 VDC	17	1 5/16	4.05
W12X-2	DPDT	12 VDC	64	1 5/16	4.05
W12X-3	DPDT	24 VDC	215	1 5/16	4.05
W12X-4	DPDT	115 VDC	5000	1 5/16	4.55
W12X-5	3PDT	6 VDC	17	1 7/8	4.95
W12X-6	3PDT	12 VDC	64	1 7/8	4.95
W12X-7	3PDT	24 VDC	215	1 7/8	4.95
W12X-8	3PDT	115 VDC	5000	1 7/8	5.45
W12X-9	4PDT	6 VDC	17	1 7/8	5.85
W12X-10	4PDT	12 VDC	64	1 7/8	5.85
W12X-11	4PDT	24 VDC	215	1 7/8	5.85
W12X-12	4PDT	115 VDC	5000	1 7/8	6.35
W12X-13	6PDT	6 VDC	17	2 3/16	7.65
W12X-14	6PDT	12 VDC	64	2 3/16	7.65
W12X-15	6PDT	24 VDC	215	2 3/16	7.65
W12X-16	6PDT	115 VDC	5000	2 3/16	8.15

AC Voltage Specified

Stock Part No.	10 Amp Contacts	Coil Volts	Coil Ohms	Dim. "L"	Prices 1-24
W12AX-1	DPDT	6 VAC	1.2	1 5/16	4.05
W12AX-2	DPDT	12 VAC	9	1 5/16	4.05
W12AX-3	DPDT	24 VAC	19	1 5/16	4.05
W12AX-4	DPDT	115 VAC	645	1 5/16	4.05
W12AX-5	3PDT	6 VAC	1.2	1 7/8	4.95
W12AX-6	3PDT	12 VAC	9	1 1/8	4.95
W12AX-7	3PDT	24 VAC	19	1 7/8	4.95
W12AX-8	3PDT	115 VAC	645	1 7/8	4.95
W12AX-9	4PDT	6 VAC	1.2	1 7/8	5.85
W12AX-10	4PDT	12 VAC	9	1 7/8	5.85
W12AX-11	4PDT	24 VAC	19	1 7/8	5.85
W12AX-12	4PDT	115 VAC	645	1 7/8	5.85
W12AX-13	6PDT	6 VAC	1.2	2 3/16	7.65
W12AX-14	6PDT	12 VAC	9	2 3/16	7.65
W12AX-15	6PDT	24 VAC	19	2 3/16	7.65
W12AX-16	6PDT	115 VAC	645	2 3/16	7.65

class 19 ultra-small general purpose relays / SPDT or DPDT / less than ½ cubic inch 1 amp / dc operation only



5/8" x 13/16" x 51/64"

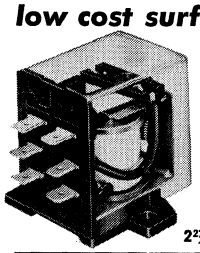
These ultra-small and feather-light relays feature cadmium plated and chromate dipped parts to prevent corrosion as well as silicone glass insulation material and beryllium copper hinges to assure stable performance under shock,, vibration and temperature extremes.

Palladium contacts rated 1 amp at 28 VDC or 115 VAC resistive load in SPDT or DPDT. Easily mounted with one 2-56 screw.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	1 Amp Contacts	Coil Volts	Coil Ohms	Prices 1-24
W19X-1	SPDT	6 VDC	50	5.85
W19X-2	SPDT	12 VDC	200	5.85
W19X-3	SPDT	24 VDC	800	5.85
W19X-4	DPDT	6 VDC	30	7.50
W19X-5	DPDT	12 VDC	120	7.50
W19X-6	DPDT	24 VDC	500	7.50

class 89CQ low cost surface mounted power relay



2 27/64" x 2 1/2" x 1 15/16"

- **Size:** 2 27/64" x 2 1/2" x 1 15/16"
- **Contacts:** DPDT; 20 amps at 115 VAC or 28 VDC res.
- **Terminals:** Accepts .250" Amp "Faston" receptacles or equivalent
- **Mounting:** Surface mounted thru 2 elongated mounting holes .170" x .263"
- **Weight:** 4.5 oz. approx.

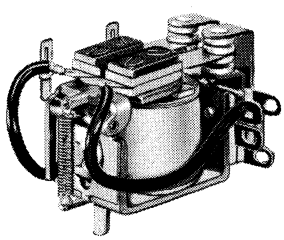
Crack resistant, see through plastic dust cover

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts 20 Amps	COIL †Volts	COIL *Ohms	List Price	Nominal Power
W89ACQX-1	DPDT	6 VAC	—	6.6VA	7.25
W89ACQX-2		12 VAC	—		7.25
W89ACQX-3		24 VAC	—		7.25
W89ACQX-4		120 VAC	—		7.25
W89ACQX-5		240 VAC	—		7.50
W89CQX-1	DPDT	6 VDC	14	3W	7.15
W89CQX-2		12 VDC	53		7.15
W89CQX-3		24 VDC	210		7.15
W89CQX-4		110 VDC	4400		7.95

class 88R power relays

DPDT 15 amps AC or DC operation.



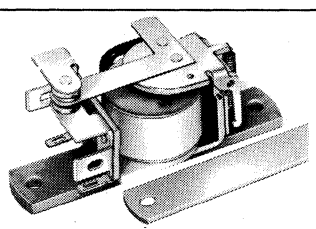
- Small Size: 1 7/8" x 1 5/16" x 1 5/32"
- Silver alloy, gold-flashed, contacts, rated at 15 amps at 115 volts AC, or 28 volts DC, resistive load.
- Solder terminals for easy wiring.
- Easy mounting: One #6-32 tapped mounting hole with locating boss.
- Designed for high current switching in small space.
- Rugged hinge pin armature for long life and stability of operation.
- Weight: 3 oz. approx.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts 15 Amps	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
W88ARX-2	DPDT	12VAC	—	3VA	7.21
W88ARX-3		24VAC	—		7.21
W88ARX-4		115VAC	—		7.40
W88RX-2	DPDT	12VDC	100	1.5W	7.14
W88RX-3		24VDC	400		7.14

class 88K low cost relays

SPDT 15 amps AC or DC operation.



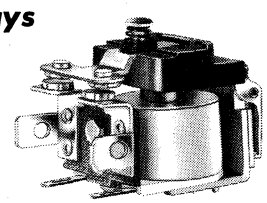
- Size: 2 5/8" x 1 3/16" x 1 1/4"
- Silver alloy, gold-flashed, contacts, SPDT rated at 15 amps, 115 volts AC or 28 VDC, resistive load.
- Mounting base insulator furnished.
- Terminals accept AMP Faston 250 Quick-Disconnect receptacles for contacts, 110 Series for coil, or equivalent, or solder connection can be used.
- Weight: 3 ozs. approx.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts 15 Amps	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
W88AKX-1	SPDT	24VAC	—	3VA	5.38
W88AKX-2		115VAC	—		5.38
W88AKX-3		230VAC	—		6.51
W88KX-1	SPDT	6VDC	25	1.5W	5.15
W88KX-2		12VDC	100		5.15
W88KX-3		24VDC	400		5.15
W88KX-4		110VDC	8000		5.96

class 88KD low cost power relays

50 amps SPST-NO-DM, 1 HP. AC or DC operation.



- Size: 1 15/16" x 1 1/16" x 1 1/2"
- 50 amp resistive, heavy duty silver alloy contacts for power switching.
- Terminals accept AMP Faston 250 Quick-Disconnect receptacles for contacts, 110 Series for coil, or equivalent, or solder connections can be used.
- Easy mounting: One #6-32 tapped mounting hole and locating boss.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts 50 Amps	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
W88KADX-1	SPST-NO-DM	24VAC	—	3VA	5.57
W88KADX-2		115VAC	—		5.57
W88KADX-3		230VAC	—		5.96
W88KDX-1	SPST-NO-DM	6VDC	25	1.5W	4.94
W88KDX-2		12VDC	100		4.94
W88KDX-3		24VDC	400		4.94
W88KDX-4		110VDC	8000		5.86

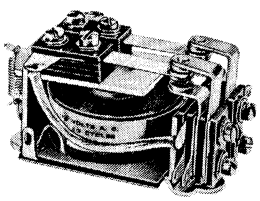
*Resistance Values ±10% at 25°C.
†Voltage Specified Relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays. at 25°C.

MAGNECRAFT® ELECTRIC COMPANY • 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

Magnecraft® power relays

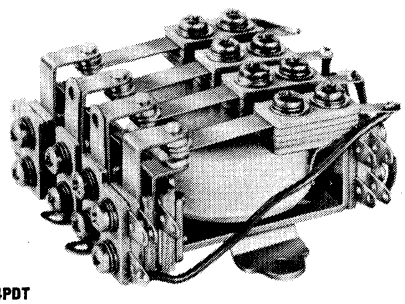
class 94 power relays

15 amps SPDT to 4PDT / AC or DC operation



DPDT

2 23/32" x 1 29/32" x 1 3/4"



4PDT

3 1/16" x 1 29/32" x 2 15/32"

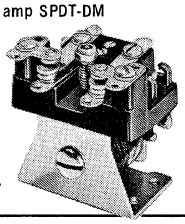
Compact and positive-acting relays for either AC or DC. Used in air conditioning and lighting systems, small motor starting, transformers, garage door openers — wherever dependable circuit switching is necessary. The 1/4" dia. silver contacts are rated at 15 amps resistive, 5 amps inductive at 115 VAC or 28 VDC. The large contact surfaces are kept clean by good wiping action.
Mounting Data: 2 tapped holes 6-32 NC-2; 2" centers.
Weight: 8 oz.

Stock Part No.	15 Amp Contacts	Coil		Prices 1-24
		Volts	Ohms	
W94AX-1	SPDT	6 VAC	1.6	5.88
W94AX-2	SPDT	12 VAC	4	5.88
W94AX-3	SPDT	24 VAC	16	5.88
W94AX-4	SPDT	115 VAC	400	5.88
W94AX-5	SPDT	220 VAC	1600	6.67
W94X-1	SPDT	6 VDC	16	5.88
W94X-2	SPDT	12 VDC	63	5.88
W94X-3	SPDT	24 VDC	250	5.88
W94X-4	SPDT	110 VDC	4000	7.19
W94AX-6	DPDT	6 VAC	1.6	8.66
W94AX-7	DPDT	12 VAC	4	8.66
W94AX-8	DPDT	24 VAC	16	8.66
W94AX-9	DPDT	115 VAC	400	8.66
W94AX-10	DPDT	220 VAC	1600	9.45
W94X-5	DPDT	6 VDC	16	8.66
W94X-6	DPDT	12 VDC	63	8.66
W94X-7	DPDT	24 VDC	250	8.66
W94X-8	DPDT	110 VDC	4000	9.98

Stock Part No.	15 Amp Contacts	Coil		Prices 1-24
		Volts	Ohms	
W94AX-11	3PDT	6 VAC	1.6	12.81
W94AX-12	3PDT	12 VAC	4	12.81
W94AX-13	3PDT	24 VAC	16	12.81
W94AX-14	3PDT	115 VAC	400	12.81
W94AX-15	3PDT	220 VAC	1600	13.60
W94X-11	3PDT	6 VDC	16	12.81
W94X-12	3PDT	12 VDC	63	12.81
W94X-13	3PDT	24 VDC	250	12.81
W94X-14	3PDT	110 VDC	4000	13.07
W95AX-16	4PDT	6 VAC	1.6	16.85
W94AX-17	4PDT	12 VAC	4	16.85
W94AX-18	4PDT	24 VAC	16	16.85
W94AX-19	4PDT	115 VAC	400	16.85
W94AX-20	4PDT	220 VAC	1600	17.64
W94X-15	4PDT	6 VAC	16	16.85
W94X-16	4PDT	12 VDC	63	16.85
W94X-17	4PDT	24 VDC	250	16.85
W94X-18	4PDT	110 VDC	4000	18.17

class 96 power relays

15 amp DPDT or 30 amp SPDT-DM
AC or DC operation



1 23/32" x 1 7/8" x 1 1/2"

A continuous duty general purpose power relay, available in AC or DC with DPDT (2C) and SPDT-DB-DM (1Z) contact arrangements. Excellent for general industrial power control circuits. Silver Cadmium oxide contacts rated at 15 or 30 amps at 28 VDC or 115 VAC resistive.

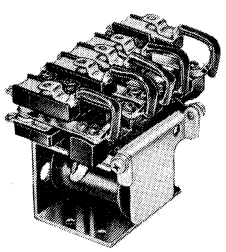
Mounting Data: 4 tapped holes 6-32 NC-2; 1/2" x 1 5/16" centers.

Weight: 4.4 oz.

Stock Part No.	Contacts		Coil		Prices 1-24
	Form	Amps	Volts	Ohms	
W96AX-1	DPDT	15	6 VAC	1.8	8.20
W96AX-2		15	24 VAC	28.8	8.20
W96AX-3		15	115 VAC	661	8.20
W96AX-4		15	220 VAC	2647	8.60
W96X-1		15	6 VDC	14	7.95
W96X-2		15	12 VDC	56	7.95
W96X-3		15	24 VDC	230	7.95
W96X-4	SPDT-	30	6 VDC	14	8.25
W96AX-5	DB-DM	30	115 VAC	661	8.50

class 93 power relays

3 PDT or 5PDT / 20 amp AC or DC operation



2" x 2 5/16" x L

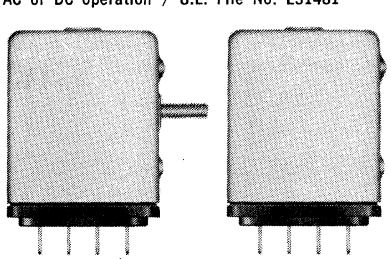
Designed and constructed with a variety of features which contribute to the sensitivity and longevity of this relay. Contacts and terminals are mounted on molded phenolic blocks with integral barriers. Moveable contact blades are made of spring temper phosphor bronze for high conductivity and long life. Adjusting screws on each blade permit close adjustment. Armature pivots on machined phosphor bronze bearing pins and pivot holes are precision reamed. Mounting Data: 4 tapped holes 6-32 NC-2; 1/2" x 1 5/16" centers.

Contacts: 1/4" dia. silver — 20 amps resistive at 115 VAC or 28 VDC.

Stock Part No.	20 Amp Contacts	Coil		Dim. "L"	Prices 1-24
		Volts	Ohms		
DC VOLTAGE SPECIFIED					
W93X-1	3PDT	6 VDC	14	1 13/16	7.77
W93X-2	5PDT	6 VDC	10	2 5/16	11.34
W93X-3	3PDT	24 VDC	218	1 13/16	7.77
W93X-4	5PDT	24 VDC	164	2 5/16	11.34
W93X-5	3PDT	110 VDC	4580	1 13/16	8.09
W93X-6	5PDT	110 VDC	3430	2 5/16	11.66
AC VOLTAGE SPECIFIED					
W93AX-1	3PDT	6 VAC	.8	1 13/16	7.77
W93AX-2	5PDT	6 VAC	.6	2 5/16	11.34
W93AX-3	3PDT	24 VAC	12.5	1 13/16	7.77
W93AX-4	5PDT	24 VAC	9.6	2 5/16	11.34
W93AX-5	3PDT	115 VAC	253	1 13/16	7.77
W93AX-6	5PDT	115 VAC	194	2 5/16	11.34

class 97 enclosed plug-in or stud mounting

Low cost 25 amp power relays / U.L. recognized
AC or DC operation / U.L. File No. E31481



1 5/16" x 1 5/16" x 1 29/32"

The Class 97 is a low cost 25 amp relay for 1 and 2 pole, 120/240 VAC applications. It is available with socket for plug-in applications or for use with standard quick-connect terminals for simplicity and ease in wiring. The class 97 relay offers high quality, dependable performance and long life.

Holding Circuit permits sustaining operation of the relay from momentary switches, without sacrificing one of the heavy-duty load contacts where the coil voltage may be different from the load circuit voltages.

SOCKETS

Stock Part No.	Prices 1-24
70-311	2.06
70-312	2.35
70-313 (Use with Holding Circuit	3.13
70-314 (U.L. Recognized)	3.18

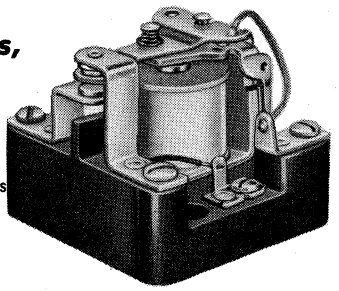
Stock Part No.	Coil		Prices 1-9
	Volts	Ohms	
STUD MOUNTING			
W97ACSX-1	12 VAC	4	9.98
W97ACSX-2	24 VAC	14	9.98
W97ACSX-3	115 VAC	250	9.98
W97ACSX-4	220 VAC	1000	10.30
W97CSX-1	12 VDC	50	9.98
W97CSX-2	24 VDC	250	9.98
PLUG-IN			
W97ACPX-1	12 VAC	4	9.98
W97ACPX-2	24 VAC	14	9.98
W97ACPX-3	115 VAC	250	9.98
W97ACPX-4	220 VAC	1000	10.30
W97CPX-1	12 VDC	50	9.98
W97CPX-2	24 VDC	250	9.98
HOLDING CIRCUIT (Plug-In)			
W97ALCPX-1	115 VAC	250	11.51
W97ALCPX-2	220 VAC	1000	11.81

Magnecraft® power relays

class 99 heavy duty power relays, *UL listed (UL File E43641)*

AC or DC operation — 25 amps 1 HP.
SPDT, DPST-NO, and DPDT.

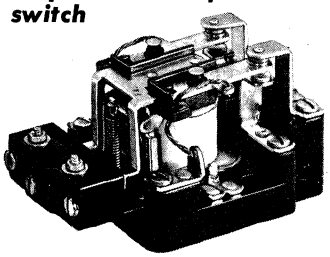
- Size: SPDT — 2½" x 2½" x 2 3/16"
  DPST-NO — 2½" x 2½" x 2⅜",
  DPDT — 3 3/16" x 2½" x 2⅜"
- Oversize silver alloy, gold-flashed contacts, rated at 25 amps at 115 VAC or 28 VDC, resistive load, or 1 HP, AC.
- Heavy duty hinge-pin armature for long life and stability of operation. Screw type terminals and molded phenolic base.
- Easy mounting: Two 3/16" diameter clearance holes on 1⅞" centers.



Stock Part No.	Contacts 25 Amps	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
CLASS 99					
W99AX-1	SPDT	24VAC	—	10VA	5.66
W99AX-2	SPDT	115VAC	—	10VA	5.68
W99AX-3	SPDT	230VAC	—	10VA	5.86
W99X-1	SPDT	6VDC	18	2.0W	5.42
W99X-2	SPDT	12VDC	70	2.0W	5.42
W99X-3	SPDT	24VDC	290	2.0W	5.44
W99X-4	SPDT	110VDC	6000	2.0W	5.83
W99AX-8	DPST-NO	24VAC	—	10VA	6.65
W99AX-9	DPST-NO	115VAC	—	10VA	6.67
W99AX-10	DPST-NO	230VAC	—	10VA	6.85
W99X-9	DPST-NO	6VDC	18	2.0W	6.36
W99X-10	DPST-NO	12VDC	70	2.0W	6.36
W99X-11	DPST-NO	24VDC	290	2.0W	6.38
W99X-12	DPST-NO	110VDC	6000	2.0W	6.77
W99AX-4	DPDT	24VAC	—	10VA	8.43
W99AX-5	DPDT	115VAC	—	10VA	8.43
W99AX-6	DPDT	230VAC	—	10VA	8.63
W99AX-7**	DPDT	440VAC	—	10VA	8.68
W99X-5	DPDT	6VDC	18	2.0W	8.12
W99X-6	DPDT	12VDC	70	2.0W	8.12
W99X-7	DPDT	24VDC	290	2.0W	8.14
W99X-8	DPDT	110VDC	6000	2.0W	8.53
W99AX-56	DPDT ‡ (Relay)	115VAC	—	10VA	14.97
W99AX-57	DPDT ‡ (Relay)	230VAC	—	10VA	15.18

**W99AX-7 440VAC relay not UL Listed.
‡With Aux. Snap Switch.

class 99 power relays 25 amp — 1 hp with 22 amp. aux. snap switch

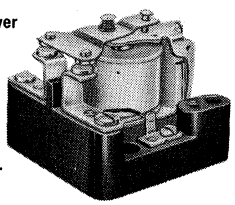


- Size: 4½" x 2½" x 2⅜"
- Basic Class 99 relay equipped with SPDT snap switch.
- DPDT Power Contacts rated 25 amps or 1 HP, SPDT snap switch rated 22 amps.
- Availability of snap switch increases relay switching capabilities.
- Panel or chassis mtg.—Two 3/16 dia. mtg. holes.
- Screw terminals.

class 99D power relay

50 amps — SPST-NO-DM — 2 HP.

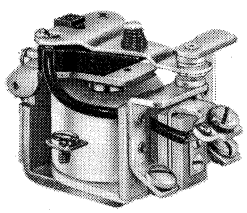
- Size: 2½" x 2½" x 2 3/16"
- AC or DC operation
- Oversize silver alloy, gold-flashed, contacts, rated at 50 amps at 115 VAC or 28 VDC resistive load, or 2 HP.



Stock Part No.	Contacts	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
CLASS 99D					
W99ADX-1	SPST-NO-DM 50 Amps	24VAC	—	10VA	5.64
W99ADX-2	SPST-NO-DM 50 Amps	115VAC	—	10VA	5.64
W99ADX-3	SPST-NO-DM 50 Amps	230VAC	—	10VA	5.85
W99DX-1	SPST-NO-DM 50 Amps	6VDC	18	2.0W	5.35
W99DX-2	SPST-NO-DM 50 Amps	12VDC	70	2.0W	5.35
W99DX-3	SPST-NO-DM 50 Amps	24VDC	290	2.0W	5.37
W99DX-4	SPST-NO-DM 50 Amps	110VDC	6000	2.0W	5.74

class 99S space saver power relay

25 amps — SPDT — 1 HP.

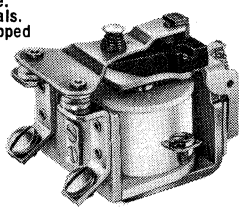


- Size: 2 7/8" x 2" x 1 15/16"
- Power switching in small space.
- One #6-32 tapped mtg. hole and locating boss.
- AC or DC operation.
- Screw terminals.
- SPDT silver alloy, gold-flashed, contacts rated at 25 amps or 1 HP.

class 99SD space saver power relay

50 amps — SPST-NO-DM — 2 HP.

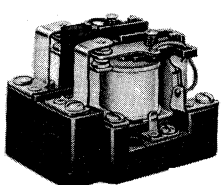
- Size: 2½" x 2 x 1 15/16"
- 50 amp switching in small space.
- Screw terminals.
- One #6-32 tapped mtg. hole and locating boss.
- AC or DC operation.



Stock Part No.	Contacts	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
CLASS 99S					
W99SAX-1	SPDT 25 Amps at 115VAC	24VAC	—	10VA	7.35
W99SAX-2	SPDT 25 Amps at 115VAC	115VAC	—	10VA	7.40
W99SAX-3	SPDT 25 Amps at 115VAC	230VAC	—	10VA	7.62
W99SX-1	SPDT 25 Amps at 115VAC	6VDC	18	2.0W	7.11
W99SX-2	SPDT 25 Amps at 115VAC	12VDC	70	2.0W	7.13
W99SX-3	SPDT 25 Amps at 115VAC	24VDC	290	2.0W	7.15
W99SX-4	SPDT 25 Amps at 115VAC	110VDC	6000	2.0W	7.47
CLASS 99SD					
W99SADX-1	SPST-NO-DM 50 Amps at 115VAC	24VAC	—	10VA	6.26
W99SADX-2	SPST-NO-DM 50 Amps at 115VAC	115VAC	—	10VA	6.34
W99SADX-3	SPST-NO-DM 50 Amps at 115VAC	230VAC	—	10VA	6.56
W99SDX-1	SPST-NO-DM 50 Amps at 115VAC	6VDC	18	2.0W	6.10
W99SDX-2	SPST-NO-DM 50 Amps at 115VAC	12VDC	70	2.0W	6.10
W99SDX-3	SPST-NO-DM 50 Amps at 115VAC	24VDC	290	2.0W	6.14
W99SDX-4	SPST-NO-DM 50 Amps at 115VAC	110VDC	6000	2.0W	6.44
CLASS 99B					
W99ABX-6	DPDT 10 Amps DC	115VAC	—	10VA	13.49
W99ABX-7	DPDT 10 Amps DC	230VAC	—	10VA	13.81
W99BX-10	DPDT 10 Amps DC	110VDC	6000	2.0W	13.65
W99BX-11	DPDT 10 Amps DC	220VDC	20000	2.0W	16.08
CLASS 99DB					
W99ADBX-2	SPST-NO-DM 20 Amps DC	115VAC	—	10VA	9.02
W99ADBX-3	SPST-NO-DM 20 Amps DC	230VAC	—	10VA	9.36
W99DBX-5	SPST-NO-DM 20 Amps DC	110VDC	6000	2.0W	9.18
W99DBX-6	SPST-NO-DM 20 Amps DC	220VDC	20000	2.0W	11.61

*Resistance values ±10% measured at 25°C.
†Voltage specified relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays, at 25°C.

class 99B power relays with blowout magnet for dc arc-quenching

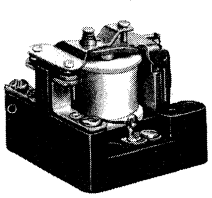


3 3/16" x 2½" x 2 7/16"

10 amp. at 110 VDC — DPDT AC or DC operation

Magnetic blowouts and the resulting extended DC switching capability enable the use of the Class 99B in applications where larger relays are usually used. The net result is a significant reduction in size and cost.

class 99DB power relays with blowout magnet for dc arc-quenching

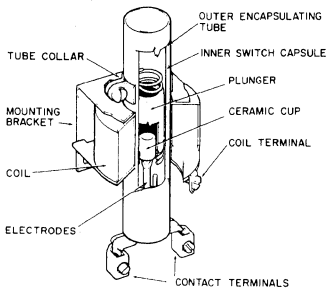


2½" x 2½" x 2 3/16"

20 amp. at 110 VDC — SPST-NO-DM AC or DC operation

Magnetic blowouts with double make contacts and the resulting extended DC switching capability enable the use of the Class 99DB in applications where larger relays are usually used. The net result is a significant reduction in size and cost.

Magnecraft® mercury displacement power relays



TYPE BSX-CUTAWAY VIEW

FEATURES:

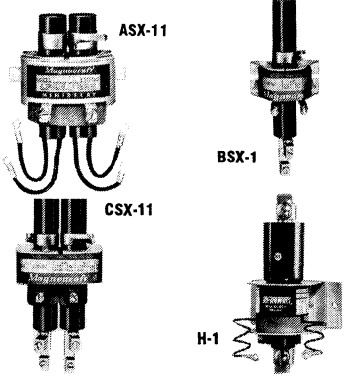
- INERT HYDROGEN ATMOSPHERE FOR RAPID ARC-QUENCHING
- 100% INSPECTED
- DESIGNED FOR U.L. CSA APPROVAL
- HERMETICALLY SEALED
- MERCURY-TO-MERCURY CONTACTS
- SILENT
- ACCESSIBLE TERMINALS
- HYBRID RELAY/SOLID STATE PACKAGES

NOMALLY OPEN, COIL ENERGIZED:
Activated coil pulls the magnetic plunger sharply downward, displacing mercury from lower electrode reservoir sufficiently to flood the mercury-filled ceramic (alumina) cup surrounding the other electrode. The action produces a sharp, clean contact between the two mercury pools.

COIL DE-ENERGIZED:
The plunger floats high in the mercury pool causing the mercury level to drop sharply, thus breaking the liquid mercury contact.

ALSO AVAILABLE FOR NORMALLY CLOSED OPERATION

"HI-POWER" armored shell



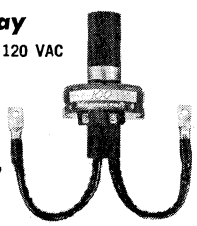
High performance relays have hermetically sealed armored shells with ceramic lined electrode chamber, epoxy insulation. Similar to our standard mercury displacement relays, but with maximum reliability. Impervious to physical or thermal shock, moisture and dirt. Rated to switch loads up to 550 volts AC. Coils — 120 Vac, 60 Hz. Special coil voltage available.

TYPE **ASX**
MINIATURE ARMORED
ENCAPSULATED
POWER RELAYS
20 Amp — SPST or DPST
TYPE **BSX**
ARMORED ENCAPSULATED
POWER RELAYS
35 Amp —SPST— DPST —3PST
TYPE **CSX**
ARMORED ENCAPSULATED
POWER RELAYS
60 Amp — SPST – DPST — 3PST
TYPE **H**
ARMORED ENCAPSULATED
POWER RELAYS
100 AMPERES/120 Vac
90 Amperes/240 Vac
SPST — DPST — 3PST

Type	Description	Coil Volts 50/60 Hz	Size	1-9
WASX-1	SPST-NO	120 VAC	3½" x 1⅞" x 1¾"	$10.84
WASX-1	SPST-NO	240 VAC	3½" x 1⅞" x 1¾"	10.98
WASX-2	SPST-NC	120 VAC	3½" x 1⅞" x 1¾"	11.18
WASX-11	DPST-NO	120 VAC	3½" x 3" x 2⅛"	22.03
WBSX-1	SPST-NO	120 VAC	5½" x 2⅝" x 2⅜"	13.17
WBSX-1	SPST-NO	240 VAC	5½" x 2⅝" x 2⅜"	14.07
WBSX-2	SPST-NC	120 VAC	5½" x 2⅝" x 2⅜"	13.52
WBSX-11	DPST-NO	120 VAC	6" x 3" x 2½"	24.30
WBSX-111	3PST-NO	120 VAC	6" x 4" x 3¼"	36.70
WCSX-1	SPST-NO	120 VAC	5½" x 2⅝" x 2⅜"	19.40
WCSX-1	SPST-NO	240 VAC	5½" x 2⅝" x 2⅜"	20.40
WCSX-2	SPST-NC	120 VAC	5½" x 2⅝" x 2⅜"	19.80
WCSX-11	DPST-NO	120 VAC	6" x 3" x 2½"	31.60
WCSX-111	3PST-NO	120 VAC	6" x 4" x 3¼"	45.20
WH-1	SPST-NO	120 VAC	7½" x 4" x 3⅝"	67.73
WH-11	DPST-NO	120 VAC	7½" x 6½" x 4"	135.45
WH-111	3PST-NO	120 VAC	7½" x 6½" x 5¼"	190.05

"100" relay

100 AMPERES — 120 VAC
(CSA Listed)


"W100"

Rated 100A at 120 Vac or 12kW resistive load capacity. Coil operating current, .260A. Coils, 120 Vac, 60 Hz.

Dimensions: 6½"H x 3¼"W x 3½"D

Type	Description	1-9
W100-1	Single Pole, N.O.	$45.26

miniature "MR" series

20 AMPERES — 120 VAC
(CSA Listed)

MR-11

Compact units capable of handling loads nearly twice that of equal size ordinary armature type units. Hermetically sealed, mercury-to-mercury contacts. No contacts to pit, stick or corrode. Full 20 ampere rating (per pole) at 120 Vac with inductive or resistive loads.

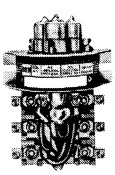
Coil current at 120 V, 60 Hz:
WMR-1, -2, .042A WMR-11, .084A WMR-111, .120A

Dimensions (H x W x D):
WMR-1, 3½" x 1⅞" x 1¾" WMR-11, 4½" x 3" x 2".
WMR-2, 4" x 1⅞" x 1¾" WMR-111, 5" x 3¼" x 2¾"

Type	Description	1-9
WMR-1	Normally Open, SPST	$14.02
WMR-2	Normally Closed, SPST	14.60
WMR-11	2-Pole, Both N.O.	25.99
WMR-111	3-Pole, All N.O.	37.38

"EM" series

35 AMPERES — 120 VAC
(UL and CSA Listed)


EM-111

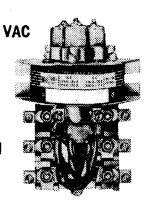
Rated 35A (per pole) at 120 Vac. Coil operating at 120 Vac 60 Hz: EM-1, EM-2, .050A; EM-11, .120A; EM-111, .200A.

Dimensions (H x W x D):
WEM-1, 4½" x 2⅝" x 2⅜" WEM-11, 5⅜" x 3⅜" x 2½"
WEM-2, 5⅛" x 2⅝" x 2⅜" WEM-111, 6¼" x 4" x 3⅜"

Type	Description	1-9
WEM-1	Single Pole, N.O.	$15.10
WEM-2	Single Pole, N.C.	16.50
WEM-11	2-Pole, Both N.O.	29.20
WEM-111	3-Pole, All N.O.	42.40

"HD" series

60 AMPERES — 120 VAC
(CSA Listed)


HD-111

Type WHD load rated 60A for 120 Vac and 35A for 230 Vac, 60 Hz. per pole. Coils — 120 Vac 60 Hz.

Dimensions (H x W x D):
WHD-1, 5¼" x 4" x 2⅜" WHD-11, 5¾" x 4" x 2½"
WHD-2, 5¼" x 4" x 2⅜" WHD-111, 6¼" x 4" x 3⅜"

Type	Description	1-9
WHD-1	Single Pole, N.O.	$22.35
WHD-2	Single Pole, N.C.	22.50
WHD-11	2-Pole, Both N.O.	40.50
WHD-111	3-Pole, All N.O.	57.50

Magnecraft® time delay relays

solid state (hybrid) time delay relays

CLASS 211CP

- Size 2⅞ x 2⅜ x 1¾".
- DPDT 10 amp output contacts.
- ±2% repeat accuracy.
- Adjustable delay up to 300 sec.
- 8 or 11 pin octal style plug.
- Solid state timing circuit.
- Weight: 10 oz. approx.

Stock Part No.	Contacts 10 Amps	Coil Voltage	Time Delay	Prices 1-9
Operate Delay				
W211ACPSOX-18	DPDT	120 VAC	.2-1 Second	$18.98
W211ACPSOX-5			1-10 Second	18.98
W211ACPSOX-7			1-180 Second	18.98
W211ACPSOX-8			2-300 Second	18.98
W211CPSOX-10	DPDT	24 VDC	.2-1 Second	18.98
W211CPSOX-1			1-10 Second	18.98
W211CPSOX-3			1-180 Second	18.98
W211CPSOX-4			2-300 Second	18.98
Release Delay				
W211ACPSRX-14	DPDT	120 VAC	.2-1 Second	22.93
W211ACPSRX-5	WD-12		1-10 Second	22.93
W211ACPSRX-7			1-180 Second	22.93
W211ACPSRX-8			2-300 Second	22.93
W211CPSRX-9	DPDT	24 VDC	.2-1 Second	22.93
W211CPSRX-1	WD-12		1-10 Second	22.93
W211CPSRX-3			1-180 Second	22.93
W211CPSRX-4			2-300 Second	22.93

Compact Size 2⅛ x 1⅜ x 1⅜"

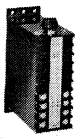
CLASS 214CP

Now in the size of a general purpose relay, Magnecraft has developed a fully adjustable solid state time delay relay.

- Repeat Accuracy: ±2% at nominal voltage, 25°C.
- Contacts: DPDT, 5 amps at 28VDC or 115VAC, res.
- Steady State Current: 20 ma.
- Mode of Time Delay: Delay on operate.
- Convenient top screw driver time adjustment.
- Reset and Recycle Time: Typically 100 ms.
- Transient protection to twice input voltage for 8 ms.
- Enclosure: Molded dust cover.
- Mounting: Standard 8 pin octal style plug-in.
- Weight: 3 oz. approx.
- Polarity Protection (DC Models)

Stock Part No.	Contact	Input Volts	Timing Range	Price 1-9
W214ACPSOX-1	5 amp	120VAC	.3 to 30 sec.	22.33
W214ACPSOX-2	DPDT	120VAC	3 to 240 sec.	22.33
W214CPSOX-3	DPDT	24VDC	.3 to 30 sec.	22.33
W214CPSOX-4	DPDT	24VDC	3 to 240 sec.	22.33

CLASS 211M



- Size 4½ x 4½ x 1½".
- DPDT 10 amp output contacts.
- ±2% repeat accuracy.
- Adjustable delay up to 300 sec.
- Mounting: Six ⅜" holes ½" x 4⅛" centers.
- Solid state timing circuit.
- Weight: 10 oz. approx.

Stock Part No.	Cont. 10 Amp	Nominal Voltage	Timing Range	Prices 1-9
TIME DELAY ON OPERATE				
W211MASOX-1	DPDT	120 VAC	.2-1	$25.79
W211MASOX-2			1.0-10	25.79
W211MASOX-3			1.0-180	25.79
W211MASOX-4			2.0-300	25.79
W211MSOX-1	DPDT	24 VDC	.2-1	25.79
W211MSOX-2			1.0-10	25.79
W211MSOX-3			1.0-180	25.79
W211MSOX-4			2.0-300	25.79
TIME DELAY ON RELEASE				
W211MASRX-1	DPDT	120 VAC	.2-1	$30.37
W211MASRX-2			1.0-10	30.37
W211MASRX-3			1.0-180	30.37
W211MASRX-4			2.0-300	30.37
W211MSRX-1	DPDT	24 VDC	.2-1	30.37
W211MSRX-2			1.0-10	30.37
W211MSRX-3			1.0-180	30.37
W211MSRX-4			2.0-300	30.37

class 218, low cost panel — solid state timing — calibrated dial

Screw Terminals

Size 3⅝" x 2½" x 4"

Quick Connect or Solder Terminals

Size 3⅝" x 2½" x 3 11/16"

- **Input Voltage:** 120 VAC nominal . . . DC input versions also available
- **Output Switching:** Solder terminals; DPDT, 10 amps @ 120 VAC 60 Hz resistive load, ¼ horsepower . . . Screw terminals; SPDT 10 amps @ 120 VAC or 28 VDC resistive load
- **Contact Life:** 25 million mechanical min. . . . 5 million at half load . . . ½ million at full rated load
- **Repeatability Accuracy:** ±2% under fixed conditions and typical use . . . ±10% under voltage and temperature extremes
- **Calibrated Dial Accuracy:** ±10% of full scale
- **Reset Time:** 1/10 second during timing; 1/10 second after timing
- **Electrical Protection:** Dielectric 1000 VAC RMS all contacts to case . . . Input transients to twice nominal, input voltage up to 8 milliseconds

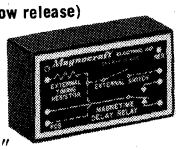
IN STOCK FOR IMMEDIATE DELIVERY

Stock Part Numbers	Nominal Input Voltage	Contacts	Min. Time Seconds	Max. Time Seconds	Price 1-9
TIME DELAY ON OPERATE — SCREW TERMINALS					
W218ACSOSX-2	120 VAC	10 AMP SPDT	1	10	$19.52
W218ACSOSX-4			1	180	19.52
W218ACSOSX-5			2	300	19.52
TIME DELAY ON OPERATE — QUICK CONNECT OR SOLDER TERMINALS					
W218ACSOX-9	120 VAC	10 AMP DPDT	1	10	$16.97
W218ACSOX-10			1	180	16.97
W218ACSOX-11			2	300	16.97

printed circuit mounting

CLASS 502PCSO & 503PCSO (Slow operate)

CLASS 502PCSR & 503PCSR (Slow release)



Size 2¼ x 1¼ x ¾"

- 15 VA @ 1 amp SPST-NO, 10 VA @ .5 amp SPDT reed output contacts.
- Repeat Accuracy: Slow release ±2%. Slow operate ±5%
- Adjustable delay up to 5 minutes, using a remote pot, or fixed resistor.
- Printed circuit mtg.
- Encapsulated solid state timing circuit.

SLOW OPERATE

Stock Part No.	Volts DC ± 15%	Timing Range	*External Adjustment	Prices 1-9
SPST-NO (Form A)				
W502PCSOX-2	12	100 m sec. to 100 sec.	50K ohm/sec.	$19.91
W502PCSOX-3	24	100 m sec. to 100 sec.	50K ohm/sec.	19.91
W502PCSOX-5	12	3 sec. to 5 min.	10K ohm/sec.	22.37
W502PCSOX-6	24	3 sec. to 5 min.	10K ohm/sec.	22.37
SPDT (Form C)				
W503PCSOX-2	12	100 m sec. to 100 sec.	50K ohm/sec.	21.86
W503PCSOX-3	24	100 m sec. to 100 sec.	50K ohm/sec.	21.86
W503PCSOX-5	12	3 sec. to 5 min.	10K ohm/sec.	23.43
W503PCSOX-6	24	3 sec. to 5 min.	10K ohm/sec.	23.43

SLOW RELEASE

Stock Part No.	Volts DC ± 15%	Timing Range	*External Adjustment	Prices 1-9
SPST-NO (Form A)				
W502PCSRX-2	12	200 m sec. to 100 sec.	50K ohm/sec.	$28.07
W502PCSRX-3	24	200 m sec. to 100 sec.	50K ohm/sec.	28.07
W502PCSRX-5	12	1 sec. to 5 min.	10K ohm/sec.	31.33
W502PCSRX-6	24	1 sec. to 5 min.	10K ohm/sec.	31.33
SPDT (Form C)				
W503PCSRX-2	12	200 m sec. to 100 sec.	50K ohm/sec.	30.02
W503PCSRX-3	24	200 m sec. to 100 sec.	50K ohm/sec.	30.02
W503PCSRX-5	12	1 sec. to 5 min.	10K ohm/sec.	33.29
W503PCSRX-6	24	1 sec. to 5 min.	10K ohm/sec.	33.29

*External Resistor and/or switch, not furnished.

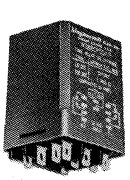
solid state (hybrid) time delay relays class 213CP

- Size: 2⅞ x 2⅜ x 1¾"
- DPDT 10 Amp output contacts.
- ±1% repeatability.
- Adjustable delay up to 300 sec.
- 8 or 11 pin octal style plug.
- Solid state timing circuit.
- Immune to false operation.
- Weight: 10 oz. approx.
- Calibrated dial.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part Number	Input Voltage	Time Delay	Mode Of Operation	Prices 1 - 9
W213ACPSOX-7	120 VAC	1 - 10 Sec.	Slow Operate	37.61
W213ACPSOX-9	120 VAC	1 - 180 Sec.	Slow Operate	37.61
W213ACPSOX-10	120 VAC	2 - 300 Sec.	Slow Operate	37.61
W213ACPSRX-4	120 VAC	1 - 10 Sec.	Slow Release	43.79
W213ACPSRX-6	120 VAC	1 - 180 Sec.	Slow Release	43.79
W213ACPSRX-7	120 VAC	2 - 300 Sec.	Slow Release	43.79

class 388TD solid state (hybrid) time delay relay



2 3/16 x 1 17/32 x 1 13/32

2 23/32 x 1 17/32 x 1 13/32

- **Repeat Accuracy:** ±3% at nominal voltage, 25°C
- **Contacts:** DPDT 10 amps @ 28 VDC or 115 VAC, res.
- **Immune to false operations**
- **Steady State Current:** 20 ma @ 120 VAC, 75 ma @ 24 VDC
- **Mode of Time Delay:** Delay on operate
- **Nominal Input:** 120 VAC and 24 VDC
- **Transient Protection:** To twice input voltage for 8 ms. Polarity protection (D.C. models)
- **Reset and Recycle Time:** Less than 100 ms.
- **Mounting:** Standard style plug-in or surface mount
- **Enclosure:** Molded dust cover
- **Weight:** 3 oz. approx.

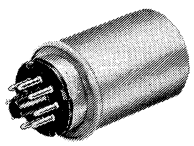
STOCK PART NO.	CONTACTS 10 AMPS	INPUT VOLTS	TIMING RANGE	EXTERNAL* RESISTOR	PRICE 1-9
PLUG-IN					
W388ACPSOX-1	DPDT	120 VAC	1.0 to 10 sec	200K	14.80
W388ACPSOX-2		120 VAC	1.0 to 120 sec	2.4 Meg	16.10
W388CPSOX-1		24 VDC	1.0 to 10 sec	160K	17.05
W388CPSOX-2		24 VDC	1.0 to 120 sec	2 Meg	18.50
SURFACE MOUNT					
W388ACQSOX-1	DPDT	120 VAC	1.0 to 10 sec	200K	14.80
W388ACQSOX-2		120 VAC	1.0 to 120 sec	2.4 Meg	16.10
W388CQSOX-1		24 VDC	1.0 to 10 sec	160K	17.05
W388CQSOX-2		24 VDC	1.0 to 120 sec	2 Meg	18.50

* Resistor not furnished

Magnecraft® special purpose relays

solid state (hybrid) relays

class 501QCP



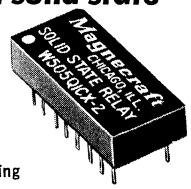
- Size: 2 1/32 x 1 21/32"
- SPST-NO (1 form A) solid state output, reed triggered triac.
- Load rating: 6 Amps @ 120 VAC RMS or 200 VDC peak at 25°C.
- Surge rating: 100 Amps for .016 sec.
- Operate time: .003 sec.
- IC compatible.
- 8 pin octal size plug-in.
- Weight: 3 oz. approx.

class 501QPC

- Size: 2¼ x 1¼ x ¾"
- SPST-NO (1 form A) solid state output, reed triggered triac.
- Load rating: 3 Amps @ 120 VAC RMS or 200 VDC peak at 25°C.
- Surge rating: 100 amps for .016 sec.
- Operate time: .003 sec.
- IC compatible.
- PC package.
- Weight: 2 oz. approx.

Stock Part No.	INPUT VDC	INPUT Ohms	INPUT Watts	VAC Switching Capability	Prices 1 - 9
W501QPCX-1	5	1000	40 MW	3 Amps @ 120	12.47
W501QPCX-7	24	1500	400 MW	3 Amps @ 120	12.47
W501QPCX-11	5	1000	40 MW	3 Amps @ 240	13.03
W501QPCX-17	24	1500	400 MW	3 Amps @ 240	13.03
W501QCPX-2	5	1000	40 MW	6 Amps @ 120	15.92
W501QCPX-5	24	1500	400 MW	6 Amps @ 120	15.92
W501QCPX-7	5	1000	40 MW	6 Amps @ 240	16.63
W501QCPX-10	24	1500	400 MW	6 Amps @ 240	16.63

class 505QIC solid state relay dual-inline all solid state relay



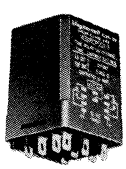
The Three-In-One Relay: Switching, Latching, Timing

Contact Load Rating: 0.7 amp at 30 VDC at 25°C. Case, maximum at any type of load
Contact Combination: DPDT (2 form C)
Sensitive Input Impedance: 50,000 ohms
Switching Time: 50 microseconds max.
Isolation Resistance: 30 x 10^6 ohms, minimum
Typical Life: Greater than 1 billion operations
Case Dissipation: 1.35 watts maximum

Standby Voltage: Pin 7 and 4
Input Coil: Pin 1 and 4
Latching Jumper: Pin 6 and 2
Slow Operate Capacitor: Pin 2 and 4
Slow Release Capacitor: Pin 1 and 4
AC Switching: Use bridge rectifier
Ground Jumper: Pin 4 and 11

Stock Part No.	Must Operate Voltage	Must Release Voltage	Driver Supply Voltage (VDC) (MA)	†Contacts	Prices 1 - 9
W505QICX-1	2.5 VDC	1.1 VDC	3.6 @ 45	1 amp 30 VDC	25.68
W505QICX-3	9.0 VDC	4.5 VDC	12 @ 45*	750 MA 30 VDC	25.68

class 388SS amplifier driven general purpose relay



2 3/16 x 1 17/32 x 1 13/32

2 29/32 x 17/32 x 1 13/32

New Super Sensitive solid state hybrid device allows full 10 amps switching with extremely low power (70 microwatts) control.
A control voltage as small as 2.4 VDC will signal the amplifier to energize the relay, provided the 24 VDC driver supply voltage is maintained. Relay drop out occurs when the control voltage decreases to 1.5 VDC or less.

SPECIFICATIONS:
Driver Supply Voltage: 24 VDC +15% (applied to terminal A positive and B negative)
Nominal Control Power: 70 microwatts at 2.4 VDC
Nominal Driver Power: 1.5 watts
Polarity Protection: Standard
Transient Protection: Standard
Operate Time: 12 ms. typical

Release Time: 25 ms. typical
Temperature Range:
Operate: −10°C to 55°C
Storage: −54°C to 85°C
Contact Combination: SPDT and DPDT as a standard
Contact Rating: 10 amps at 28 VDC or 115 VAC resistive load
Enclosure: Molded red dust cover
Mounting: Standard plug-in or surface mount
Weight: 3 oz. approx.

Stock Part No.	10 Amp Contacts	Prices 1 - 24
W388SSCPX-1	SPDT Plug-In	$13.70
W388SSCPX-2	DPDT Plug-In	
W388SSCQX-1	SPDT Surface Mount	14.15
W388SSCQX-2	DPDT Surface Mount	

class 150 thermal time delay relay

2 amp NC or NO contacts — ±10% repeatability

1 29/32" x 1 9/32" x 13/16"

Efficient, low-cost units used in conjunction with various relays for delayed making or breaking of controlled circuits. Applicable wherever a time delay of 5 to 60 seconds is needed. Operating on the bimetal thermal principle, these types are housed in unglazed porcelain, and are obtainable with either normally-open or normally-closed contacts.

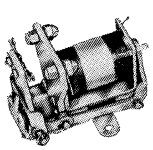
Mounting Data: 2 holes .154 dia. for 6-32 NC-2 screws; 1⅜" centers.

Stock Part No.	2 Amp Contacts	Coil Volts	Coil Ohms	Prices 1 - 24
W150ASOX-1	SPST-NO	115 VAC	7,500	3.96
W150ASOX-2	SPST-NC	115 VAC	7,500	3.96

Contacts: 2 amps resistive at 115 VAC or 28 VDC.

class 158 high voltage relays

Up to 5000 Volts



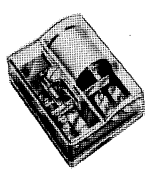
3 1/16" x 2 7/32" x 1 29/32"

The Class 158 relay was developed especially for making and breaking high voltage circuits of low current capacities. Its excellent insulation characteristics will permit the relay to handle high voltages than relays of comparable size. A system of levers operating the armature provides the necessary wide gap for high voltage switching, but keeps the size of the relay to a minimum. The contact assembly is mounted on ceramic to insure high insulation plus strength and low energy loss. The specially designed contact assembly provides for minimum bounce. The ¼" diameter silver cadmium oxide contacts will break up to 5000 V RMS at 200 milliamps current.

Stock Part No.	20 MA Contacts	Coil Volts	Coil Ohms	Prices 1 - 24
W158HVX-1	SPDT DB-DM	24 VDC	120	25.02
W158HVX-2	SPDT DB-DM	110 VDC	3,000	25.92

class 62 ultra-sensitive relays

1 amp. SPDT contacts



2 5/8" x 1 15/16" x 2 1/16"

The Class 62 is an ultra-sensitive, durable, dustite and fully adjustable relay incomparable for use in any DC circuit restricted to a few thousandths of a watt power consumption. The counter-balanced armature design permits excellent operation in any position. The transparent, molded plastic cover guards against dust or dirt reaching the contacts or other working parts — yet allows immediate visual inspection. The sturdy molded bakelite base has both screw and solder terminal connectors, and convenient means of mounting is provided.
Standard factory adjustment is 5 milliwatt sensitivity and field adjustments are easily made by using the vernier screws. The silver contacts and spring tenion can be accurately and permanently set — yet easily changed.
Mounting Data: 2 holes ⅝" dia.

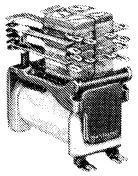
Stock Part No.	Coil Current	Coil Ohms	Prices 1 - 24
W62SCX-1	1000 MA	.005	11.33
W62SCX-2	2.25 MA	1,000	11.79
W62SCX-3	1.80 MA	1,600	11.79
W62SCX-4	1.50 MA	2,200	11.79
W62SCX-5	1.20 MA	3,500	11.99
W62SCX-6	0.95 MA	5,500	12.48
W62SCX-7	0.75 MA	8,700	13.42
W62SCX-8	0.70 MA	10,000	13.42
W62SCX-9	0.60 MA	14,000	14.41
W62SCX-10	0.50 MA	20,000	15.84
W62SCX-11	0.4 MA	30,000	15.84
W62SCX-12	0.35 MA	40,000	16.94

Contacts: 1 amp resistive at 115 VAC or 28 VDC

Magnecraft® telephone type relays

class 33

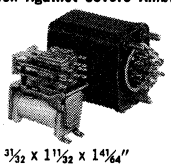
Sub-miniature 1¼" x 1 1/16" x 1¼" for DPDT
1¼" x 1 1/16" x 1 7/16" for 4PDT



- DPDT — 4PDT, 5 amp contacts.
- Hinge pin assures long life.
- Telephone type switching versatility.
- Fast operate and release time.
- Rigid mount — Four 4-40 mtg. holes.
- Weight: 1 oz.

class 33HS

Miniature Hermetically Sealed
to Afford Maximum
Protection Against Severe Ambient Conditions.



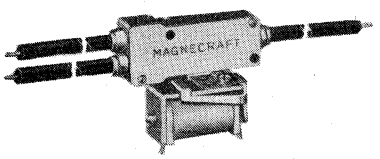
- Size: 3/32 x 1 11/32 x 1 41/64"
- DPDT — 4PDT 5 amp contacts.
- Telephone versatility and reliability.
- High resistance to shock and vibration.
- Widely used in military and civilian equipment.
- #4-40 three stud mtg. — 8 or 14 pin solder terminal header.
- Weight: 3 oz.

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts	COIL †Volts	COIL *Ohms	Nominal Power	Prices 1-9
CLASS 33					
W33X237	DPDT 5 Amps	6VDC	17	2.0W	5.11
W33X238		12VDC	75		5.11
W33X239		24VDC	280		5.16
W33X240		110VDC	6500		5.78
W33X241	4PDT 5 Amps	6VDC	17	2.0W	6.91
W33X242		12VDC	75		6.91
W33X243		24VDC	280		6.96
W33X244		110VDC	6500		7.59
CLASS 33HS					
W33HSX177	DPDT 5 Amps	6VDC	17	2.0W	13.87
W33HSX178		12VDC	75		13.87
W33HSX179		24VDC	280		13.92
W33HSX180		110VDC	6500		14.56
W33HSX181	4PDT 5 Amps	6VDC	17	2.0W	17.48
W33HSX182		12VDC	75		17.48
W33HSX183		24VDC	280		17.54
W33HSX184		110VDC	6500		18.23

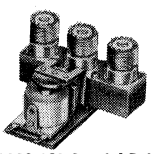
Magnecraft® coaxial relays

class 120

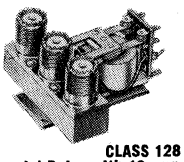


- Size: 1 13/16 x 1 47/64 x 43/64", less cables.
- DC operation.
- SPDT RF switching.
- Silver alloy, gold flashed contacts.
- Rated 100 watts of RF power.
- Impedance matched to 50 ohm cable.
- VSWR 1.25:1 max from 0 to 470 MHz.
- Cables: RG58A/U, 12" long.
- Cables can be equipped with a wide selection of connectors on special order.

class 128



CLASS 128 Coaxial Relay



CLASS 128
Coaxial Relay with 10 amp DPDT Aux. Contacts

- Size: 2 7/8 x 2 5/8 x 1 7/16".
- SPDT RF switching silver alloy contacts.
- Rated 100 watts of RF power.
- Impedance matched to 50 ohms cable.
- Equipped with std. UHF connectors.
- VSWR 1.25: 1 max. from 0 to 500 MHz.
- Operate Time: 25 ms. max.
- Coaxial cavity, with removable plug, for contact inspection.
- AC or DC operation.
- Release Time: 25 ms. max.
- 4-40 thd. — 4 mtg. holes.

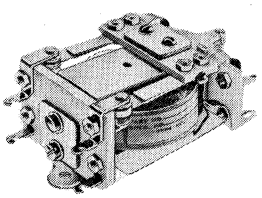
IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Coaxial Contacts	COIL Volts†	COIL (Ω)*	Nominal Power	Prices 1-9
Class 120 Relay					
W120X-14	SPDT	12VDC	100	—	9.25
Class 128 Relay					
W128AX-7	SPDT	115VAC	—	3VA	19.39
W128X-9		12VDC	100	1.5W	19.04
W128X-10		24VDC	400	1.5W	19.11
Class 128 Relay with DPDT Auxiliary Contacts					
W128AX-11	SPDT	115VAC	—	3VA	21.89
W128X-14		12VDC	100	1.5W	21.02
W128X-15		24VDC	400	1.5W	21.08

*Resistance Values ±10% at 25°C.
†Voltage Specified Relays pull in at 80% of nominal or less for DC relays and 85% of nominal or less for AC relays at 25°C.
††Current Specified Relays pull in at Specified Value or less.

Magnecraft® antenna relays

class 151 dpdt ½ kilowatt 10 amp. R.F. relays / ac or dc operation



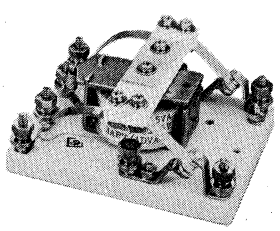
2 13/16" x 1 23/32" x 1 15/32"

The Class 151 is designed specifically for Radio Frequency operation. The small size of this unit makes it ideal for use in compact sets where the load does not exceed ½ KW. High contact pressure is obtained through the use of long phosphor bronze springs. Low-loss handling of radio frequency energy is assured by the steatite insulation, and adequate spacing between contacts. This relay is fast and positive in action and will operate in any position. Standard contact rating is 10 amps resistive at 115 VAC or 28 VDC.
Mounting Data: 2 tapped holes; 6-32 NC-2; 2" centers.

Stock Part No.	10 Amp Contacts	Coil Volts	Coil Ohms	Prices 1-24
W151X-1	DPDT	6 VDC	10	23.40
W151X-2	DPDT	12 VDC	40	23.40
W151X-3	DPDT	24 VDC	160	23.40
W151AX-1	DPDT	115 VAC	400	25.80
W151AX-2	DPDT*	115 VAC	400	28.32

* With SPDT auxiliary contacts

class 155 rf relays / 15 amp. dpdt — 1 kilowatt



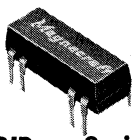
3 19/32" x 2 25/32" x 1 21/32"

The Class 155 relay is designed especially for heavy duty Radio Frequency transmitter antenna changeover, and high voltage switching applications. This relay is for fixed-station usage with a conservative rating of 1 KW. It is also ideal for switching industrial loads because of its ¼" diameter silver contacts and wide contact gap. The Class 155 relay is built for easy connection to antenna lines and is available with auxiliary single pole single throw normally open contacts. Insulated with ceramic steatite. Excellent wiping action of contacts assures flow of most minute currents for receiving positions.
Mounting Data: 4 holes .157" dia.; clearance for 6-32 screws.

Stock Part No.	Contacts	Coil Volts	Coil Ohms	Prices 1-24
W155AX-1	DPDT	115 VAC	400	26.16

Magnecraft® dual-inline package reed relay DIP

(1 form A)



EPOXY MOLDED CONSTRUCTION

class 171DIP — 8-pin SPST-NO — .500 amps

Size: .750" x .260" x .275"
Contact Load Rating: 10VA or .500 amps max. or 100 VDC max. resistive
Contact Combination: SPST-NO (1 form A)
Operate Time: 500 microseconds average
Contact Bounce: Less than 200 microseconds average
Dielectric Withstanding Voltage: Across open contacts; 250 VDC min. Coil to contact; 750 VAC
Contact Resistance: 150 milliohms average
Insulation Resistance: 10^{11} ohms min.
Typical Life at Rated Load: 25 million operations, longer at reduced loads
Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C

class 107DIP

Size: .750 x .250 x .187
Contact Load Rating: 3 VA at .110 amps max. or 28 VDC max. resistive
Contact Combination: SPST-NO (1 form A)
Operate Time: 200 microseconds typical
Dielectric Strength between Contacts: 200 VDC min.
Contact Resistance: 200 milliohms average
Typical Life at Rated Load: 10 million operations, longer at reduced loads
Epoxy molded construction

class 117DIP (1 form A)

Size: .750 x .260 x .210
Contact Load Rating: 10 VA at .250 amps max. or 100 VDC max. resistive
Contact Combination: SPST-NO (1 form A)
Operate Time: 500 microseconds, typical
Dielectric Withstanding Voltage between Contacts: 200 VDC min.
Contact Resistance: 150 milliohms average
Typical Life at Rated Load: 25 million operations, longer at reduced loads. Higher rating up to .5 amp at reduced life
Epoxy molded construction

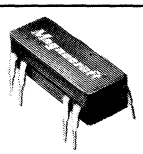
class 173DIP — 8-pin position free mercury wetted SPST-NO —. 110 amps

Size: .750" x .260" x .275"
Contact Load Rating: 3VA or .110 amps max. or 28 VDC max. resistive
Contact Combination: SPST-NO (1 form A)
Operate Time: 500 microseconds average
Contact Bounce: None, with diode suppressed coil
Dielectric Withstanding Voltage: Across open contacts; 250 VDC min. Coil to contact; 750 VAC
Contact Resistance: 150 milliohms average
Insulation Resistance: 10^{11} ohms
Typical Life at Rated Load: 20 million operations, longer at reduced loads
Mechanical Characteristics: Shock 50 g's; ½ sine wave, 11 milliseconds, Vibration 50 g's 10 to 2000 Hz.
Temperature Range: −38°C to +85°C

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts and Contact Ratings	Max. Pickup Voltage	Coil Volts	Coil Ohms†	Typical Power Required	Internal Clamping Diode*	Prices 1-24
W171DIP-1	SPST-NO 1 Form A 10 VA	3.8 VDC	5	200	125 MW	No	2.80
W171DIP-2		3.8 VDC	5	500	50 MW		3.18
W171DIP-3		4.5 VDC	6	500	75 MW		2.80
W171DIP-4		9.0 VDC	12	500	290 MW		2.80
W171DIP-5		18.0 VDC	24	2200	270 MW		3.15
W171DIP-6		3.8 VDC	5	200	125 MW	Yes	3.39
W171DIP-7		3.8 VDC	5	500	50 MW		3.73
W171DIP-8		4.5 VDC	6	500	75 MW		3.39
W171DIP-9		9.0 VDC	12	500	290 MW		3.39
W171DIP-10		18.0 VDC	24	2200	270 MW		3.73
W107DIP-1	SPST-NO 1 Form A 3 VA	3.8 VDC	5	500	50 MW	No	4.00
W107DIP-2		4.5 VDC	6	500	75 MW		3.50
W107DIP-3		9.0 VDC	12	500	300 MW		3.50
W107DIP-4		18.0 VDC	24	1200	500 MW		3.75
W107DIP-5		3.8 VDC	5	500	50 MW	Yes	4.70
W107DIP-6		4.5 VDC	6	500	75 MW		4.20
W107DIP-7		9.0 VDC	12	500	300 MW		4.20
W107DIP-8		18.0 VDC	24	1200	500 MW		4.45
W117DIP-1	SPST-NO 1 Form A 10 VA	3.8 VDC	5	200	125 MW	No	3.55
W117DIP-2		4.5 VDC	6	200	180 MW		3.23
W117DIP-3		9.0 VDC	12	500	300 MW		3.33
W117DIP-4		18.0 VDC	24	1200	500 MW		3.43
W117DIP-5		3.8 VDC	5	200	125 MW	Yes	4.30
W117DIP-6		4.5 VDC	6	200	180 MW		3.92
W117DIP-7		9.0 VDC	12	500	300 MW		3.92
W117DIP-8		18.0 VDC	24	1200	500 MW		4.17
W173DIP-1	SPST-NO 1 Form A 3 VA	3.8 VDC	5	100	250 MW	No	6.25
W173DIP-2		4.5 VDC	6	100	360 MW		5.98
W173DIP-3		9.0 VDC	12	350	420 MW		5.98
W173DIP-4		18.0 VDC	24	1850	320 MW		6.16
W173DIP-5		3.8 VDC	5	100	250 MW	Yes	6.95
W173DIP-6		4.5 VDC	6	100	360 MW		6.66
W173DIP-7		9.0 VDC	12	350	420 MW		6.66
W173DIP-8		18.0 VDC	24	1850	320 MW		6.85

(2 form A)



EPOXY MOLDED CONSTRUCTION

class 117DIP

Size: .750 x .260 x .210
Contact Load Rating: 3 VA at .110 amps max. or 28 VDC max. resistive
Contact Combination: DPST-NO (2 form A)
Operate Time: 400 microseconds typical
Dielectric Strength between Contacts: 200 VDC min.
Contact Resistance: 200 milliohms average
Typical Life at Rated Load: 10 million operations, longer at reduced loads
Epoxy molded construction

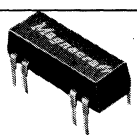
class 171DIP — 8-pin DPST-NO — .110 amps

Size: .750" x .260" x .275"
Contact Load Rating: 3VA or .110 amps max. or 28 VDC max. resistive
Contact Combination: DPST-NO (2 form A)
Operate Time: 700 microseconds average
Contact Bounce: Less than 300 microseconds average
Dielectric Withstanding Voltage: Across open contacts; 200 VDC min. Coil to contact; 750 VAC, Between contact; 750 VAC
Contact Resistance: 200 milliohms average
Insulation Resistance: 10^{10} ohms min.
Typical Life at Rated Load: 10 million operations, longer at reduced loads
Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C

Stock Part No.	Contacts and Contact Ratings	Max. Pickup Voltage	Coil Volts	Coil Ohms†	Typical Power Required	Internal Clamping Diode*	Prices 1-24
W117DIP-9	DPST-NO 2 Form A 3 VA	3.8 VDC	5	200	125 MW	No	5.75
W117DIP-10		4.5 VDC	6	200	180 MW		5.28
W117DIP-11		9.0 VDC	12	500	300 MW		5.28
W117DIP-12		18.0 VDC	24	1200	500 MW		5.60
W171DIP-21	DPST-NO 2 Form A 3 VA 2A	3.8 VDC	5	200	125 MW	No	5.18
W171DIP-22		4.5 VDC	6	200	180 MW		4.98
W171DIP-23		9.0 VDC	12	500	290 MW		4.98
W171DIP-24		18.0 VDC	24	2200	270 MW		5.90
W171DIP-25		3.8 VDC	5	200	125 MW	Yes	6.05
W171DIP-26		4.5 VDC	6	200	180 MW		5.95
W171DIP-27		9.0 VDC	12	500	290 MW		5.95
W171DIP-28		18.0 VDC	24	2200	270 MW		6.18

*This diode prevents back flow of high voltage transients.
†Resistance values ±10% measured at 25°C.

(1 form B)



EPOXY MOLDED CONSTRUCTION

class 117DIP

Size: .750 x .260 x .210
Contact Load Rating: 3 VA at .110 amps max. or 28 VDC max. resistive
Contact Combination: SPST-NC (1 form B)
Operate Time: 200 microseconds typical
Dielectric Withstanding Voltage between Open Contacts: 100 VDC min.
Contact Resistance: 200 milliohms average
Typical Life at Rated Load: 10 million operations, longer at reduced loads. Higher ratings up to .5 amp at reduced life
Epoxy molded construction

class 171DIP — 8-pin SPST-NC — .250 amps

Size: .750" x .260" x .275"
Contact Load Rating: 10 VA or .250 amps max. or 100 VDC max. resistive
Contact Combination: SPST-NC (1 form B)
Operate Time: 400 microseconds average
Contact Bounce: Less than 100 microseconds average
Dielectric Withstanding Voltage: Across open contacts; 250 VDC min. Coil to contact; 750 VAC
Contact Resistance: 150 milliohms average
Insulation Resistance: 10^{11} ohms min.
Typical Life at Rated Load: 10 million operations, longer at reduced loads
Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C

Stock Part No.	Contacts and Contact Ratings	Max. Pickup Voltage	Coil Volts	Coil Ohms†	Typical Power Required	Internal Clamping Diode*	Prices 1-24
W117DIP-13	1 Form B 3 VA	4 VDC	5	500	50 MW	No	4.35
W171DIP-11	SPST-NC 1 Form B 10 VA	3.8 VDC	5	200	125 MW	No	3.58
W171DIP-12		3.8 VDC	5	500	50 MW		3.78
W171DIP-13		4.5 VDC	6	500	75 MW		3.58
W171DIP-14		9.0 VDC	12	500	290 MW		3.58
W171DIP-15		18.0 VDC	24	2200	270 MW		3.75
W171DIP-16		3.8 VDC	5	200	125 MW	Yes	3.85
W171DIP-17		3.8 VDC	5	500	50 MW		4.05
W171DIP-18		4.5 VDC	6	500	75 MW		3.85
W171DIP-19		9.0 VDC	12	500	290 MW		3.85
W171DIP-20		18.0 VDC	24	2200	270 MW		4.04

(1 form C)

EPOXY MOLDED CONSTRUCTION

class 118DIP

Size: .750 x .260 x .210
Contact Load Rating: 6 VA at .250 amps max. resistive
Contact Combination: SPDT (1 form C)
Operate Time: 500 microseconds typical
Dielectric withstanding Voltage between Contacts: 200 VDC min.
Contact Resistance: 200 milliohms average
Typical Life: 5 million at rated load. Longer at reduced loads. Higher rating up to .5 amp at reduced life
Epoxy molded construction

class 172DIP — 8-pin SPDT — .250 amps

Size: .750" x .260" x .275"
Contact Load Rating: 8 VA at .250 amps max. or 100 VDC max. resistive
Contact Combination: SPDT (1 form C)
Operate Time: 500 microseconds average
Contact Bounce: Less than 200 microseconds average
Dielectric Withstanding Voltage: Across open contacts; 250 VDC min.
Contact Resistance: 200 milliohms average
Insulation Resistance: 10^{10} ohms min.
Typical Life at Rated Load: 10 million operations, longer at reduced loads
Mechanical Characteristics: Shock 100 g's; ½ sine wave, 11 milliseconds, Vibration 100 g's 10 to 2000 Hz.
Temperature Range: −55°C to +85°C

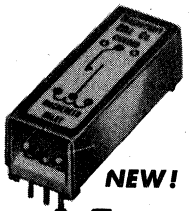
Stock Part No.	Contacts and Contact Ratings	Max. Pickup Voltage	Coil Volts	Coil Ohms†	Typical Power Required	Internal Clamping Diode*	Prices 1-24
W118DIP-1	SPDT 1 Form C 6 VA	3.8 VDC	5	200	125 MW	No	7.80
W118DIP-2		4.5 VDC	6	200	180 MW		7.30
W118DIP-3		9.0 VDC	12	500	290 MW		7.30
W118DIP-4		18.0 VDC	24	1200	500 MW		7.50
W118DIP-5		3.8 VDC	5	200	125 MW	Yes	8.50
W118DIP-6		4.5 VDC	6	200	180 MW		8.00
W118DIP-7		9.0 VDC	12	500	300 MW		8.00
W118DIP-8		18.0 VDC	24	1200	500 MW		8.25
W172DIP-1	SPDT 1 Form C 8 VA	3.8 VDC	5	200	175 MW	No	5.25
W172DIP-2		4.5 VDC	6	200	180 MW		4.97
W172DIP-3		9.0 VDC	12	500	290 MW		4.97
W172DIP-4		18.0 VDC	24	2200	270 MW		5.29
W172DIP-5		3.8 VDC	5	200	175 MW	Yes	5.60
W172DIP-6		4.5 VDC	6	200	180 MW		5.38
W172DIP-7		9.0 VDC	12	500	290 MW		5.38
W172DIP-8		18.0 VDC	24	2200	270 MW		5.70

*This diode prevents back flow of high voltage transients.
†Resistance values ±10% measured at 25°C.

MAGNECRAFT® ELECTRIC COMPANY • 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282 5500 • TWX 910-221-5221

Magnecraft® mercury wetted relays

class 137MPC position-free mercury wetted reed relay



NEW!

Size: 1⅛ x 13/32 x ⅜
Contact Load Rating: 1 Volt-amperes max. at .100 amperes max. or 10 VDC max. resistive
Nominal Coil Power: 500 MW
Operate and Release Time: .5 millisecond average
Contact Bounce: None, with diode suppressed coil
Dielectric withstanding Voltage between Contacts: 500 VDC
Dielectric withstanding Voltage between Contacts and Coil: 500 VAC, RMS
Contact Resistance: 100 milliohms average
Typical Life at Rated Load: 20,000,000 operations; longer at reduced loads
Note: To Achieve Bounce-Free Operation Provide Diode Across Coil.

IN STOCK FOR IMMEDIATE DELIVERY

Cat. No.	Contact Combination	Max. Pickup Voltage	COIL DC Volts	COIL DC Ohms	Price 1-24
W137MPCX-1	SPST-NO (1 Form A)	4.8 VDC	6	70	6.34
W137MPCX-2		9.6 VDC	12	300	6.34
W137MPCX-3		19.2 VDC	24	1100	6.34

Magnecraft® miniature dry reed relays

IN STOCK FOR IMMEDIATE DELIVERY

class 101M & 104M

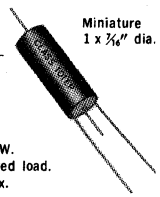
- 101M — SPST-NO — 10 VA @ 0.5 amp.
- 104M — SPDT — 3 VA @ .25 amp.
- In-line axial lead.
- Molded bobbin.
- Nom. Power: 101M, 600 MW 104M, 500 MW.
- Life: 10 x 10^6 at rated load.
- Weight: 1 oz. approx.

Miniature 1 x ½ x 7/16"

LOW COST

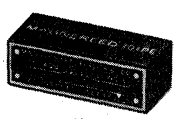
class 101EP & 104EP

Miniature 1 x 7/16" dia.

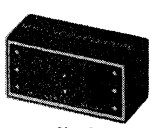


- 101EP — SPST-NO — 10 VA @ .5 amp.
- 104EP — SPDT — 3 VA @ .25 amp.
- In-line axial lead.
- Encapsulated.
- Nom. Power: 600 MW.
- Life: 10 x 10^6 at rated load.
- Weight: 1 oz. approx.

class 101PC & 104PC



Size 1
SPST-NO or SPDT
1½ x ½ x 9/16"

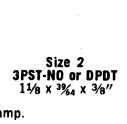


Size 2
DPST-NO or DPDT
1½ x 11/16 x 9/16"

- 101PC — 10 VA @ .5 amp.
- SPST-NO — DPST-NO.
- 104PC — 3 VA @ .25 amp.
- SPDT, DPDT.
- Encapsulated — Printed circuit mtg.
- Nom. Power: Size 1: 600 MW Size 2: 900 MW.
- Life: 10 x 10^6 at rated load.
- Weight: 1 oz. approx.

class 101MPC & 104MPC

Size 1
SPST-NO or SPDT
1⅛ x 13/32 x ⅜"



Size 2
3PST-NO or DPDT
1⅛ x 39/64 x ⅜"

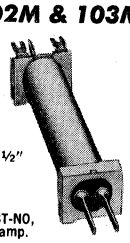
- 101MPC — 10 VA @ .5 amp.
- SPST-NO or 3PST-NO.
- 104MPC — 3 VA @ .25 amp.
- SPDT or DPDT.
- Printed circuit mtg. — Low profile.
- Nom. Power: Size 1: 500 MW Size 2: 700MW.
- Life: 10 x 10^6 at rated load.
- Weight: Size 1: 1 oz. Size 2: 2 oz. approx.

Stock Part No.	Contacts	COIL — DC ‡MA	COIL — DC †Volts	COIL — DC *Ohms	Prices 1-24
W101MX-1	SPST-NO	—	6	100	2.20
W101MX-2		—	12	250	2.25
W101MX-3		—	24	500	2.25
W101MX-4		9	—	2500	2.43
W104MX-1	SPDT	—	6	100	5.63
W104MX-2		—	12	250	5.68
W104MX-3		—	24	500	5.68
W104MX-4		9	—	2500	5.87
W101EPX-5	SPST-NO	—	6	65	3.80
W101EPX-6		—	12	225	3.80
W101EPX-7		—	24	1000	4.45
W101EPX-8		8	—	5000	4.91
W104EPX-2	SPDT	—	6	65	7.74
W104EPX-3		—	12	225	7.74
W104EPX-4		—	24	1000	8.45
W104EPX-5		8	—	5000	8.98
W101PCX-5	SPST-NO Size 1	—	6	65	5.37
W101PCX-6		—	12	250	5.42
W101PCX-7		—	24	1000	5.52
W101PCX-8		8	—	5000	5.96
W104PCX-7	SPDT Size 1	—	6	65	10.57
W104PCX-8		—	12	225	10.63
W104PCX-9		—	24	1000	10.73
W104PCX-10		8	—	5000	11.17
W101PCX-9	DPST-NO Size 2	—	6	40	7.51
W101PCX-10		—	12	150	7.54
W101PCX-11		—	24	650	7.60
W101PCX-12		8	—	5000	8.07
W104PCX-3	DPDT Size 2	—	6	40	15.32
W104PCX-4		—	12	150	15.35
W104PCX-5		—	24	650	15.41
W104PCX-6		8	—	5000	15.89
W101MPCX-1	SPST-NO	—	6	70	3.60
W101MPCX-2		—	12	300	3.60
W101MPCX-3		—	24	1100	3.63
W101MPCX-4		—	48	4300	3.77
W104MPCX-1	SPDT Size 1	—	6	70	6.82
W104MPCX-2		—	12	300	6.83
W104MPCX-3		—	24	1100	6.85
W104MPCX-4		—	48	4300	6.98
W101MPCX-5	3PST-NO Size 2	—	6	50	6.75
W101MPCX-6		—	12	220	6.75
W101MPCX-7		—	24	850	6.77
W101MPCX-8		—	48	3300	6.85
W104MPCX-5	DPDT Size 2	—	6	50	11.62
W104MPCX-6		—	12	220	11.63
W104MPCX-7		—	24	850	11.65
W104MPCX-8		—	48	3300	11.73

Magnecraft® standard reed relays

IN STOCK FOR IMMEDIATE DELIVERY

class 102M & 103M

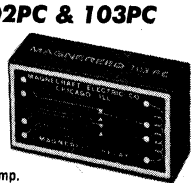


Size
2⅛ x 13/32 x ½"

- 102M — SPST-NO, 15 VA @ 1 amp.
- 103M — SPDT, 10 VA @ .5 amp.
- In-line axial lead.
- Molded bobbin.
- Nom. Power: 300 MW.
- Life: 20 x 10^6 at rated load.
- Weight: 1 oz. approx.

class 102PC & 103PC

Size 1
SPST-NO or SPDT
2¼ x 21/32 x 5/8"

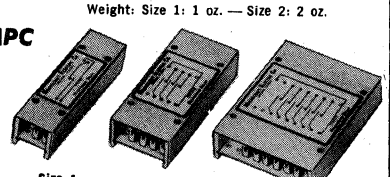


Size 2
DPST-NO or DPDT
2¼ x 1¼ x 5/8"

- 102PC — 15 VA @ 1 amp.
- SPST-NO or DPST-NO.
- 103PC — 10 VA @ .5 amp.
- SPDT or DPDT.
- Encapsulated — Printed circuit mtg.
- Nom. Power: Size 1: 400 MW. Size 2: 700 MW.

Life: 20 x 10^6 at rated load.
Weight: Size 1: 1 oz. — Size 2: 2 oz.

class 102MPC & 103MPC



Size 1
SPST-NO or SPDT
2⅝ x ¾ x 41/64"

Size 2
3PST or DPDT
2⅝ x 1 13/16 x 41/64"

Size 3
6PST-NO or 4PDT
3⅝ x 1 51/64 x 41/64"

- 102MPC — 15 VA @ 1 amp.
- Size 1: SPST-NO — Size 2: 3PST-NO — Size 3: 6PST-NO.
- 103MPC — 10 VA @ .5 amp.
- Size 1: SPDT — Size 2: DPDT — Size 3: 4PDT.
- Printed circuit mtg. — low profile.
- Nom. Power: Size 1: 500 MW — Size 2: 750 MW — Size 3: 1.5 W.

Life: 20 x 10^6 at rated load.

- Weight: Size 1: 1 oz. — Size 2: 2 oz. — Size 3: 3 oz. approx.

*Resistance Values ±10% at 25°C.
†Voltage Specified Relays pull in at 80% of nominal or less for DC relays at 25°C.
††Current Specified Relays pull in at Specified Value or less.

Stock Part No.	Contacts	COIL — DC ‡MA	COIL — DC †Volts	COIL — DC *Ohms	Prices 1-24
W102MX-1	SPST-NO	40	—	100	2.29
W102MX-2		—	6	200	2.36
W102MX-3		—	12	500	2.36
W102MX-4		—	24	2000	2.59
W102MX-5		5.5	—	5000	2.76
W103MX-1	SPDT	—	6	200	4.44
W103MX-2		—	12	500	4.44
W103MX-3		—	24	2000	4.67
W103MX-4		5.5	—	5000	4.85
W102PCX-1	SPST-NO Size 1	—	6	100	5.01
W102PCX-2		—	12	400	5.07
W102PCX-3		—	24	1500	5.11
W102PCX-4		6.5	—	5000	5.59
W103PCX-1	SPDT Size 1	—	6	100	7.58
W103PCX-2		—	12	400	7.63
W103PCX-3		—	24	1500	7.69
W103PCX-4		6.5	—	5000	8.15
W102PCX-5	DPST-NO Size 2	—	6	50	6.53
W102PCX-6		—	12	200	6.59
W102PCX-7		—	24	800	6.65
W102PCX-8		9	—	5000	7.12
W103PCX-5	DPDT Size 2	—	6	50	11.31
W103PCX-6		—	12	200	11.33
W103PCX-7		—	24	800	11.38
W103PCX-8		9	—	5000	11.88
W102MPCX-5	SPST-NO	140	—	30	3.45
W102MPCX-6		—	6	70	3.45
W102MPCX-7		—	12	250	3.45
W102MPCX-8		—	24	1000	3.45
W102MPCX-9		—	48	4000	3.63
W102MPCX-10		9	—	7000	4.35
W102MPCX-48	3PST-NO	—	6	50	5.90
W102MPCX-49		—	12	175	5.90
W102MPCX-50		—	24	750	6.06
W102MPCX-51		—	48	3000	6.27
W102MPCX-52	6PST-NO	—	6	25	9.64
W102MPCX-53		—	12	100	9.77
W102MPCX-54		—	24	375	9.82
W102MPCX-55		—	48	1500	9.90
W103MPCX-1	SPDT	140	—	30	6.12
W103MPCX-2		—	6	70	6.12
W103MPCX-3		—	12	250	6.12
W103MPCX-4		—	24	1000	6.12
W103MPCX-5		—	48	4000	6.30
W103MPCX-6		9	—	7000	7.01
W103MPCX-30	DPDT	—	6	50	8.75
W103MPCX-31		—	12	175	8.75
W103MPCX-32		—	24	750	8.89
W103MPCX-33		—	48	3000	9.10
W103MPCX-34	4PDT	—	6	25	15.33
W103MPCX-35		—	12	100	15.44
W103MPCX-36		—	24	375	15.51
W103MPCX-37		—	48	1500	15.62

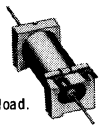
Magnecraft® reed relays

IC compatible reed relays

class/101M & 104M

SPST-NO, 101M — 10 VA @ 0.5 amp. max. resistive.
SPDT, 104M — 3 V @ 0.25 amp. max. resistive.
In-Line Axial Lead.
Molded Bobbin.

Nom. Power: 50 MW (Sensitive).
Life: 5 x 10^6 at rated load.
Weight: 1 oz. approx.

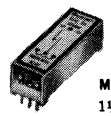


Miniature Size
2¼ x ½ x 7/16"

class 101MPC & 104MPC

SPST-NO 101MPC — 10 VA @ 0.5 amp. max. resistive.
SPDT 104MPC — 3 VA @ 0.25 amp. max. resistive. Printed Circuit — Low Profile.
Molded Bobbin and Steel Cover.

Nom. Power: 101MPC 50 MW, 104MPC 80 MW.
Life: 5 x 10^6 at rated load.
Weight: 1 oz. approx.



Miniature Size
1⅛ x 11/32 x ⅜"

IN STOCK FOR IMMEDIATE DELIVERY

Stock Part No.	Contacts	Max. Pick-up Voltage	COIL — DC Volts	COIL — DC *Ohms	Prices 1-24
CLASS 101M					
W101MX-35	SPST-NO	4VDC	5	500	2.81
W101MX-41		2.4VDC	3	250	2.81
CLASS 104M					
W104MX-9	SPDT	4VDC	5	500	6.51
W104MX-10		2.4VDC	3	250	6.51
CLASS 101MPC					
W101MPCX-104	SPST-NO	4VDC	5	450	4.33
CLASS 104MPC					
W104MPCX-46	SPDT	4VDC	5	300	7.91

class 105MPC

SPST-NO 0.1 VA @ 10 MA. max. resistive.
Printed Circuit Mtg. — Low Profile.
Molded Bobbin — Steel Cover.

Nom. Power: 300 MW.
Life: 10 x 10^6 at rated load.
Weight: 1 oz. approx.

Micro-Miniature
⅝ x 5/16 x 11/32"

Stock Part No.	Contacts	‡MA	†Volts	*Ohms	Prices 1-24
W105MPCX-1	SPST-NO	—	6	120	5.72
W105MPCX-2		—	12	500	5.74
W105MPCX-3		—	24	2000	5.86

class 105EP

SPST-NO 0.1 VA @ 10 MA. max. resistive.
Encapsulated-In-Line
Axial Leads.

Nom. Power: 400 MW.
Life: 10 x 10^6 at rated load.
Weight: 1 oz. approx.

Micro-Miniature
7/16 x ¼" dia.

W105EPX-1	SPST-NO	—	6	90	6.49
W105EPX-2		—	12	350	6.49
W105EPX-3		—	24	1300	6.62

class 101MPC low cost!

SPST-NO 10VA @ .5 amp. max. resistive.
Printed Circuit Mtg.
Molded Bobbin.

Nom. Pow: 500MW
Life: 5 x 10^6 at rated load.
Weight: 1 oz. approx.

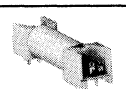
Miniature Size
1⅛ x ⅜ x ⅜"

W101MPCX-122	SPST-NO	—	6	70	2.78
W101MPCX-123	.5 amp	—	12	300	2.78
W101MPCX-124		—	24	1100	2.78

class 102MPC low cost!

SPST-NO 15VA @ 1 amp.
Printed Circuit Mtg.
Molded Bobbin.

Nom. Pow: 500MW
Life: 20 x 10^6 at rated load
Weight: 1 oz. approx.

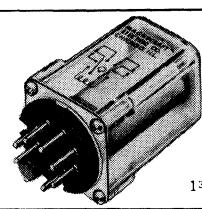


Small Size
⅝ x ⅜ x 23/32"

W102MPCX-146	SPST-NO	—	6	70	2.63
W102MPCX-147	1 amp	—	12	250	2.63
W102MPCX-145		—	24	1000	2.63

class 103CP plug-in mtg.

10 VA @ 0.5 amp. max. resistive.
DPDT or 3PDT.
8 or 11 Pin Octal Style Plug.
Nom. Power: DPDT 500 MW — 3PDT 900 MW
Life: 25 x 10^6 at rated load.
Weight: 5 oz. approx.



Small Size
1⅜ x 1⅜ x 2⅜"

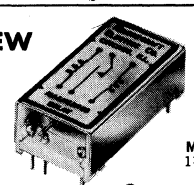
Stock Part No.	Contacts	‡MA	†Volts	*Ohms	Prices 1-24
W103CPX-7	DPDT	—	6	75	13.57
W103CPX-8		—	12	300	13.60
W103CPX-9		—	24	1000	13.66
W103CPX-10		8	—	5000	14.25
W103CPX-11	3PDT	—	6	40	17.61
W103CPX-12		—	12	150	17.67
W103CPX-13		—	24	650	17.80
W103CPX-14		10	—	5000	18.38

Magnetic latching reed relay class 101LMPC

NEW

Uses no biasing magnet — no standby power

SPST 3 VA @ .010 amp. or 28 VDC max. resistive.
Double Wound Coil.
Molded Bobbin and Steel Cover.
Printed Circuit Mounting-Low Profile
Intermittent Duty, 50% Duty Cycle, 4 min. max. on time.
Life: 1 x 10^6 at rated load.
Vibration and Shock Resistant.

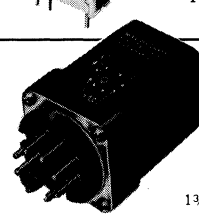


Miniature Size
1⅛ x ⅜ x 39/64"

Stock Part No.	Con-tacts	COIL Min. VDC	Nom. VDC	Max. VDC	*Ohms	Prices 1-24
W101LMPCX-10	SPST	4	5	6	RMV. 9.2/80	9.66
W101LMPCX-11		4	6	8	15/130	
W101LMPCX-12		10	12	14	65/525	
W101LMPCX-13		22	24	26	300/2000	

††class 103LCP plug-in mtg.

Latching-Bi-Stable.
SPDT 10 VA @ 0.2 amp. max. resistive.
Single and Double Wound Coils.
8 or 11 Pin Octal Style Plug.
Nom. Power: Single Coil 150 MW — Double Coil 300 MW.
Life: 25 x 10^6 at rated load.
Weight: 5 oz. approx.

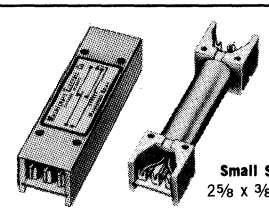


Small Size
1⅜ x 1⅜ x 2 11/16"

Single Wound Coils					
W103LCPX-7	SPDT	—	6	250	8.72
W103LCPX-8		—	12	1000	8.75
W103-LCPX-9		—	24	4000	9.00
W103LCPX-10		4	—	7000	9.24
Double Wound Coils					
W103LCPX-11	SPDT	—	6	120/120	10.36
W103LCPX-12		—	12	460/460	10.47
W103LCPX-13		—	24	1800/1800	10.52
W103LCPX-14		8	—	3000/3000	10.84

††class 103LMPC

Latching-Bi-Stable.
SPDT 10 VA @ 0.2 amp. max. resistive.
Single and Double Wound Coils.
Molded Bobbin and Steel Cover.
Printed Circuit Mtg. — Low Profile.
Nom. Power: Single Coil 150 MW — Double Coil 300 MW.
Life: 25 x 10^6 at rated load.
Weight: 1 oz. approx.

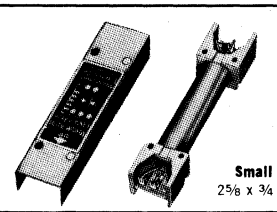


Small Size
2⅝ x ⅜ x 4 1/64

Single Wound Coils					
W103LMPCX-3	SPDT	40	—	70	7.42
W103LMPCX-4		—	6	250	7.42
W103LMPCX-5		—	12	1000	7.42
W103LMPCX-6		—	24	4000	7.62
W103LMPCX-7		4	—	7000	8.41
Double Wound Coils					
W103LMPCX-8	SPDT	80	—	30/30	8.63
W103LMPCX-9		—	6	120/120	8.75
W103LMPCX-10		—	12	460/460	8.75
W103LMPCX-11		—	24	1800/1800	9.45
W103LMPCX-12		8	—	3000/3000	10.54

††class 133LMPC

Latching-Bi-Stable.
SPDT 50 VA @ 2 amp. max. resistive.
Mercury Wetted Contacts.
Single and Double Wound Coils.
Molded Bobbin — Steel Cover.
Printed Circuit Mtg.
Nom. Power: Single Coil 150 MW — Double Coil 300 MW.
Life: 25 x 10^6 at rated load.



Small Size
2⅝ x ¾ x 4 1/64"

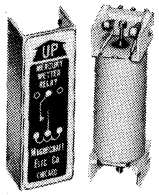
Single Wound Coils					
W133LMPCX-17	SPDT	40	—	70	10.36
W133LMPCX-18		—	6	250	10.36
W133LMPCX-19		—	12	1000	10.42
W133LMPCX-20		—	24	4000	10.57
W133LMPCX-21		4	—	7000	10.68
Double Wound Coils					
W133LMPCX-22	SPDT	80	—	30/30	11.79
W133LMPCX-23		—	6	120/120	11.81
W133LMPCX-24		—	12	460/460	11.89
W133LMPCX-25		—	24	1800/1800	11.99
W133LMPCX-26		8	—	3000/3000	12.08

*Resistance Values ±10% at 25°C. †Voltage Specified Relays pull in at 80% of nominal or less for DC relays at 25°C. ††Single Wound Coil — Switches by reversing polarity. Double Wound Coil — Switching by use of dual input. ‡Current specified relays pull-in at specified values or less.

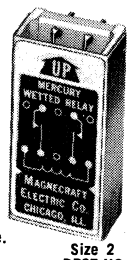
MAGNECRAFT® ELECTRIC COMPANY • 5575 NORTH LYNCH AVENUE • CHICAGO, ILLINOIS 60630 • (312) 282-5500 • TWX 910-221-5221

Magnecraft® mercury wetted relays

class 131MPC



Size 1
SPST-NO
1⅛ x 1⅛₂ x ⅜"



Size 2
DPST-NO
1⅛ x ³⁹⁄₆₄ x ⅜"

28 VA @ 1 amp. max. resistive.
Miniature.
Mercury Wetted Contacts.
Molded Bobbin and Steel Cover.
Printed Circuit Mtg. —
Low Profile.
Operating Position: Upright.
Nom. Power: Size 1 — 500 MW,
Size 2 — 700 MW.
Life: 50 x 10⁶ at rated load.
Wt. Size 1: 1 oz. — Size 2: 2 oz.

class 131PC

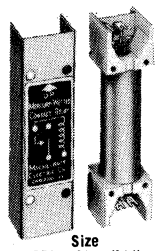
Size 1
SPST-NO
1½ x ½ x ⁹⁄₁₆"

Size 2
DPST-NO
1½ x ¹¹⁄₁₆ x ⁹⁄₁₆"

28 VA @ 1 amp. max. resistive.
Encapsulated — Miniature.
Mercury Wetted Contacts.
Printed Circuit Mtg. —
Low Profile.
Operation Position: Upright.
Nom. Power: Size 1 — 600 MW,
Size 2 — 900 MW.
Life: 50 x 10⁶ at rated load.
Wt. Size 1: 1 oz. — Size 2: 2 oz.

class 132MPC & 133MPC

132MPC — SPST-NO — 50 VA @ 3 amp. max. resistive.
133MPC — SPDT — 50 VA @ 2 amp.
Operating Position: Upright.
Printed Circuit Mtg.
Molded Bobbin and Steel Cover.
Nom. Power: 500 MW.
Life: 50 x 10⁶ at rated load.
Weight: 2 oz. approx.



Size
2⅝ x ¾ x ⁴¹⁄₆₄"

IN STOCK FOR IMMEDIATE DELIVERY

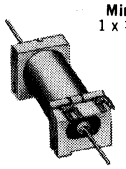
Stock Part No.	Contacts	COIL—DC †Volts	COIL—DC *Ohms	PRICES 1-24
W131MPCX-2	SPST-NO	6	70	6.72
W131MPCX-3		12	300	6.80
W131MPCX-4		24	1100	6.86
W131MPCX-5		48	4300	7.33
W131MPCX-6	DPST-NO	6	50	12.11
W131MPCX-7		12	220	12.16
W131MPCX-8		24	850	12.23
W131MPCX-9		48	3300	12.53

Stock Part No.	Contacts	COIL—DC ††MA	COIL—DC †Volts	COIL—DC *Ohms	PRICES 1-24
W131PCX-8	SPST-NO	—	6	65	8.80
W131PCX-9		—	12	250	8.86
W131PCX-10		—	24	1000	8.98
W131PCX-11		8	—	5000	9.46
W131PCX-12	DPST-NO	—	6	40	11.15
W131PCX-13		—	12	150	11.19
W131PCX-14		—	24	650	11.25
W131PCX-15		8	—	5000	11.77
W132MPCX-1	SPST-NO	140	—	30	6.12
W132MPCX-2		—	6	70	6.12
W132MPCX-3		—	12	250	6.12
W132MPCX-4		—	24	1000	6.12
W132MPCX-5		—	48	4000	6.30
W132MPCX-6		9	—	7000	7.01
W133MPCX-1	SPDT	140	—	30	8.84
W133MPCX-2		—	6	70	8.84
W133MPCX-3		—	12	250	8.84
W133MPCX-4		—	24	1000	8.84
W133MPCX-5		—	48	4000	9.03
W133MPCX-6		9	—	7000	9.82

Magnecraft® high voltage reed relays

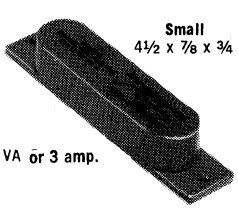
class 101VM

1 VA max.
1,000 volts Peak @
.001 amp. max. resistive.
SPST-NO — Hi-Voltage.
In-Line Axial Leads.
Molded Bobbin.
Nom. Power 600 MW.
Life: 1 x 10⁶ at rated load.
Weight: 1 oz. approx.



Miniature
1 x ½ x ⁷⁄₁₆"

class 102V

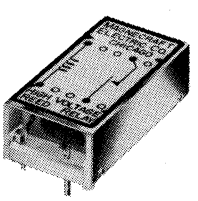


Small
4½ x ⅞ x ¾

5,000 volts Peak or 50 VA or 3 amp.
max. resistive.
SPST-NO or SPST-NC.
Solder Terminals.
Nom. Power: SPST-NO — 500 MW, SPST-NC — 225 MW.
Life: 10 x 10⁶ at rated load.
Weight: 3 oz. approx.

class 101VMPC

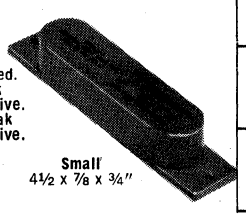
1 VA max.
1,000 volts Peak @ .001 amp.
max. resistive.
SPST-NO — Hi-Voltage.
Printed Circuit Mtg. —
Low Profile.
Nom. Power: 700 MW.
Life: 1 x 10⁶
at rated load.
Weight: 2 oz. approx.



Miniature
1⅛ x ³⁹⁄₆₄ x ⅜"

class 102HV & 102UHV

Molded Case — Encapsulated.
102HV — 10,000 volts Peak
@ .001 amp. max. resistive.
102UHV — 20,000 volts Peak
@ .001 amp. max. resistive.
SPST-NO — Hi-Voltage.
102HV Solder Terminals —
102UHV 6" Coil Leads.
Nom. Power: 1.5 W.
Life: 1 x 10⁶ at rated load.
Weight: 2 oz. approx.



Small
4½ x ⅞ x ¾"

IN STOCK FOR IMMEDIATE DELIVERY

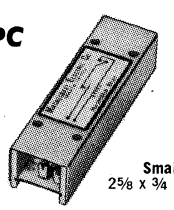
Stock Part No.	Contacts	COIL — DC ‡MA	COIL — DC †Volts	COIL — DC *Ohms	Prices 1-24
W101VMX-1	SPST-NO	—	6	100	11.45
W101VMX-2		—	12	250	11.47
W101VMX-3		—	24	500	11.48
W101VMX-4		9	—	2500	11.68
W101VMPCX-1	SPST-NO	—	6	50	12.50
W101VMPCX-2		—	12	220	12.57
W101VMPCX-3		—	24	850	12.60
W101VMPCX-4		—	48	3300	12.83
W102VX-49	SPST-NO	—	6	70	14.37
W102VX-50		—	12	250	14.42
W102VX-51		—	24	1000	14.47
W102VX-52		—	48	4000	14.86
W102HVX-1	SPST-NO	—	6	25	20.87
W102HVX-2		—	12	100	20.87
W102HVX-3		—	24	400	20.87
W102UHVX-1	SPST-NO	—	6	25	35.30
W102UHVX-2		—	12	100	35.30
W102UHVX-3		—	24	400	35.30

Stock Part No.	Contacts	COIL — DC †Volts	COIL — DC *Ohms	Nominal Power	Prices 1-24
W102VX-55	SPST-NC	24	2900	225mw	17.60

Magnecraft® power reed relays

IN STOCK FOR IMMEDIATE DELIVERY

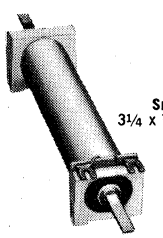
class 102RMPC



Small
2⅝ x ¾ x ⁴¹⁄₆₄"

100 VA @ 3 amps max.
resistive. SPST-NO.
Printed Circuit Mtg. —
Low Profile.
Molded Bobbin and
Steel Cover.
Nom. Power:
500 MW.
Weight: 1 oz. approx.

class 102RM



Small
3¼ x ¹⁹⁄₃₂ x ½"

100 VA @ 3 amps max.
resistive.
SPST-NO.
Molded Bobbin.
In-Line Axial Leads
Nom. Power: 500 MW.
Weight: 1 oz. approx.

Stock Part No.	Contacts	COIL — DC ‡MA	COIL — DC †Volts	COIL — DC *Ohms	Prices 1-24
W102RMPCX-1	SPST-NO	—	6	70	8.26
W102RMPCX-2		—	12	250	8.27
W102RMPCX-3		—	24	1000	8.33
W102RMPCX-4		—	48	4000	8.59
W102RMX-5	SPST-NO 3-amps.	—	6	200	4.39
W102RMX-6		—	12	500	4.43
W102RMX-7		—	24	2000	4.55
W102RMX-8		—	48	5000	4.76

*Resistance Values ±10% at 25°C.
†Voltage Specified Relays pull in at 80% of nominal or less for DC relays at 25°C.
††Current Specified Relays pull in at Specified Value or less.

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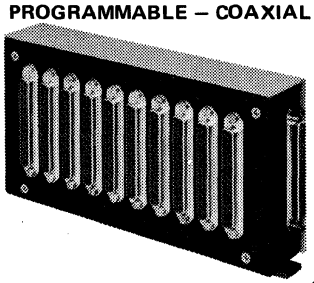
MATRIX

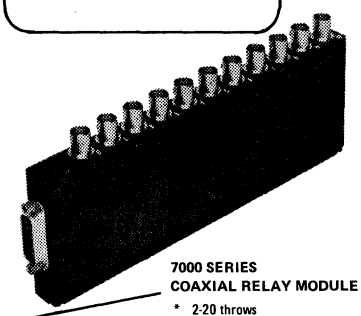
SYSTEMS CORPORATION
9411 Lurline Avenue • Chatsworth, California 91311
(213) 882-2008

COAXIAL SWITCHING SYSTEMS

PROGRAMMABLE – COAXIAL RELAY MATRIX



MODULAR ASSEMBLY



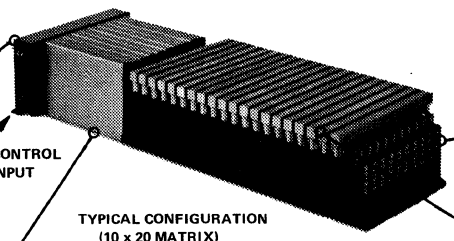
7000 SERIES COAXIAL RELAY MODULE

- 2-20 throws
- 106 dB isolation @ 100 MHz
- 100 watt switching
- DC-300 MHz
- Switched shield
- Self terminating
- 50 or 75 ohm
- Machined housing

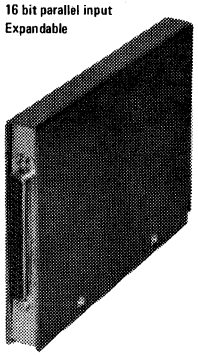
MODEL 6310 DECODE MODULE

- Computer controllable
- BCD input
- TTL/DTL compatible
- Decodes 200 switchpoints
- 16 bit parallel input
- Expandable

CONTROL INPUT

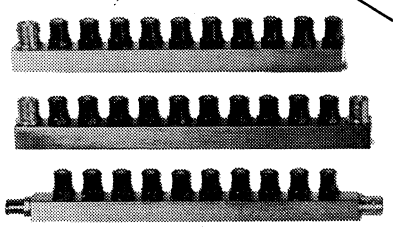


TYPICAL CONFIGURATION (10 x 20 MATRIX)



6100 SERIES LOGIC MODULE

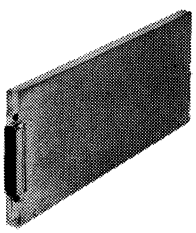
- Controls 2-20 switchpoints
- TTL/DTL compatible
- X - Y addressable
- 28 VDC control output
- Latching
- J - K flipflops
- Hex gate drivers



PUSH-ON CROSS STRAP
9100 SERIES
9200 SERIES
9300 SERIES

CROSS STRAPS INTERCONNECT COAXIAL RELAYS TO FORM CROSSBAR CONFIGURATION.

TWO WIRE AUDIO RELAY MODULE

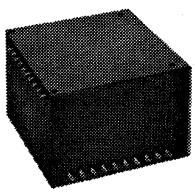


FEATURES:

- Programmable
- Two pole-twenty throw
- Contains four independent two pole, five throw relays
- Dry reed or mercury wetted contacts available
- Independent control
- Compatible with 6100 series latching and drive module
- May be connected in a 2 x 10 or 4 x 5 matrix configuration
- Reed switches easily accessible

MODEL 6157

10 x 10 VIDEO RELAY MATRIX

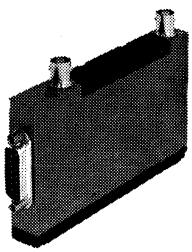


FEATURES:

- Any of ten inputs may be connected to any of ten outputs
- Computer programmable
- Random addressable
- Low VSWR
- Signal circuits isolated from control circuitry
- Switchpoints individually field replaceable
- Stripline construction
- SMA connectors

MODEL 6160

PROGRAMMABLE COAXIAL ATTENUATOR

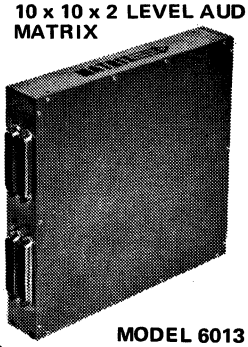


FEATURES:

- 0 - 63 dB Range
- One dB steps - .5 dB optional
- Pure six bit binary control
- Low VSWR
- Continuous shield continuity
- Signal circuits isolated from control circuitry
- Attenuator elements field replaceable
- Compatible with 6100 series latching logic

MODEL 6152

10 x 10 x 2 LEVEL AUDIO RELAY MATRIX

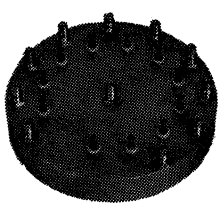


FEATURES:

- Random access
- Balanced switching
- Flexible format
- 1 ms switching
- Scanner capability
- Programmable
- DC - 100 KHz

MODEL 6013

RADIAL RELAY

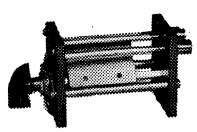


FEATURES:

- 10 throws
- Matched port to port delay
- Low VSWR
- 5 VDC control
- 50 ohm
- Machined housing
- Coaxical construction
- SMA connectors

MODEL 6210

R.F. ROTARY SWITCH



FEATURES:

- Two throw
- Center off
- Self terminating
- 50 or 75 ohm
- Hermetically sealed contacts
- Panel mount
- BNC connectors
- Low VSWR
- High Isolation

MODEL 6172

Matrix Systems Corporation manufactures a variety of Switching Devices. Whether you are Switching VHF, Video, Pulse or Audio or your control requirements are programmable or manual. Give us a call. We specialize in specials. (213) 882-2008

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THE TOTAL RELAY COMPANY

We're relay people. Industrial relays? We build 'em! Mercury wetted! We build 'em! Time Delays and Coaxial Crystal Cans? We build those, too! And many more special application relays. We know relays. We understand relays. We solve relay problems. Let us prove it. Midtex, the Total Relay Company.

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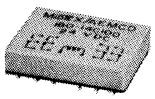
INDUSTRIAL RELAYS

MERCURY WETTED RELAYS

TYPE 155	TYPE 180/1		TYPE 159	TYPE 160
				
U/L Recognized 1, 2, & 3 PDT 5 & 10 amp	U/L Recognized 2 & 4 PDT Low Level to 2 amp	**CONTACTS**	1 PDT Form C or D 2 amp	1 PDT Form C or D 2 amp
6 to 240 VAC 6 to 110 VDC	5 to 48 VDC	**COILS**	0.28 to 120 VDC 1 & 2 Coils	0.28 to 120 VDC 1 & 2 Coils
Open and Dust Cover 1-7/16"x1-17/32"x 2-9/32"	Dust Cover 0.340" High 180:1.4"x1.2"x0.34" 181:1.1"x1.2"x0.34"	**ENCLOSURES**	Bi-Stable Monostable Polar	Bi-Stable Monostable Polar
Solder, Plug-in, Wire-wrap, 3/16" Quick Disconnect	Printed Circuit	**TERMINALS**	.040" PCB Pins	.025" PCB Pins

NEW WIRE-WRAP RELAY SOCKETS*

*Trademark Gardner Denver Co.

TYPE 670-0020

First in the Industry.
Specifically designed for the
4 PDT 3 Ampere Type 156 Relay.

NUMBER OF TERMINALS
14
TERMINAL SIZE
.031"x.062"x0.75"
NUMBER OF WRAPS (Max.)
3
SOCKET BODY
U/L Approved G.P. Phenolic
MOUNTING CENTERS
1.3" (2-0.16" D.A. Holes)
ACCEPTS
20 to 26 AWG Solid Leadwires

TYPE 156	INDUSTRIAL RELAYS	TYPE 157
U/L Recognized 1, 2, 3 & 4 PDT Low Level to 3 amp	**CONTACTS**	U/L Recognized 1, 2 & 3 PDT 5 & 10 amp
6 to 240 VAC 6 to 110 VDC	**COILS**	6 to 240 VAC 6 to 110 VDC
Dust Cover and Hermetically Sealed* 1.109"x.859"x1.281"	**ENCLOSURES**	Open and Dust Cover 1.525"x1.40"x1.905"
Solder/Plug-in, Printed Circuit, #78 Taper Tab	**TERMINALS**	Solder/Plug-in, 3/16" Quick Disconnect

TYPE 670-0034

First in the industry.
Specifically designed for the
3 PDT 5 & 10 Amp Type 157 Relay
and 613 Time Delay.

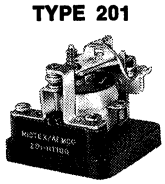
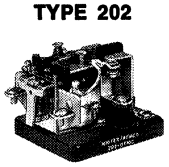
NUMBER OF TERMINALS
11
TERMINAL SIZE
.031"x.062"x0.75"
NUMBER OF WRAPS (Max.)
3
SOCKET BODY
U/L Approved G.P. Phenolic
MOUNTING CENTERS
1.687" (2-.170" Dia. Holes)
ACCEPTS
20 to 26 AWG Solid Leadwires

*Not U/L Recognized

TIME DELAY RELAYS

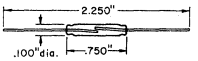
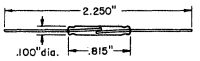
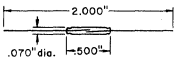
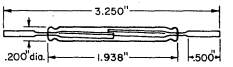
TYPE 615		TYPE 613
12, 24, 48 VDC 120 VAC	**INPUT VOLTAGES**	24-110 VDC 24-120 VAC
1 to 3 PDT, 10 amp, 120/240 VAC	**CONTACTS**	1 to 2 PDT, 10 amp 120/240 VAC
Plug-in, Solder or Screw	**TERMINALS**	Plug-in, solder 3/16" QDC
Delay on Operate Delay on Release Repeat Cycle Timing	**DELAY TYPES**	Delay on Operate
0.1 to 1 sec., 1-100 1 to 10 sec., 1-300	**DELAY RANGE**	1 to 100 sec. 3 to 300 sec.
2% at nom. volt. 10% over range.	**REPEAT ACCURACY**	3% at nom. volt. 10% over range.
—40°F. to +150°F.	**TEMPERATURE RANGE**	—40°F. to +150°F.

POWER RELAYS

TYPE 201		TYPE 202
		
SPDT 30 amps resistive @ 277 VAC 1 H.P. @ 120/240 VAC	**CONTACTS**	DPDT 30 amps @ 240 VAC 1 H.P. @ 12/240 VAC
6 to 125 VDC 6 to 480 VAC	**COILS**	6 to 125 VDC 6 to 480 VAC
Screw, ¼" QDC	**TERMINALS**	Screw, ¼" QDC

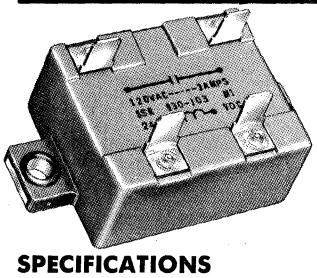
MIDTEX INCORPORATED
AEMCO DIVISION
10 STATE STREET, MANKATO, MINNESOTA 56001
PHONE (507) 388-6286 TWX 910-565-2244

REED SWITCHES

	Miniature Dry Reed Switch 69-2421	RF Miniature Dry Reed Switch 69-2721	Subminiature Dry Reed Switch 69-2821	Standard Dry Reed Switch 69-4321
				
Contact Ratings (max.)				
Voltage	100 VDC, 150 VAC	28 VDC	28 VDC	150 VDC, 250 VAC
Current (switch)	.5 amp	0.010 amps	0.110 amps	1.5 amps
Current (carry)	3 amps		1.5 amps	6 amps
Power (D.C.)	15 watts	0.3 watts	3 watts	25 watts
Power (A.C. suppressed)	25 VA		3VA	40 VA
Resistance (initial)	200 milliohms	200 milliohms	200 milliohms	50 milliohms
Peak breakdown voltage	300 volts	300 volts	200 volts	500 volts
Operating Parameters				
Pull-in (specify range)	17.5 to 62.5 ampere-turns	25 to 80 ampere-turns	7.5 to 32.5 ampere-turns	40 to 150 ampere-turns
Drop-out (specify range)	approx. ½ of pull-in	close differential	approx. ½ of pull-in	approx. ½ of pull-in
Operate speed	1 msec (incl. bounce)	1.5 msec (incl. bounce)	0.5 msec (incl. bounce)	2.5 msec (incl. bounce)
Release speed	0.1 msec	0.1 msec	0.1 msec	1.0 msec
Closure rate (maximum)	2000 Hertz		2000 Hertz	400 Hertz
Temperature range	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C
Insulation resistance	10^{12} ohms min.	10^{10} ohms min.	10^{10} ohms min.	10^{9} ohms min.
Capacitance	0.5 picofarad	0.5 picofarad	0.2 picofarad	1.5 picofarads
Shock	200G max, 11 ±1 msec	200G max, 11 ±1msec	100G max, 11 ±1 msec	100G max, 11 ±1 msec
Vibration	30G max@0 to 1700 Hertz	30G max@0 to 1700 Hertz	20G max@0 to 4000 Hertz	30G max @ 0 to 600 Hertz
Life and Reliability				
(End-of-Life criteria: contact loss of 500 MV max. for Rated and Intermediate Loads, 100 MV max. for Low Level Load, 50 ohms max. for Dry Circuit Loads.)				
Rated Power Load — Life	20 x 10^6		1 x 10^6	20 x 10^6
Intermediate Load — Life	100 x 10^6		50 x 10^6	100 x 10^6
Low Level Load — Life	100 x 10^6		50 x 10^6	100 x 10^6
Dry Circuit Load — Life	500 x 10^6		50 x 10^6	500 x 10^6

All above switches have Form A (SPSTNO) contact arrangement, rhodium contact material, dry inert gas atmosphere. Termination is solderable or weldable for all except No. 69-2721 which is solderable only.

SSR MODULE

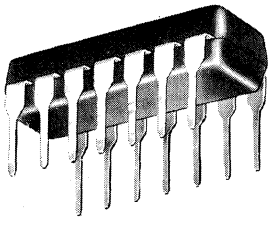


The new 930 series hybrid solid state relay module. Provides complete isolation between a low control power input and a high power load. Compatible with TTL logic. Can be used to switch inductive, capacitive, tungsten or resistive loads.

SPECIFICATIONS

Control Voltage (nominal)	5 - 48 VDC
Load Voltage (maximum)	200 or 400 Volts (peak)
Load Current (maximum)	10 amps AC
Life	up to 500 x 10^6 operations
Size	2.63″L x 1.52″W x .850″H

DIP REED RELAY



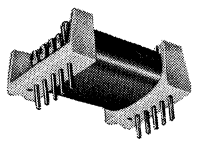
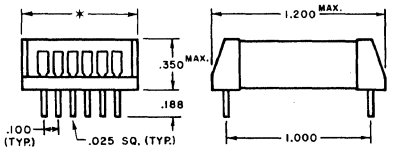
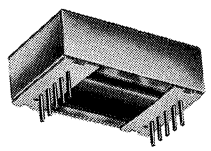
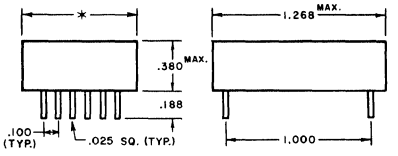
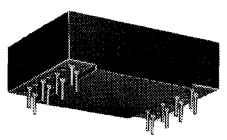
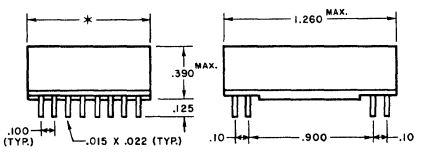
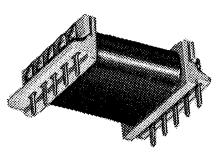
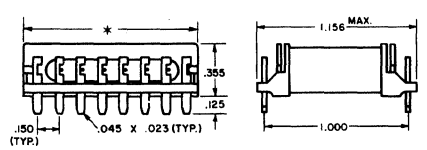
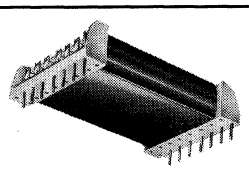
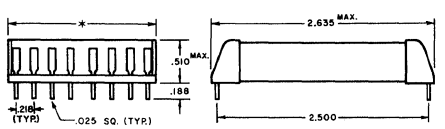
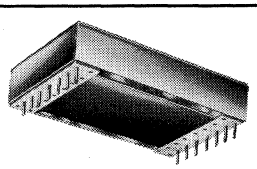
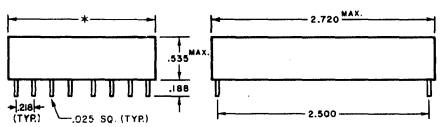
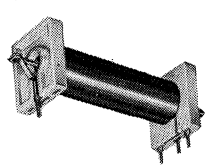
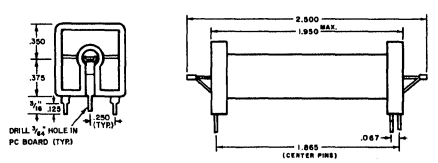
The new 814 series 14-pin dual-in-line relay for high density packaging. Epoxy molded unit is automatically insertable and fits IC sockets. Comes as standard product in 1A with nominal coil voltage of 5, 6, 12 or 24 volts, options available in 2A, 1B and 1C (true form) packages.

SPECIFICATIONS

Current (switch)	0.110 amps
Voltage	28 VDC
Power (DC)	3 watts
Life	up to 50 x 10^6 operations
Configuration	.100 x .300 pin centers

wabash Write for details and design assistance

REED RELAYS

SERIES		END (TYP.) AND SIDE VIEWS	AVAILABLE CONTACT FORMS
822†‡ MINIATURE			1A 1A2B 3C 2A 1A1C(2A1B) 1A(mag.latch) 3A 2A1B 2A(mag.latch) 4A 1B1C(1A2B) 5A 2A2B 1B 2C (2A2B) 2B 1C 1A1B 2C
823†‡ MINIATURE			1A 1A2B 3C 2A 1A1C(2A1B) 1A(mag.latch) 3A 2A1B 2A(mag.latch) 4A 1B1C(1A2B) 5A 2A2B 1B 2C (2A2B) 2B 1C 1A1B 2C
824 MINIATURE			1A 1A1B 1C 2A 1A2B 2C 3A 1A1C(2A1B) 3C 4A 2A1B 4C 5A 3A1B 1A(mag.latch) 6A 3A2B 2A(mag.latch) 1B 4A1B 2B 1B1C(1A2B)
832 MINIATURE			1A 1A1B 4A2B 2A 1A2B 1B1C(1A2B) 3A 1A1C(2A1B) 1C 4A 2A1B 2C 5A 2A2B 3C 6A 3A1B 4C 1B 3A2B 1A(mag.latch) 2B 4A1B 2A(mag.latch)
842†‡ STANDARD			1A 1B 3A2B 2A 2B 4A1B 3A 1A1B 5A2B 4A 1A2B 1B1C(1A2B) 5A 1A1C(2A1B) 1C 6A 2A1B 2C 8A 2A2B 1A(mag.latch) 12A 3A1B 2A(mag.latch)
843 STANDARD			1A 1B 3A2B 2A 2B 4A1B 3A 1A1B 5A2B 4A 1A2B 1B1C(1A2B) 5A 1A1C(2A1B) 1C 6A 2A1B 2C 8A 2A2B 1A(mag.latch) 12A 3A1B 2A(mag.latch)
852 STANDARD			1A

†Recognized under the component program of Underwriters' Laboratories, Inc.
‡This relay is listed by the Canadian Standards Association as certified.

*Variable dimension depending on series and contact configuration. (Range: 832 Series: .445 to 1.20; 822 Series: .405 to .780; 823 Series: .465 to .855; 824 Series: .382 to .882; 842 Series: .645 to 3.030; 843 Series: .700 to 3.080 inches.)

CONTACT RATINGS For miniatures, see preceding page reed switch part number 69-2421; for standards see reed switch part number 69-4321.

LIFE AND RELIABILITY For Miniatures see preceding page reed switch part number 69-2421; for standards see reed switch part number 69-4321.

OPERATING PARAMETERS	MINIATURE	STANDARD
Temperature:	−55°C to +105°C	−55°C to +105°C
Shock:	200G max, 11 ±1 msec	100G max, 11 ±1 msec
Vibration:	30G max @ 0 to 1700 Hertz	30G max @ 0 to 600 Hertz
Insulation resistance:	10^{12} ohms min	10^{12} ohms min
Capacitance:	.5 picofarad	1.5 picofarads

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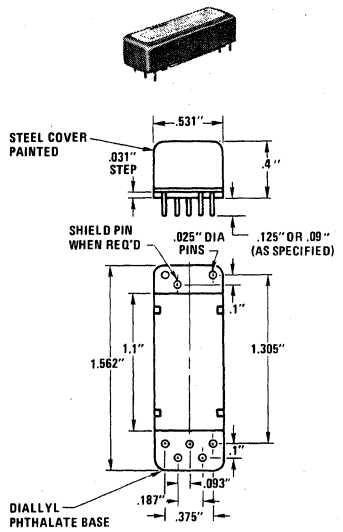
A subsidiary of Wabash Magnetics, Inc.

wabash

See our expanded line of mercury wetted contact relays... next page →

MERCURY WETTED CONTACT RELAYS

SERIES 5501/5101



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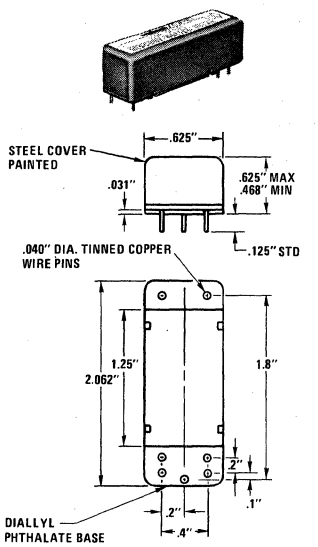

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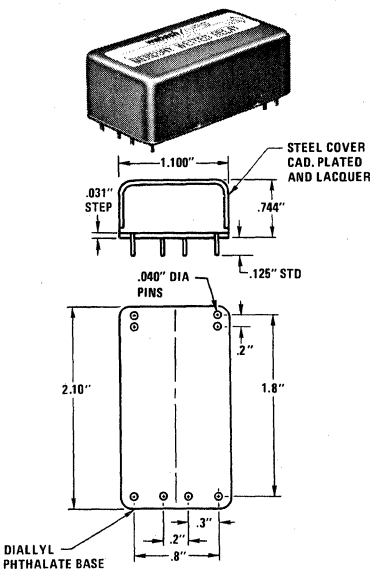

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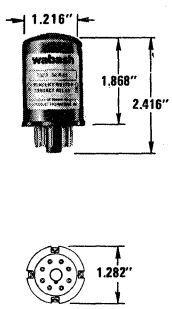

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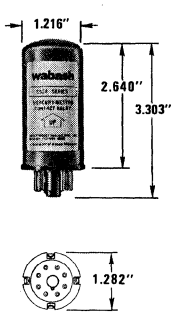

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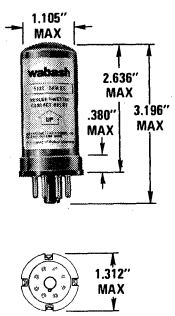
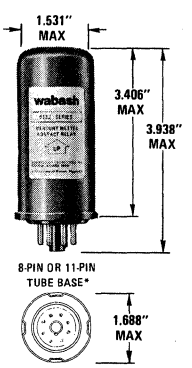


SERIES 5132/5133



*14-Pin Glass-To-Metal Header Also Available

SERIES	CONTACT FORM	TYPE	ADJUSTMENT (COIL)
5501	1C	P. C. Mount	Single or Dual Wound Single Side or Bi-Stable
5101	1D		
5504	1C	P. C. Mount	Single or Dual Wound Single Side or Bi-Stable
5104	1D		
5505	2C	P. C. Mount	Single Wound Single Side or Bi-Stable
5105	2D		
5523	1C	Plug-In (8 pin base)	Single or Dual Wound Single Side or Bi-Stable
5123	1D		
5524	1C	Plug-In (8 pin base)	Single or Dual Wound Single Side or Bi-Stable
5124	1D		
5131	Heavy Duty 1D	Plug-In (8 pin base)	Single or Dual Wound
5132	Heavy Duty 2D	Plug-In (8, 11 or 14 pin base)	Single Wound
5133	Heavy Duty 3D		

SPECIFICATIONS

Contact Resistance: 50 milliohms (max)

Contact Ratings: 2 amps peak (max)
500 volts peak (max)
100 VA peak (contact protection required)
(Up to 5 amps peak max and 250 VA peak in neutral Form D switches)

Bounce: None

Life: Up to 1 x 10^9 operations

Contact Rise Time: (less contact protection) 10 nano seconds or less

Stand Off Voltage: 1000 VAC, 60 Hertz (max)

Insulation Resistance: 1000 megohms (min) @ 500 VDC 25°C and 45% RH

Bridging Time: Form D. 500 microseconds (max) neutral Form D. 1 msec (max)

Transfer (Null) Time: Form C. 600 microseconds (max)

Write for details and design assistance

NPE/New Product Engineering, Inc.
A subsidiary of Wabash Magnetics, Inc.

wabash

See our full line of reed relays and switches... preceding two pages

RELAYS FOR EVERY NEED.

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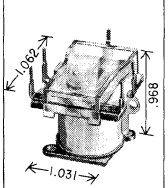
NORTH AMERICAN PHILIPS CONTROLS CORP.
A NORTH AMERICAN PHILIPS COMPANY
E. Church & 2nd St. · Frederick, Md. 21701 · (301) 663-5141

	SERIES	DESCRIPTION		CONTACTS FORMS	CONTACTS AMPS	CONTACTS VOLTS	COIL VOLTS	COIL OHMS RES
INDUSTRIAL — GENERAL PURPOSE	**ELECTROMECHANICAL TYPES**							
	10	Sensitive, low cost, highly reliable. For industrial and commercial control functions.		SPDT	3	28 dc	3-24 dc	27-7000
	19	Low-cost with proven reliability and economy for industrial and commercial use.		SPDT	10	28 dc; 115V, 60 hz	3-24 dc	27-1760
	28	Sensitive relay for direct PC mounting. For Appliance Controls; Remote TV Tuning; Industrial Process Controls, etc.		SPDT	3	28 dc	3-24 dc	27-7000
	12	Compact, low cost. Unique spiral wrap coil core minimizes eddy current losses. Open and enclosed types. .187" quick connect terminals.		1-3PDT	10	28 dc; 115V, 60 hz	6-110 dc; 6-230V, 60 hz	32.1-10,000 4.2- 9,100
	13	Compact, low cost. Unique spiral wrap coil core minimizes eddy current losses. Open and enclosed types. Octal, PC or stud terminals.		1-3PDT	5 or 10	28 dc; 115V, 60 hz	6-110 dc; 6-240V, 60 hz	32-10,000 dc 6- 9,100 ac
	LATCHING AND MEMORY TYPES							
	29	Stabilized memory for remote and sequence control in Appliances and Entertainment Devices.		SP	3 or 10	28 dc	3-24 dc	17.5-1760
	45	Sensitive 6-pole magnetic latching reed for Computer-Controlled Message Switching Systems.		1 to 6A	0.5	50 dc	5-12 dc	290-1840
	REED RELAYS							
	40	Compatible with standard 14-terminal, dual-in-line IC. Interfaces with RTL, HNIL, DTL and TTL logic.		1A	100 ma	30 dc	5,6,12 dc	200-1440
	41	Compact DIP low profile relay for high-speed switching circuits where input/output isolation and high density packaging are required.		2 to 8A	0.5	50 dc	3-24 dc	15-1840
	42	SPNO miniature reed relay for Communication and Computer Equipment.		1A	100 ma	28 dc	3-24 dc	37-2400
	43	Rugged, low-cost, standard size for PC mounting.		1A	1.5	150 dc	6-24 dc	75-1200
	44	Open type miniature relay for use on PC boards	Dry Relays	Up to 6A,4B,4C	.1 .5	28 dc 200 dc	3-48 dc	8-10500
			Mercury Wetted Relays	Up to 6A,4B	1.0	1000 dc	3-48 dc	5-6720
MILITARY	**MEET APPLICABLE SECTIONS OF MIL-R-5757**							
	02	General purpose, hermetically sealed, QPL listed MIL-R-5757/8		DPDT	2	28 dc; 115V, 400 hz	6-132 dc	25-10,000
	03	Low-cost. For Communications Systems. QPL listed MIL-R-5757/1.		6PDT	2	28 dc; 115V, 400 hz	6-120 dc	12.5-4800
	07	High performance. For Aerospace Industry. QPL listed M5757/23, MS27245, MS27247.		DPDT	10	28 dc; 3 phase, 115/200/400 hz	6-120 dc 115V, 400 hz	19-7600 1200
	CC	Crystal can. For Aerospace and Communications		DPDT	3	28 dc	6-48 dc	35-5000

INDUSTRIAL

ELECTROMECHANICAL

10



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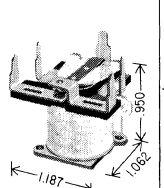

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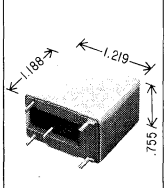

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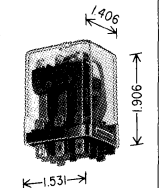

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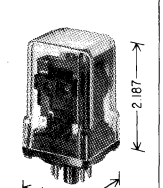

LATCHING

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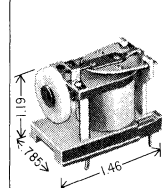

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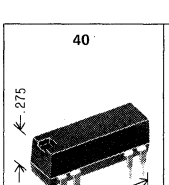

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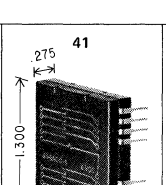

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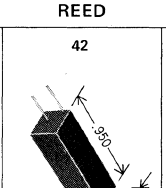

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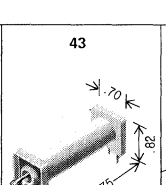

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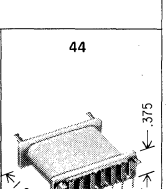

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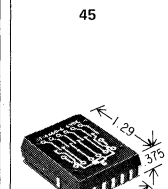
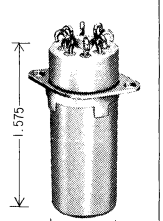


MILITARY

02



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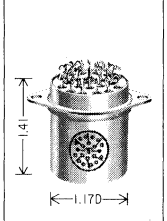

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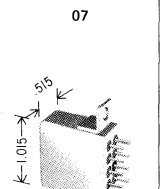

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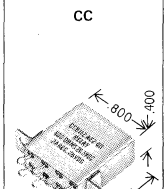
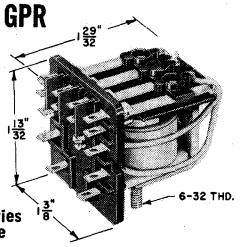
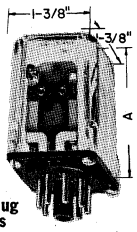


OHMITE® electro-mechanical relays

MODEL GPR



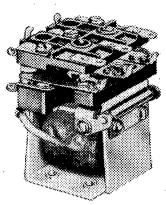
GPR Series 4-Pole

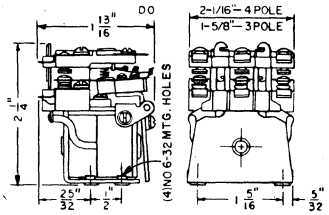


For Octal Plug GPR Series

Simple, rugged, low cost relays handling substantial power for small size. Uncomplicated design provides unusual flexibility for making and changing connection and mounting.

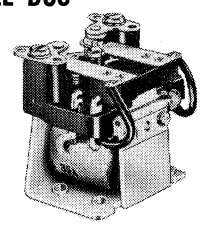
MODEL DO

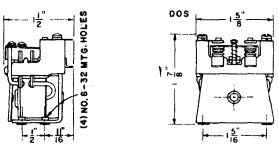




Particularly adaptable to aircraft and mobile equipment applications where severe shock and vibration are encountered. Design of molded parts around contact arms protects against mechanical injury. Stocked in 3-pole or 4-pole type, and also in hermetic enclosures and in latching types.

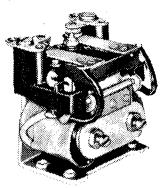
MODEL DOS

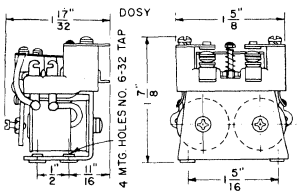




Wide application, general purpose relay, compact and lightweight. Handles loads usually demanded of much larger relays. Meets rigorous aircraft relay standards.

SENSITIVE MODEL DOSY





Similar in construction to Model DOS relay but equipped with twin coils for increased sensitivity. The DOSY relay is adaptable to a wide range of electronic control applications such as plate circuit controls, or as overload or underload controls in D.C. circuits to signal attainment of predetermined current levels.

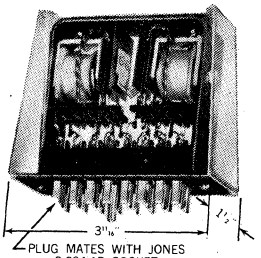
SPECIFICATIONS

Model	Coil Data				
	GPR	DO	DOS	GPR Latching	DOSY
6 VAC	.334-650 Amps	2.33 Amps	.890 Amps	.650 Amps	
12 VAC	.167-.309 Amps	1.28 Amps	.460 Amps	.309 Amps	
24 VAC	.084-.155 Amps	5.7 Amps	.269 Amps	.155 Amps	
115 VAC	.0174-.0325 Amps	1.10 Amps	.043 Amps	.0325 Amps	Maximum Pull In Current = 5 MA to 11 MA
230 VAC	.007-.0147 Amps	.070 Amps	.030 Amps	.0147 Amps	
6 VDC	.230 Amps	.487 Amps	.450 Amps	.350 Amps	
12 VDC	.114 Amps	.231 Amps	.210 Amps	.185 Amps	
24 VDC	.060 Amps	.105 Amps	.105 Amps	.093 Amps	
110 VDC	.011 Amps	.022 Amps	.022 Amps	.022 Amps	
220 VDC	——	.014 Amps	.013 Amps	——	
Coil AC Wattage	1.6-2.4 W.	6 W.	3 W.	1.6-2.4 W.	1 W.
DC	1.4 W.	3 W.	2.5 W.	2.4 W.	1 W.

Maximum Contact Arrangement	4PDT	4PDT	DPDT	6PDT	DPDT
Contact Rating	5 Amp & 10 Amp	10 Amp & 20 Amp	15 Amp & 25 Amp	5 Amp	15 Amp
Weight (Unenclosed)	2.5-3.5 oz.	5-6 oz.	4 oz.	7 oz.	4.5 oz.
Enclosures Available	Yes	Yes	Yes	Yes	No

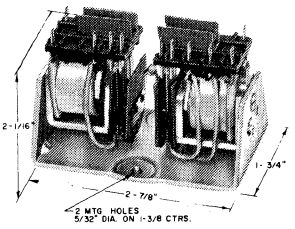
MANY MODELS ARE UL RECOGNIZED AND CSA LISTED

MODEL GPR LATCHING RELAYS



Enclosed Latching Relay

Relay 6PDT Latching

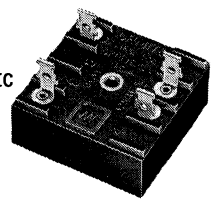


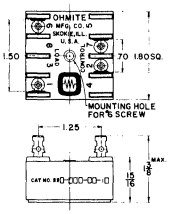
Latching relays consist of two GPR relays with armatures linked so that the n.o. contacts of one are mechanically latched in closed position when, and after, this relay is energized. When 2nd relay is energized, first relay restores and latches 2nd. Permits switching of twice the number of circuits and holding without coil current.

FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

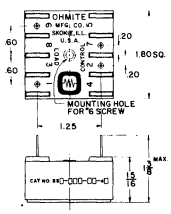
OHMITE® solid state relays

- No moving parts for longest life
- Optically coupled
- Zero voltage — synchronous switching
- For interfacing I.C. logic with motors, solenoids, lamps, heaters, etc
- False actuation protection
- Built-in inductive load commutation
- Competitive prices

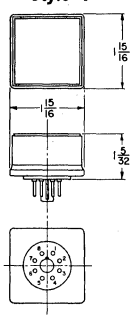




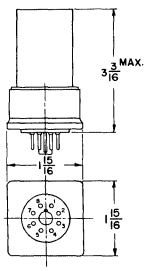
Solder/Faston Term. Style 1



P.C. Pin Term. Style 4



Octal Socket Term. Style 5



Octal Socket w/Heatsink Style 6

INPUT/CONTROL

	Solid State Relays			Hybrid Relays (Reed Relay Coil TRIAC Contacts)			
	SSB Series SPST - N.O.	SSC Series SPST - N.O.		SSH Series SPST - N.O.			
				SSH3	SSH6	SSH12	SSH24
Input Voltage	3 to 32 VDC (Polarized)	25 to 50 VAC	80 to 140 VAC	3 to 9 VDC 3.5 V. Nom.	5 to 9 VDC 6 V. Nom.	10 to 18 VDC 12 V. Nom.	20 to 30 VDC 24 V. Nom.
Input Current	3mA. to 30mA.	10mA. to 25mA.	5mA. to 15mA.	11.5mA.	33mA.	17mA.	10mA.
Thresh-old Volts	4.0 V. Max. 2.5 V. Min.	20 VAC Min.	60 VAC Min.	3.5 V. Max. 1.0 V. Min.	5 V. Max. 1 V. Min.	10 V. Max. 3 V. Min.	20 V. Max. 5 V. Min.
Dropout Volts	—	10 V.	40 V.	0.5 V.	0.5 V.	1.0 V.	2.0 V.
Coil Im-pedance	—	—	—	300 Ω	150 Ω	600 Ω	2000 Ω

SPDT AND DPST MODELS AVAILABLE — CONSULT FACTORY

OUTPUT/LOAD

Load Voltage: 120 or 240 VAC, rms., depending on model.

Load Ratings: (@ 25°C ambient).

Maximum Load Current:

Free Air	2A.	3.5A.	4.5A.	5A.	8A.	12A.
Mounted	2A.	5A.	10A.	15A.	25A.	40A.
Typical Minimum	20mA.	20mA.	20mA.	45mA.	25mA.	65mA.

Surge Current: Withstand at least 10 times rated current for 1 cycle of load current.

Voltage Drop: Closed ("on"), 1.6 volts, typical at rated current.

Transient Protection: Ohmite relays and switches are protected from transient line voltages which can **damage** and cause **false operation.** Ohmite's field proven snubber network limits the dV/dT seen by the device to 1V/μsec., in the "off" state.

Dielectric Strength: 1500 Volts, rms for all units for input or output to heat sink. 1500 Volts, rms for input to output on standard non-synchronous units only.

Isolation: 500 Gigaohms between "coil" and "contacts," "contacts" to case and case to "coil."
SSH Synchronous: 150KΩ @ 120 V. Load — 220KΩ @ 240 V Load.

Speed of Operation: Drop-out (Turn "off"): ½ cycle load current, all models. Pick-up (Turn "on"): ½ cycle load current, Models SSB, SSC, SSH synchronous. 1 Msec SSH Standard.

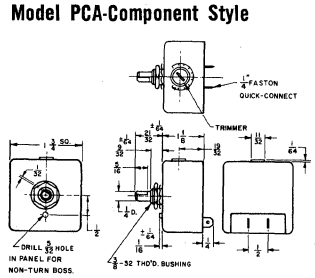
OHMITE® OHMITROL solid state power and motor speed controls

FEATURES:

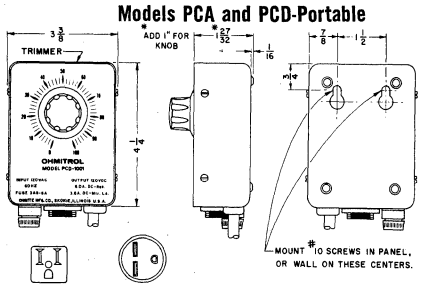
- Conserves space & power
- Smallest 1 & 2 KW control
- AC & DC output types
- Built-in on-off switch
- Adjustable control range
- Choice of component & portable styles
- Long life

Catalog No. Component Style	Catalog No. Portable Style	Input Volts	Freq.	Output Range (Nominal)	Load Capacity Rating (Maximum)
PCA-1000-08	PCA-1001-08	120 VAC	60 Hz	0-120 VAC	1 KW, 8.3 Amps AC
PCA-1000-15	—				15 Amps AC
PCA-1100-08	PCA-1101-08		50 Hz		1 KW, 8.3 Amps AC
PCA-1020-08	PCA-1021-08	240 VAC	60 Hz	0-240 VAC	2 KW, 8.3 Amps AC
PCA-1120-08	PCA-1121-08		50 Hz		
PCD-1000-06	PCD-1001-06	120 VAC	60 Hz	0-120 VDC and Full 120 VDC	6.0 Amp DC Resistive 3.5 Amp DC Motor Load
PCD-1100-06	PCD-1101-06		50 Hz		
PCD-1020-06	PCD-1021-06	240 VAC	60 Hz	0-240 VDC and Full 240 VDC	
PCD-1120-06	PCD-1121-06		50 Hz		

Model PCA-Component Style



Models PCA and PCD-Portable



RECEPTACLE FOR TYPE PCD 1001 (AMPHENOL 91-PM3F)

RECEPTACLE FOR TYPE PCA 1001

RECEPTACLE FOR TYPE PCA 1021

FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

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1200			Antennas & Accessories
1300	Vol.1•308	Vol.4•310	Audio Equipment & Accessories
1400	Vol.3•308	Vol.4•311	Cabinets, Chassis, Containers, Racks, Boxes, etc.
1500	Vol.3•342	Vol.4•314	Capacitors (All Types)
1600	Vol.3•516	Vol.4•324	Chemicals (Acids, Adhesives, Coatings, Lubricants, etc.)
1700	Vol.2•323		Circuit Assemblies, Circuit Boards & Breadboarding Kits
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5400	Vol.3•1235	Vol.4•558	Tools (Hand & Power); Soldering Supplies
5500	Vol.2•1175		Transducers & Associated Equipment
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5700	Vol.2•1181		Tubes, Tube Parts, Shields, Inserts, etc.
5800	Vol.1•938		Ultrasonic, Sonic, Subsonic Equipment
5850			Vacuum Equipment & Accessories
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6000	Vol.3•1311	Vol.4•566	Wire, Cable, Harnesses & Accessories

UNITED TECHNICAL PUBLICATIONS, INC. • 645 Stewart Avenue, Garden City, New York 11530 • (516) 248-9700
Division of Cox Broadcasting Corporation

POTTER & BRUMFIELD RELAYS

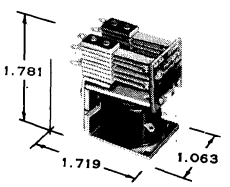
Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

Potter & Brumfield's broad line of standard relays is listed on the following pages with dimensions, terminal and mounting information. We offer a wide selection of standard relays to fit practically any type of physical and electrical contact requirement you might encounter. You can order any of these relays from your local P&B authorized distributor. He will give you fast, economical, off-the-shelf service.

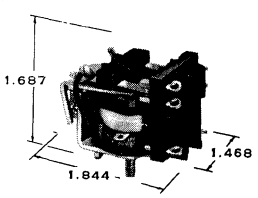
And if a standard model won't meet your requirements, we'll make one that will. Unusual requirements such as the so-called dry circuit (low voltage circuits with extremely small electron flow) cannot be handled by just any relay. Almost without exception, this application requires a relay with special adjustments, contact materials, or other special features. Non-resistive load elements can also cause contact problems. So, check with your P&B representative before making a final selection.

P&B applications engineers, particularly, are at your service to help solve any unusual switching problems. Special contact forms or materials, coil voltages, terminal configurations, enclosures, or many other non-standard electrical or mechanical modifications can be engineered to specifications which meet your application requirements.

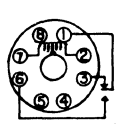
GA SERIES Low cost, all purpose, multiple contact, voltage switching relay. Used for many industrial control applications. Tinned, pierced solder type terminals. Contacts: Silver, designed for maximum self-cleaning action. Mounting: No. 8-32 tapped core with locating boss. Weight: 3½ ozs.
See GF Series for similar relays having 10 amp ratings.

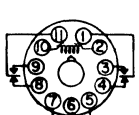


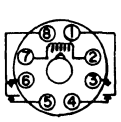
KA AND KAP SERIES Small, low cost, highly efficient general purpose relays for handling light power loads such as small motors, solenoids and other relays, and general automation work. All KA and KAP relays with "Y" suffix bear CSA listing (File No. LR-15734) and carry U/L component recognition (File No. E22575). Mechanical life expectancy: 10 million operations. Duty: Continuous Contacts: Movable, Gold-flashed silver; stationary, Silver overlay.

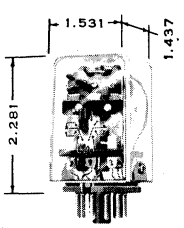


The KA is the open version of this series. Mounting: One No. 6-32 threaded stud and locating tab on .438 centers. Wt: 2 ozs. The KAP is the enclosed model and is protected by a clear polycarbonate dust cover. Terminals: 8 or 11-pin plug. Weight: 3 ozs.
"G" suffix indicates silver-cadmium oxide contacts on movable rated 10 amps.


KAP5


KAP14


KAP11



GENERAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. In Ohms	Nom. Power	Arrangement	Amp Rating	
GA11A	6V	1.7	6VA	DPDT	5	$4.05
	12V	6.8				4.05
	24V	24				4.05
	120V	690				4.05
GA11D	6V	18	2.0W	DPDT	5	4.05
	12V	72				4.05
	24V	288				4.05
	110V	6,050				4.55
GA14A	24V	24	6VA	3PDT	5	4.85
	120V	690				4.85
GA17A	6V	1.7	6VA	4PDT	5	5.85
	12V	6.8				5.85
	24V	24				5.85
	120V	690				5.85
	240V	2,950				6.25
GA17D	6V	18	2.0W	4PDT	5	5.85
	12V	72				5.85
	24V	288				5.85
	110V	6,050				6.35
KA5AY	6V	6	2VA	SPDT	• 5	3.75
	12V	21				3.75
	24V	85				3.75
	120V	2,250				3.75
	240V	9,110				4.25
KA5AG	6V	6	2VA	SPDT	• 10	3.80
	12V	21				3.80
	24V	85				3.80
	120V	2,250				3.80
	240V	9,110				4.30
KA5DY	6V	32.1	1.2W	SPDT	• 5	3.60
	12V	120				3.60
	24V	472				3.60
	110V	10,000				4.30
KA5DG	6V	32.1	1.2W	SPDT	• 10	3.65
	12V	120				3.65
	24V	472				3.65
	110V	10,000				4.35
KA11AY	6V	6	2VA	DPDT	• 5	4.55
	12V	21				4.55
	24V	85				4.55
	120V	2,250				4.55
	240V	9,110				4.95
KA11AG	6V	6	2VA	DPDT	• 10	4.65
	12V	21				4.65
	24V	85				4.65
	120V	2,250				4.65
	240V	9,110				5.05
KA11DY	6V	32.1	1.2W	DPDT	• 5	4.00
	12V	120				4.00
	24V	472				4.00
	48V	1,800				4.20
	110V	10,000				4.70
KA11DG	6V	32.1	1.2W	DPDT	• 10	4.15
	12V	120				4.15
	24V	472				4.15
	110V	10,000				4.85
KA14AY	6V	6	2VA	3PDT	• 5	4.95
	12V	21				4.95
	24V	85				4.95
	120V	2,250				4.95
	240V	9,110				5.45
KA14AG	6V	6	2VA	3PDT	• 10	5.15
	12V	21				5.15
	24V	85				5.15
	120V	2,250				5.15
	240V	9,110				5.65
KA14DY	6V	32.1	1.2W	3PDT	• 5	4.50
	12V	120				4.50
	24V	472				4.50
	110V	10,000				5.20
KA14DG	6V	32.1	1.2W	3PDT	• 10	4.70
	12V	120				4.70
	24V	472				4.70
	110V	10,000				5.40

KA-KAP Series continued on page 4.

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**D**N

• Denotes U/L § Enclosed Relay † Sealed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

KAP HOLD-DOWN SPRING

Will accommodate machine screw or rivet. Hold-down spring, 20C206
Box of 50, 9KA1 **LIST $6.00**

KDP SERIES This compact, general purpose DC relay offers 8 Form C (8PDT) switching with bifurcated gold over silver contacts rated 1 amp @ 30V DC, resistive, or 0.5 amp @ 120V AC. Designed for dense packaging applications, the KDP provides electrical isolation on both the input and switching sides. Operate speed is 15 milliseconds @ nominal voltage @ 25°C. Mechanical life expectancy: in excess of 10 million operations. Duty: Continuous. Enclosure: Clear polycarbonate dust cover. Mounting: Solder terminal sockets with snap-lock spring for front insertion into chassis or panel. Approximate weight without socket: 1.3 ozs.

KDP SERIES SOCKETS

8PDT Solder terminal socket, 27E093
Box of 10, 9KD2 **LIST $9.50**

Hold-down spring, 20C238
Box of 50, 9KD3 **LIST $5.50**

KHU/KHP/KHS SERIES Small, rugged, 4PDT relays available for AC or DC operation. Only KHU relays are recognized under the Component Program of Underwriters' Laboratories, Inc. KHU has clear polycarbonate and KHP has nylon dust cover; KHS is hermetically sealed in metal enclosure. Relays are designed to meet exacting requirements of data processing, computer and process control applications. Various contacts available: suffix "1" denotes gold-flashed silver rated 3 amps @ 30 V DC or 120 V AC, resistive; suffix "2" denotes silver-cadmium oxide rated 3 amperes; suffix "3" indicates gold alloy contacts for low level to 2 amp applications; suffix "6" indicates gold overlay on silver, bifurcated contacts rated 1 amp @ 30V DC, resistive, or 120V AC. Mounting: Solder terminals with No. 3-48 stud .312" long. All relays fit sockets (below) with printed circuit or solder lug terminals.Weight without sockets: KHU and KHP 1.12 oz.; KHS 1.63 oz.

NOTE: KHS RELAYS SHOULD NOT HAVE FRAMES GROUNDED WITHOUT CONSULTING FACTORY FOR LOAD LEVELS.

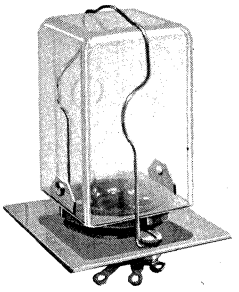
KHP SERIES SOCKETS

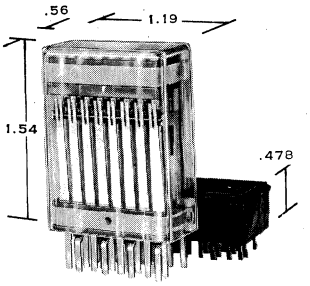
KHP, KHS, KHU relays and CD-31 time delays

4PDT Solder terminal socket, 27E006 with socket retainer, 24AO32
Box of 10, 9KH1 **LIST $6.60**

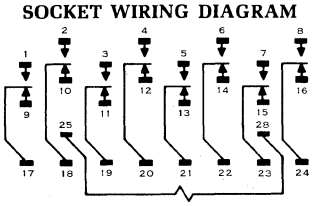
4PDT Printed circuit terminal socket, 27E007
Box of 10, 9KH2 **LIST $6.60**

Hold-down spring, 20C217
Similar to KCP/KRP
Box of 50, 9KH3 **LIST $5.50**

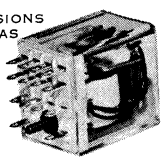




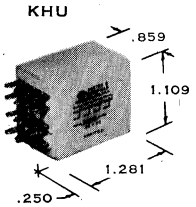
SOCKET WIRING DIAGRAM



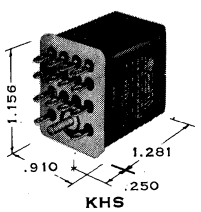
DIMENSIONS SAME AS KHP



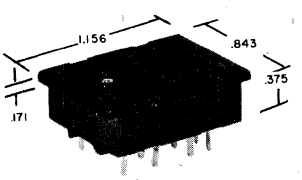
KHU

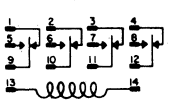


KHP



KHS





GENERAL PURPOSE RELAYS

TYPE	COILS Input	COILS Res. in Ohms	COILS Nom. Power	CONTACTS Arrang.	CONTACTS Amp. Rating	SUGG. RESALE PRICE
KAP5AG§	24V	85	2VA	SPDT	•	$6.45
	120V	2,250			10	6.45
KAP5DG§	24V	472	1.2W	SPDT	•	6.35
	110V	10,000			10	7.05
KAP11AY§	24V	85			•	7.10
	120V	2,250	2VA	DPDT	5	7.10
	240V	9,110				7.50
KAP11AG§	6V	6			•	7.20
	24V	85	2VA	DPDT	10	7.20
	120V	2,250				7.20
KAP11DG§	24V	472	1.2W	DPDT	•	7.15
	110V	10,000			10	7.85
KAP11DY§	12V	120			•	7.05
	24V	472	1.2W	DPDT	5	7.05
	110V	10,000				7.75
KAP14AY§	24V	85			•	8.75
	120V	2,250	2VA	3PDT	5	8.75
	240V	9,110				9.15
KAP14AG§	24V	85	1.2W	3PDT	•	8.90
	120V	2,250			10	8.90
KAP14DG§	24V	472	1.2W	3PDT	•	8.85
	110V	10,000			10	9.55
KAP14DY§	12V	120			•	8.65
	24V	472	1.2W	3PDT	5	8.65
	110V	10,000				9.35
KDP29D11§	24V	580	1W	8PDT	.5	9.40

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

KHU17A11§	6V	10.5	1.2VA	4PDT	•	5.60
	12V	43			3	5.60
	24V	160				5.60
	120V	3,900				6.10
KHU17D11§	6V	40	900MW	4PDT		5.10
	12V	160			•	5.10
	24V	650			3	5.10
	48V	2,600				5.30
	90V	9,000				5.95
	110V	11,000				5.95
KHU17A12§	120V	3,900	1.2VA	4PDT	•3	6.25
KHU17D12§	24V	650	900MW	4PDT	•	5.25
	110V	11,000			3	6.10
KHU17D16§	12V	160	900MW	4PDT	•	6.05
	24V	650			1	6.05
KHP17A11§	6V	10.5	1.2VA	4PDT	3	5.60
	12V	43				5.60
	24V	160				5.60
	120V	3,900				6.10
KHP17A12§	120V	3,900	1.2VA	4PDT	3	6.25
KHP17D11§	6V	40	900MW	4PDT	3	5.10
	12V	160				5.10
	24V	650				5.10
	48V	2,600				5.30
	90V	9,000				5.95
	110V	11.000				5.95
KHP17D12§	12V	160	900MW	4PDT	3	5.25
	24V	650				5.25
	48V	2,600				5.45
	110V	11,000				6.10
KHP17A13§	120V	3,900	900mW	4PDT	2	8.15
KHP17D13§	24V	650	900MW	4PDT	2	7.15
	48V	2,600				7.35
KHP17D16§	12V	160	900MW	4PDT	1	6.05
	24V	650				6.05

KH Series continued on page 5.

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

• Denotes U/L § Enclosed Relay † Sealed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

KH Series continued.

KHP SERIES SOCKETS, CONTINUED

4PDT Screw terminal socket, 27E166
Rated 3 amperes; molded Lexan
Box of 5, 9KH5 **LIST $25.00**

See Socket Track Mounting Accessories, Page 7

Socket Retainer, 24A032
Box of 100, 9KH7 **NET $2.00**

KL SERIES 4PDT relay has high dielectric phenolic insulation and affords broad versatility and utility. Widely used in such applications as industrial controls, elevator controls, communications equipment and electronic measuring devices. Contacts rated 5 or 10 amps @ 120 volts AC, 50/60 Hz resistive are available. Mounting: All models — two No. 6-32 tapped holes on 1.438" centers. Weight: 5 ozs.

KLT SERIES relays are designed for DC applications that require sensitive coils to operate transistors. Contact arrangements to 3PDT are rated 3 amperes at 120 volts AC, 50/60 Hz resistive. Coils are designed for continuous duty @ 6 watts @ +25° C on open types. Expected life is 10 million mechanical operations. Mounting: Same as KL Series. Weight: Approximately 4 ozs.

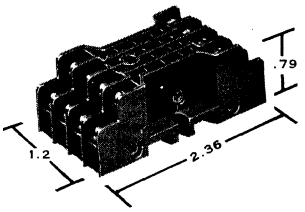
KNP SERIES A small general purpose relay designed for economizing chassis space. Recommended for a multitude of general purpose applications, these relays are recognized under the Component Program of Underwriters' Laboratories, Inc. and CSA* for ratings of 1/10 HP @ 120V AC; 3 amps @ 32V DC, resistive, or 3 amps @ 240V AC, 80% PF. U/L File No. E22575. Contacts are fine silver cross bars for low resistance point contact. Terminals are .110" quick-connect/solder designed to fit solder or printed circuit terminal sockets shown below. KNP-11 series has a 6-32" tapped hole with locating tab for chassis mounting. KNP-21 series has a 3-48" stud for chassis mounting. Enclosed in a clear polycarbonate dust cover, the KNP measures 1.45" max. high when seated. Weight: 1.4 ozs. approximately, without socket.

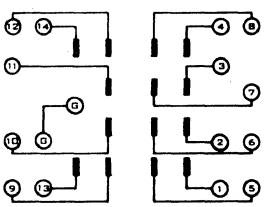
KNP SERIES SOCKETS

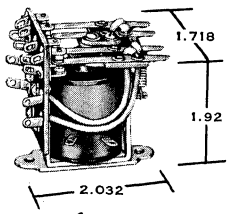
SPDT/DPDT/3PDT Solder terminal socket, 27E118
Box of 10, 9KN1 **LIST $7.00**

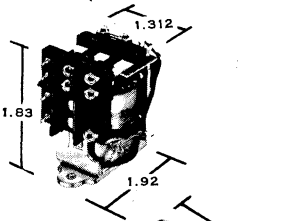
SPDT/DPDT/3PDT Printed circuit terminal socket, 27E119
Box of 10, 9KN2 **LIST $7.00**

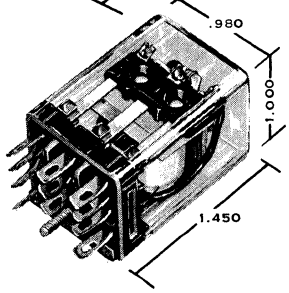
Hold-down spring, 20C246
Box of 50, 9KN3 **LIST $5.00**

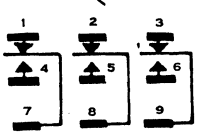




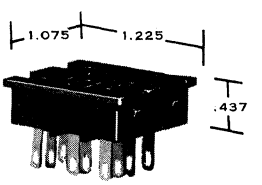








SPDT — 2, 5, 8
DPDT — (1, 4, 7)
(3, 6, 9)



GENERAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
KHS17A11†	6V 12V 24V 120V	10.5 43 160 3,900	1.2VA	4PDT	3	$9.60 9.60 9.60 9.95
KHS17A12†	120V	3,900	1.2VA	4PDT	3	10.15
KHS17A13†	120V	3,900	1.2VA	4PDT	3	11.75
KHS17D11†	6V 12V 24V 110V	40 160 650 11,000	900MW	4PDT	3	8.60 8.60 8.60 9.45
KHS17D12†	24V 110V	650 11,000	900MW 1.0W	4PDT 4PDT	3 3	8.75 9.60
KHS17D13†	24V	650	900mW	4PDT	2	10.70
KL17A	6V 12V 24V 120V	2.25 7.8 33 760	2.9VA	4PDT	5	7.70 7.70 7.70 7.70
KL17D	6V 12V 24V 110V	36 140 600 10,000	1.0W	4PDT	5	7.30 7.30 7.30 8.05
KLT5D	12V 24V	1,080 4,320	132mW	SPDT	3	4.40 4.40
KLT11D	6V 12V 24V 48V	200 810 3,240 13,000	178mW	DPDT	3	5.60 5.60 5.60 6.05
KLT14D	12V 24V	540 2,160	266mW	3PDT	3	6.25 6.25

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

KNP5A21§	6V 12V 24V 120V	10.5 43 160 3,900	1.2VA	SPDT	• 3	3.80 3.80 3.80 3.80
KNP5D21§	6V 12V 24V 110V	40 160 650 11,000	.9W	SPDT	• 3	3.65 3.65 3.65 4.20
KNP11A11§	6V 12V 24V 120V	10.5 43 160 3,900	1.2VA	DPDT	• 3	4.50 4.50 4.50 4.50
KNP11A21§	6V 12V 24V 120V	10.5 43 160 3,900	1.2VA	DPDT	• 3	4.50 4.50 4.50 4.50
KNP11D11§	6V 12V 24V 48V 110V	40 160 650 2,600 11,000	.9 W	DPDT	•3	4.05 4.05 4.05 4.20 4.70
KNP11D21§	6V 12V 24V 48V 110V	40 160 650 2,600 11,000	.9W	DPDT	• 3	4.05 4.05 4.05 4.20 4.70
KNP14A21§	6V 12V 24V 120V	10.5 43 160 3,900	1.2VA	3PDT	• 3	5.05 5.05 5.05 5.05
KNP14D21§	6V 12V 24V 48V 110V	40 160 650 2,600 11,000	.9W	3PDT	• 3	4.65 4.65 4.65 4.80 5.30

*Canadian Standards Association File No. LR-15734

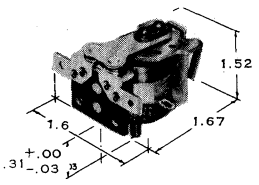
A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**D**N

• Denotes U/L § Enclosed Relay † Sealed Relay

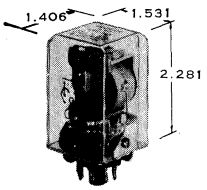
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

KR3-H SERIES Ruggedly constructed but of small size, KR3-H is a heavy duty relay especially designed for applications where limited space is a factor. Its heavy duty copper-alloy movable contact carrier has twin silver-cadmium oxide contacts rated 20 amps @ 120V AC 60 Hz, resistive, or 28V DC; 1 HP 120/240V 60 Hz. Contact arrangement is 1 Form X (SPST-NO-DM) only. Terminals: suitable for .250" quick connect, also solder; for contacts: solder only for coil. Size: 1.6" x 1.671" x 1.52". Seated height: 1.21". Mounting: One No. 6-32 stud and locating tab on .437" center. Weight: 2 ozs.



KRP3-H SERIES All electrical specifications listed above for the KR3-H series relays apply to the KRP3-H. However, the KRP3-H is enclosed in a clear polycarbonate dust cover and features an octal plug-in base. Weight: Approximately 3 ozs.

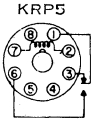


KRP3-H Hold-Down Spring
Will accommodate machine screws or rivets.
Hold-down spring, 20C206
Box of 50, 9KA1 **LIST $6.00**

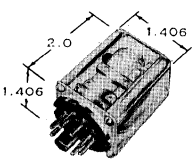
KRP3AH

KR11-E and KR14-E SERIES Hermetically sealed in a metal can. Has octal-type plug and gold-flashed silver contacts rated 5 amps resistive. Suffix "G" denotes silver cadmium oxide contacts rated 10 amps resistive.

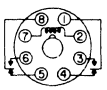
KRP5



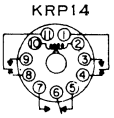
KRP SERIES Versatile, multi-contact arrangement. Enclosed in a clear polycarbonate dust cover. Standard 8-pin octal-type plug for KRP5 and KRP11, 11-pin for KRP-14. Weight: Approx. 3 ozs. Contacts: 5 amp, Gold flashed silver, 10 amp silver-cadmium oxide. See KCP-KRP hold-down spring for special mounting applications. See KRP-N indicator lamp relay for current monitoring applications.



KRP11

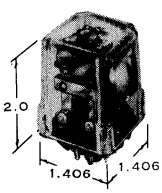


KRP14



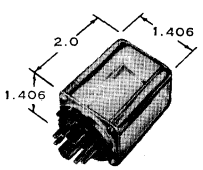
KRP-N INDICATOR
LAMP RELAY A general purpose relay incorporating a lamp to indicate current or voltage availability in power circuit. Contacts: Silver-cadmium oxide rated 10 amps. Enclosures: Clear, polycarbonate dust cover. Mounting: Standard octal plug.
Weight: Approximately 3 ozs.
Hold-down spring (Please see Page 4).

"P"—CASE A clear polycarbonate case for mounting rectifiers, capacitors, resistors, or a combination of these. Available with octal type plug with 8 or 11-pins. Comes complete with four screws. Weight: .5 ozs. each.



35D070 Case (8-pin plug) **LIST $.70**
35D072 Case (11-pin plug) **LIST $.85**

KRP Hold-Down Spring
Will accommodate machine screws or rivets.
Hold-down spring, 20C176
Box of 50, 9KR15 **LIST $6.00**



GENERAL PURPOSE RELAYS

TYPE	COILS Input	COILS Res. in Ohms	COILS Nom. Power	CONTACTS Arrang.	CONTACTS Amp. Rating	SUGG. RE-SALE PRICE
KR3AH	12V 24V 120V	21 85 2,250	2VA	SPST-NO-DM	20	$ 4.60 4.60 4.60
KR3DH	12V 24V 110V	120 472 10,000	1.2W	SPST-NO-DM	20	4.40 4.40 5.00
KR11AE†	120V	2,250	2VA	DPDT	5	11.95
KR11AGE†	120V	2,250	2VA	DPDT	10	12.15
KR11DE†	24V 48V	472 1,800	1.2W 1.3W	DPDT DPDT	5 5	11.50 11.90
KR11DGE†	24V	472	1.2W	DPDT	10	11.70
KR14AGE†	120V	2,250	2VA	3PDT	10	14.65
KRP3AH§	12V 24V 120V	21 85 2,250	2VA	SPST-NO-DM	20	7.40 7.40 7.40
KRP3DH§	12V 24V 110V	120 472 10,000	1.2W	SPST-NO-DM	20	7.15 7.15 7.85
KRP5A§	6V 12V 24V 120V	6 21 85 2,250	2VA	SPDT	5	6.35 6.35 6.35 6.35
KRP5AG§	6V 12V 24V 120V	6 21 85 2,250	2VA	SPDT	10	6.50 6.50 6.50 6.50
KRP5D§	6V 12V 24V 110V	32.1 120 472 10,000	1.2W	SPDT	5	6.30 6.30 6.30 7.00
KRP5DG§	6V 12V **24V** 110V	32.1 120 **472** 10,000	1.2W	SPDT	10	6.45 6.45 **6.45** 7.15
KRP11A§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	DPDT	5	7.05 7.05 7.05 7.05 7.50
KRP11AG§	6V 12V 24V 120V 240V	6 12 85 2,250 9,110	2VA	DPDT	10	7.30 7.30 7.30 7.30 7.75
KRP11D§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	DPDT	5	7.00 7.00 7.00 7.40 7.70
KRP11DG§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	DPDT	10	7.25 7.25 7.25 7.65 7.95
KRP14A§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	3PDT	5	8.75 8.75 8.75 8.75 9.20
KRP14AG§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	3PDT	10	9.10 9.10 9.10 9.10 9.55
KRP14D§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	3PDT	5	8.65 8.65 8.65 9.05 9.35
KRP14DG§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	3PDT	10	9.00 9.00 9.00 9.40 9.70

KRP Series continued on page 7.

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

§ Enclosed Relay † Sealed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

KRP Series continued.

KR SERIES SOCKETS

(For KRP, KRP3-H, KAP, KBP, KCP, EBT, EBA relays; CD-21, CD-38, CH, CK and CR time delays; and CP and CS sensors.)

8-pin Screw terminal socket, 27E122
Rated 10 amperes; molded Lexan
Box of 5, 9KR31 **LIST $12.50**

11-pin Screw terminal socket, 27E123
Rated 10 amperes; molded Lexan
Box of 5, 9KR32 **LIST $18.75**

SOCKET TRACK MOUNTING ACCESSORIES

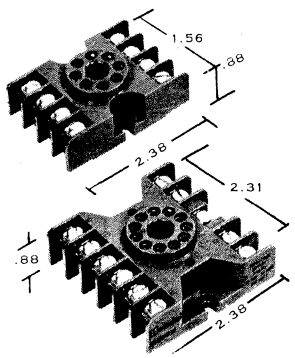
Mounting track, 24A064
Extruded aluminum; three foot section with holes on 6" centers for No. 8 screws
1 Section, 24A064 **NET $2.00**

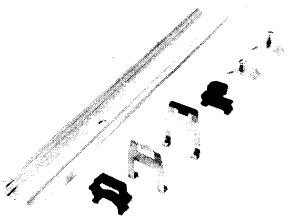
Mounting clip, 24A072
Plastic; for mounting 9KR31, 9KR32 and 9KH5 sockets.
Box of 25, 9KR42 **NET $2.50**

Mounting clip, 24A071
Aluminum; (1) #4-40 tapped hole for mounting 9KH5, 9KU6, 9KR31 and 9KR32 sockets. Includes (1) #6-40 x 13/32" screw for each clip. (2) required.
Box of 10, 9KU7 **NET $.60**

Quick-Mount clip, 24A067
Molded Lexan; no screws required;
For mounting 9KU6 sockets
Box of 10, 9KU8 **NET $.75**

Hold-down clip, 20C253
Stainless steel; restricts movement of relay inserted in 9KU6 socket. (2) required
Box of 20, 9KU9 **NET $1.50**



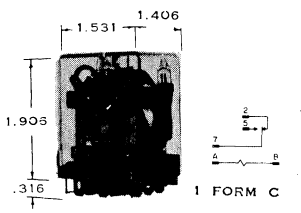


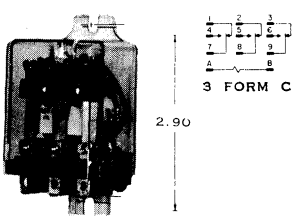
TRACK MOUNT SYSTEM

KUP SERIES This reliable 10-ampere relay for industrial control is available with a socket that is also rated 10 amperes. The .187" terminals of the relay are of the quick connect/solder type. Sockets are priced separately. The KUP with suffix "15" is enclosed in a clear polycarbonate dust cover. Silver-cadmium oxide contacts assure long contact life. Operation: Continuous.

KUP SERIES with 5-ampere rated silver contacts also available (suffix "11"). Relay has .187" quick-connect/solder terminals and polycarbonate dust cover. Mounts in sockets separately priced and described below. These reliable 5-ampere rated relays are available with DPDT or 3PDT contact arrangements.

KUP SERIES with slotted flange case (suffix "55") for direct-to-chassis mounting. Identical in both electrical and mechanical specifications as the KUP described above, except that they are not suitable for socket mounting. The .187" terminals are of the quick-connect/solder type. Slot width: .156". Weight: 3 ozs. All KUP Series models shown are recognized under the Component Program of Underwriters' Laboratories, Inc. (File No. E22575).





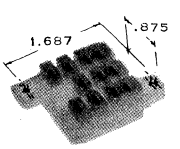
KUP SERIES SOCKETS

(For KUP plain case, KUA, KUL and KUR relays; CU and CL time delays.)

SPDT/DPDT/3PDT Pierced solder terminal socket, 27E043
Rated 10 amperes; molded nylon; (2) .165" diameter mounting holes
Box of 5, 9KU1 **LIST $4.00**

SPDT/DPDT/3PDT Printed circuit terminal socket, 27E046
Accepts .187" terminals; molded nylon; (2) .165" diameter mounting holes
Box of 5, 9KU2 **LIST $4.75**

Hold-down spring, 20C228
Box of 50, 9KU3 **LIST $5.50**



9KU1
9KU2
9KU5

KU Sockets continued on page 8.

GENERAL PURPOSE RELAYS

TYPE	COILS: Input	COILS: Res. in Ohms	COILS: Nom. Power	CONTACTS: Arrang.	CONTACTS: Amp Rating	SUGG. RESALE PRICE
KRP11AN§	6V	6				$ 8.35
	12V	21				8.35
	24V	85	2VA	DPDT	10	8.35
	120V	2,250				8.35
	240V	9,110				8.80
KRP11DN§	6V	32.1				8.25
	12V	120	1.2W	DPDT	10	8.25
	24V	472				8.25
	110V	10,000				9.00
KRP14AN§	6V	6				10.15
	12V	21				10.15
	24V	85	2VA	3PDT	10	10.15
	120V	2,250				10.15
	240V	9,110				10.60
KRP14DN§	24V	472	1.2W	3PDT	10	10.05

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

KUP5A15§	6V	5.1				$4.15
	12V	21			•	4.15
	24V	85	2VA	SPDT	10	4.15
	120V	2,250				4.15
	240V	9,110				4.60
KUP5D15§	6V	32.1			•	4.00
	12V	120	1.2W	SPDT	10	4.00
	24V	472				4.00
	110V	10,000				4.65
KUP11A11§	120V	1,030	2VA	DPDT	•5	4.90
KUP11D11§	24V	230	1.2W	DPDT	•5	4.40
KUP11A15§	6V	5.1				5.05
	12V	21			•	5.05
	24V	85	2VA	DPDT	10	5.05
	120V	2,250				5.05
	240V	9,110				5.50
KUP11D15§	6V	32.1			•	4.55
	12V	120	1.2W	DPDT	10	4.55
	24V	472				4.55
	110V	10,000				5.25
KUP14A11§	120V	1,030	2.75VA	3PDT	•5	5.45
KUP14A15§	6V	4.2				5.65
	12V	18			•	5.65
	24V	72	2.75VA	3PDT	10	5.65
	120V	1,700				5.65
	240V	7,200				6.10
KUP14D15§	6V	32.1			•	5.20
	12V	120	1.2W	3PDT	10	5.20
	24V	472				5.20
	110V	10,000				5.65
KUP5A55§	120V	2,250	2VA	SPDT	•10	4.15
KUP5D55§	24V	472	1.2W	SPDT	•10	4.00
KUP11A55§	24V	85	2VA	DPDT	•10	5.05
	120V	2,250				5.05
KUP11D55§	6V	32.1			•	4.55
	12V	120	1.2W	DPDT	10	4.55
	24V	472				4.55
	110V	10,000				5.25
KUP14A55§	6V	4.2				5.65
	12V	18			•	5.65
	24V	72	2.75VA	3PDT	10	5.65
	120V	1,700				5.65
	240V	7,200				6.10
KUP14D55§	6V	32.1			•	5.20
	12V	120	1.2W	3PDT	10	5.20
	24V	472				5.20
	110V	10,000				5.65

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

• Denotes U/L § Enclosed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

KU Sockets continued.

SPDT/DPDT/3PDT Printed circuit terminal socket, 27E046
Accepts .187" terminals; molded nylon; (2) .165" diameter mounting holes
Box of 5, 9KU2 **LIST $4.75**

Hold-down spring, 20C228
Box of 50, 9KU3 **LIST $5.50**

SPDT/DPDT/3PDT Quick-connect .187" terminal socket, 27E067
Rated 10 amperes; molded nylon; (2) .165" diameter mounting holes
Box of 5, 9KU5 **LIST $6.30**

SPDT/DPDT/3PDT Screw terminal socket, 27E121
Rated 10 amperes; molded Lexan; (2) mounting slots for No. 6 screws. Accepts .187" terminals
Box of 4, 9KU6 **LIST $14.00**

All sockets except 9KU6 are included in the Underwriters' Laboratories, Inc. Component Recognition of KU Series relays. The 9KU6 is "a suitable mounting means" when used with a U/L recognized relay.

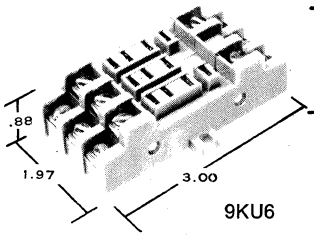
KUP93 SERIES Provides rectangular terminal configuration that has found wide acceptance in heating and air conditioning industries. Suited also to copiers, appliances, machine tool controls and many other applications. All AC and DC models are U/L recognized (File No. E22575) under the Component Program. Operating specifications, outstanding performance and long life identical to standard KUP relays. Contacts: gold-flashed fine silver, up to 3PDT arrangement. Enclosure: heat and shock resistant, clear polycarbonate dust cover. Terminals: .187" quick-connect standard. Mounting: fit specially designed custom sockets with terminals arranged in staggered rows. Socket terminals for crimp/solder or printed circuit mounting. See sockets below. Weight: 3 ozs.

KUP93 SERIES SOCKETS
(For use with plain case KUP93 relays)

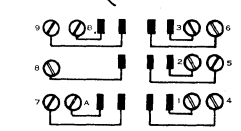
SPDT/DPDT/3PDT Deep Socket, 27E150
Rated 10 amperes; molded nylon; (2) .205" dia. mounting holes. Includes eleven .187" crimp/solder terminals (AMP 60250-1); not assembled.
Box of 1, 9KU9301 **LIST $.90**

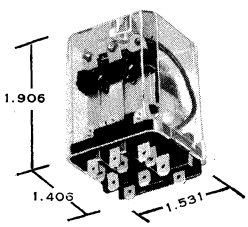
SPDT/DPDT/3PDT Printed circuit terminal socket, 27E168
Rated 10 amperes; molded nylon; (2) .205" dia. mounting holes; accepts .187" quick-connect terminals.
Box of 5, 9KU93-2 **LIST $4.75**

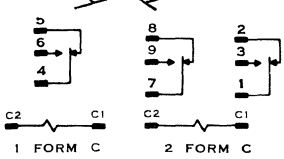
LNP SERIES are sensitive AC general purpose relays for use where limited control power is available. Has sensitivity of 0.75 volt-ampere at pick-up or nominal voltage. Operates from output of light sensitive resistors, switches and other low power control elements. Double pole, double throw contacts are rated 10 amperes @ 28V DC or 240V 60 Hz, 80% PF. Has same package, termination and mounting advantages of KUP Series general purpose relays. Terminals are .187" solder/quick-connect and fit all standard KU Series sockets. Weight: 3.0 ozs.

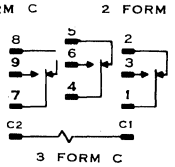


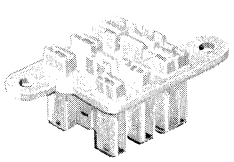
9KU6

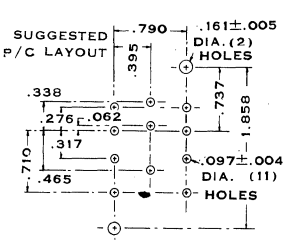


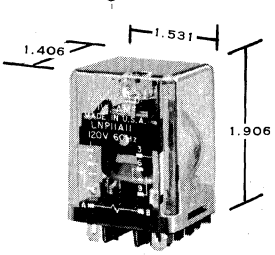


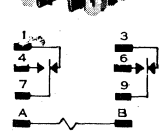












GENERAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
KUP93-5A13§	120V	2,250	2VA	SPDT	•10	$4.15
KUP93-5D13§	24V	472	1.2W	SPDT	•10	4.00
KUP93-11A13§	24V	85	2VA	DPDT	• 10	5.05
	120V	2,250				5.05
KUP93-11D13§	12V	120	1.2W	DPDT	•10	4.55
	24V	470				4.55
	110V	10,000				5.25
KUP93-14A13§	120V	1,700	2VA	3PDT	•10	5.65
KUP93-14D13§	6V	32.1	1.2W	3PDT	•10	5.20
	12V	120				5.20
	24V	470				5.20
	48V	1,800				5.40
	110V	10,000				5.65

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

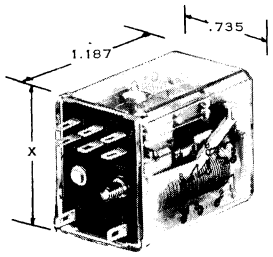
LNP11A15§	12V	33.7	0.75VA	DPDT	10	$6.35
	24V	138				6.35
	120V	3,357				6.35

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

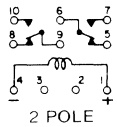
§ Enclosed Relay • Denotes U/L

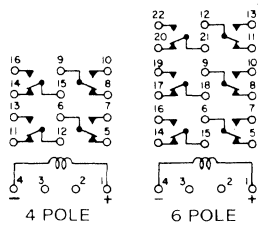
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

R10-E1 SERIES industrial relays with solder terminals and No. 3-48 stud or sockets for plug-in mounting. U/L recognized, File No. E42810. Relays provide sensitivity of 125 mW per pole. DPDT to 6PDT contact arrangement for DC coils are available with four contact styles: "W"—10 amps, "X"—5 amps, "Y"—2 amps, and "Z"—100 mA. Operating temperature: -55° C to +72° C. R10-E1 AC version also available with DPDT, 4PDT, 6PDT and 8PDT arrangements and "X" style contacts rated 5 amps. Sockets shown below fit all R10 relays and provide grounded or ungrounded versions with solder or p.c. terminals. Grounding provisions are pre-installed and wire hold down spring is included. R10-E1-Z Series has bifurcated contacts for low level loads. "J" Sensitive Current Adjustment: 85 mW (DPDT); 175 mW (4PDT). "SS" Ultrasensitive Current Adjustment: 20 mW (SPDT).



R10-E2 SERIES has printed circuit terminals for mounting on p.c. board without sockets. Available with "X", "Y", or "Z" style contacts for DPDT, 4PDT or 6PDT. Other electrical and mechanical specifications same as R10-E1 above. Weight: .8 to 1.4 ozs.





R10 SERIES SOCKETS WITH GROUNDING STRIP*

DPDT Solder terminal socket, R10-A10-10
Hold-down spring, R10-P28-1
Box of 10 each, 9XR10-1 **LIST $5.50**

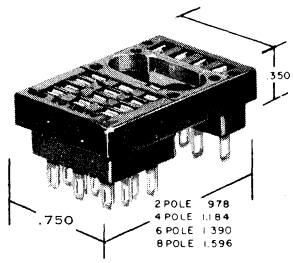
4PDT Solder terminal socket, R10-A10-20
Hold-down spring, R10-P28-2
Box of 10 each, 9XR10-2 **LIST $7.00**

4PDT Solder terminal bracket mount socket, A10-S020. Hold-down spring, R10-P28-2
Box of 5 each, 9XR10-14 **LIST $5.00**

6PDT Solder terminal socket, R10-A10-30
Hold-down spring, R10-P28-3
Box of 10 each, 9XR10-3 **LIST $9.00**

8PDT solder terminal socket, R10-A10-110
Hold-down spring, R10-P28-4
Box of 10 each, 9XR10-16 **LIST $14.00**

***Not recommended for relays carrying 5 amps AC and above.**



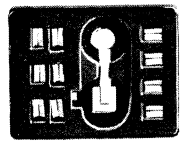
R10 RELAY SOCKET

DPDT Printed circuit terminal socket, R10-A11-10 Hold-down spring, R10-P28-4
Box of 10 each, 9XR10-4 **LIST $5.50**

4PDT Printed circuit terminal socket, R10-A11-20 Hold-down spring, R10-P28-2
Box of 10 each, 9XR10-5 **LIST $7.00**

6PDT Printed circuit terminal socket, R10-A11-30 Hold-down spring, R10-P28-3
Box 10 each, 9XR10-6 **LIST $9.00**

8PDT Printed circuit terminal socket, R10-A11-110 Hold-down spring, R10-P28-4
Box of 10 each, 9XR10-17 **LIST $14.00**


GROUNDING STRIP

R10 SOCKETS WITHOUT GROUND**

DPDT Solder terminal socket, R10-A10-40
Hold-down spring, R10-P28-1
Box of 10 each, 9XR10-7 **LIST $5.50**

4PDT Solder terminal socket, R10-A10-50
Hold-down spring, R10-P28-2
Box of 10 each, 9XR10-8 **LIST $7.00**

6PDT Solder terminal socket, R10-A10-60
Hold-down spring, R10-P28-3
Box of 10 each, 9XR10-9 **LIST $9.00**
Strap hold-down spring, R10-P49
For printed circuit sockets
Box of 50 each, 9XR10-10 **LIST $2.50**

R10 Series continued on page 10.

GENERAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
R10-E1-W4						
-V700	24VDC	700	820mW	4PDT	• 10	$ 4.90
R10-E1-Y1						
-SS1.0K	6VDC	1,000	36mW	SPDT	• 2	4.05
-SS220	3VDC	220	40mW	SPDT	2	4.05
R10-E1-Y2						
-V52	6VDC	52	690mW			3.30
-V185	12VDC	185	770mW		•	3.30
-V700	24VDC	700	820mW	2PDT	2	3.30
-V2.5K	48VDC	2,500	920mW			3.30
-V15.0K	115VDC	15,000	880mW			5.35
R10-E1-Y4						
-V52	6VDC	52	690mW			3.65
-V185	12VDC	185	770mW		•	3.65
-V700	24VDC	700	820mW	4PDT	2	3.65
-V2.5K	48VDC	2,500	920mW			3.65
-V15.0K	115VDC	15,000	880mW			5.70
R10-E1-Y6						
-V25	6VDC	25	1.4W			4.70
-V90	12VDC	90	1.6W		•	4.70
-V430	24VDC	430	1.3W	6PDT	2	4.70
-V1.5K	48VDC	1,500	1.5W			4.70
-V9.0K	115VDC	9,000	1.5W			5.60
R10-E1-X2						
-V52	6VDC	52	690mW			3.40
-V185	12VDC	185	770mW		•	3.40
-V700	24VDC	700	820mW	2PDT	5	3.40
-V2.5K	48VDC	2,500	920mW			3.40
-V15.0K	115VDC	15,000	880mW			5.45
R10-E1-X4						
-V52	6VDC	52	690mW			3.90
-V185	12VDC	185	770mW		•	3.90
-V700	24VDC	700	820mW	4PDT	5	3.90
-V2.5K	48VDC	2,500	920mW			3.90
-V15.0K	115VDC	15,000	880mW			5.95
R10-E1-X6						
-V25	6VDC	25	1.4W			5.10
-V90	12VDC	90	1.6W		•	5.10
-V430	24VDC	430	1.3W	6PDT	5	5.10
-V1.5K	48VDC	1,500	1.5W			5.10
-V9.0K	115VDC	9,000	1.5W			6.00
R10-E1-W2					•	
-V185	12VDC	185	770mW	2PDT	10	3.95
-V700	24VDC	700	820mW			3.95
R10-E1-Z2						
-V52	6VDC	52	690mW		•	3.70
-V185	12VDC	185	770mW			3.70
-700	24VDC	700	820mW	2PDT	100	3.70
-V2.5K	48VDC	2,500	920mW		mA	3.70
-V15.0K	115VDC	15,000	880mW			5.75
R10-E1-Z4						
-V52	6VDC	52	690mW			4.15
-V185	12VDC	185	770mW		•	4.15
-V700	24VDC	700	820mW	4PDT	100	4.15
-V2.5K	48VDC	2,500	920mW		mA	4.15
-V15.0K	115VDC	15,000	880mW			6.20
R10-E1-Z6						
-V25	6VDC	25	1.4W			5.35
-V90	12VDC	90	1.6W		•	5.35
-V430	24VDC	430	1.3W	6PDT	100	5.35
-V1.5K	48VDC	1,500	1.5W		mA	5.35
-V9.0K	115VDC	9,000	1.5W			6.25
R10-E1-Y2						
-J2.5K	5.8mA	2,500	85mW		•	3.60
-J5.0K	4.1mA	5,000	84mW	2PDT	2	4.10
-J10.0K	3.1mA	10,000	96mW			4.50
R10-E1-Y4						
-J2.5K	8.4mA	2,500	176mW		•	4.00
-J5.0K	6.2mA	5,000	192mW	4PDT	2	4.50
-J10.0K	4.5mA	10,000	200mW			4.90
R10-E1-Z4					•	
-J1.0K	12.0mA	1,000	144mW			4.50
-J2.5K	8.4mA	2,500	176mW	4PDT	100	4.50
-J5.0K	6.2mA	5,000	192mW		mA	5.00
R10-E1-X2	115VAC	(Diodes)	3VA	2PDT	•	
-115VAC		(2)9.0K			5	5.15
R10-E1-X4	115VAC	(Diodes)	3VA	4PDT	• 5	
-115VAC		(2)9.0K				6.30
R10-E1-X6	115VAC	(Diodes)	3VA	6PDT	•	
-115VAC		(2)7.5K			5	8.75
R10-E1-X8	115VAC	(Diodes)	3VA	8PDT	•	
-115VAC		(2)7.5K			5	10.55

**For 5 amps AC and above

• Denotes U/L **See ordering information on page 11.**

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

R10 SERIES SOCKETS WITH GROUNDING TERMINAL*

DPDT Printed circuit terminal socket, R10-A11-70. Hold-down spring, R10-P28-1.
Box of 10, 9XR10-11 **LIST $5.50**

4PDT Printed circuit terminal socket, R10-A11-80. Hold-down spring, R10-P28-2.
Box of 10, 9XR10-12 **LIST $7.00**

6PDT Printed circuit terminal socket, R10-A11-90. Hold-down spring, R10-P28-3.
Box of 10, 9XR10-13 **LIST $9.00**

*Not recommended for relays carrying 5 amps AC and above.

R10 SERIES HOLD-DOWN SPRINGS

Hold-down spring for R10-P28-1.
Box of 100, 9XR10-19 **$5.00**

Hold-down spring for R10-P28-2.
Box of 100, 9XR10-20 **$5.00**

Hold-down spring for R10-P28-3.
Box of 100, 9XR10-21 **$5.00**

Hold-down spring for R10-P28-4.
Box of 100, 9XR10-22 **$5.00**

R10L SERIES Has a light emitting diode (LED) indicator. LED produces highly visible red light when relay coil is energized. Especially useful when troubleshooting an instrument, equipment, or system. LED has long operating life and high reliability. Other operating characteristics same as standard R10 Series relays. LED is available on relays with coils up to 48 volts DC. Relays fit standard R10 Series sockets.

Note: Observe polarity indicated when wiring R10L- with LED.

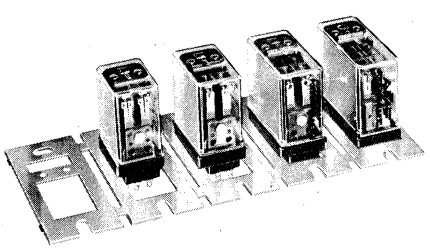
MOUNTING STRIP FOR R10 RELAYS

Contains twenty pre-punched break-away mounting plates stamped from .064" aluminum. Designed to simplify mounting one or more R10 relays on chassis or racks. Each individual plate accepts a 2, 4, 6, or 8 pole solder terminal R10 relay or socket.

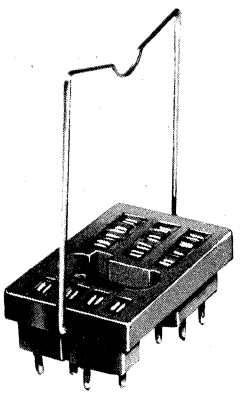
When a socket is used, it is held in place by one #3-48 screw and nut in the hole provided. Or, the relay may be mounted without a socket by inserting its mounting stud through the hole in the plate and fastening a #3-48 nut on relay stud.

Single plates may be mounted over a rectangular hole measuring 1.62" x .750" maximum or a 1.62" round hole.

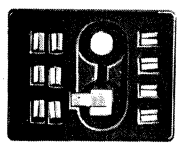
For rack or panel installation, the entire 20-piece strip (approx. 24" long) may be mounted. Reinforcing of the strip will be required depending on the number of plates used and the particular mounting circumstances.



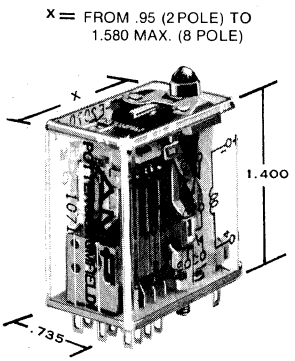
R10 Mounting strip, R10P126
Box of 12 strips, 9XR10-15 **LIST $28.20**

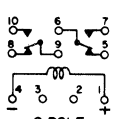


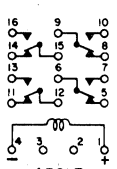
WIRE HOLD-DOWN SPRING

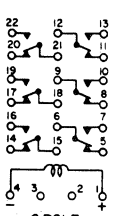


GROUNDING TERMINAL









GENERAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
R10-E2-W2 -V700	24VDC	700	820mW	DPDT	• 10§	$3.95
R10-E2-X2 -V700	24VDC	700	820mW	2PDT	• 5	3.40
R10-E2-Y2 -V185	12VDC	185	770mW	2PDT	• 2	3.30
-V700	24VDC	700	820mW			3.30
R10-E2-Y4 -V185	12VDC	185	770mW	4PDT	• 2	3.65
-V700	24VDC	700	820mW			3.65
R10-E2-Y6 -V90	12VDC	90	1.6W		•	4.70
-V430	24VDC	430	1.3W	6PDT	2	4.70
-V1.5K	48VDC	1500	1.5W			4.70
R10-E2-Z4 -V185	12VDC	185	770mW	4PDT	• 100 mA	4.15
-V700	24VDC	700	820mW			4.15
R10-E2-Z4 -J2.5K	8.4mA	2500	176mW	4PDT	• 100 mA	4.50
-J5.OK	6.2mA	5000	192mW			5.00
R10-E2-Z6 -V90	12VDC	90	1.6W		•	5.35
-V430	24VDC	430	1.3W	6PDT	100	5.35
-V1.5K	48VDC	1500	1.5W			5.35
R10L-E1-X2 -V185	12VDC	185	770mW	2PDT	5	6.90
-V700	24VDC	700	820mW			6.90
R10L-E1-X4 -V185	12VDC	185	770mW			7.40
-V700	24VDC	700	820mW	4PDT	5	7.40
-V2.5K	48VDC	2500	920mW			7.40
R10L-E1-X6 -V430	24VDC	430	1.3W	6PDT	5	8.60
R10L-E1-Y2 -V52	6VDC	52	690mW			6.80
-V185	12VDC	185	770mW	2PDT	2	6.80
-V700	24VDC	700	820mW			6.80
-V2.5K	48VDC	2500	920mW			6.80
R10L-E1-Y4 -V52	6VDC	52	690mW			7.15
-V185	12VDC	185	770mW	4PDT	2	7.15
-V700	24VDC	700	820mW			7.15
R10L-E1-Y6 -V430	24VDC	430	1.3W	6PDT	2	8.20
R10L-E1-Z4 -V700	24VDC	700	820mW	4PDT	100 mA	7.65
R10L-E2-Y2 -V185	12VDC	185	770mW	2PDT	2	6.80
R10L-E2-Y4 -V700	24VDC	700	820mW	4PDT	2	7.15

§ Use ungrounded frame for AC loads 5 amps and more.

• Denotes U/L

See ordering information on page 11.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

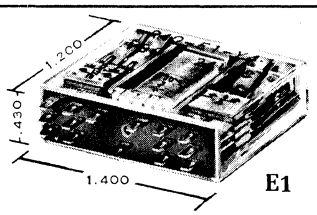
Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

R40 SERIES SLIMLINE DC operated 4PDT relays are designed for printed circuit board use. All are recognized under U/L Component Program, File No. E46750. Features low profile—only .430" height. Allows easy circuit board layout and 6" board mounting centers. Also available with solder/plug-in terminals to fit sockets described below. A variety of contact styles provide switching dry circuit to 5 ampere loads. A wide range of coils for DC voltage is available. Nominal pick-up power is 720 mW. Weight: .8 to 1.05 ozs.

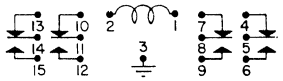
R40-E1 SERIES provides solder terminals or plug-in socket mounting. (See sockets below). Bifurcated contacts for low level applications available or with cross bar contacts for dry circuit use.

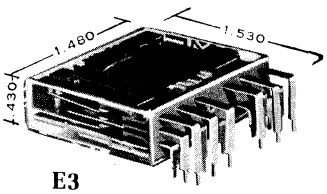
R40-E2 SERIES has printed circuit pins for vertical mounting.

R40-E3 SERIES is equipped for mounting relay flat on a printed circuit board. Weight: .8 to 1.05 ozs.

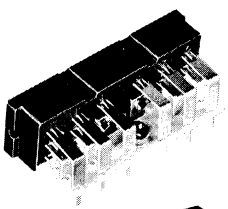


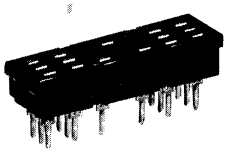
E1

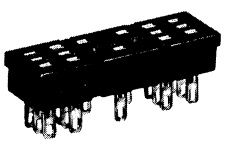




E3







R40 SERIES SOCKETS

4PDT Right angle printed circuit terminal socket, R40-S410
Hold-down spring, R40-P33
Box of 10 each, 9XR40-1 **LIST $14.00**

4PDT Vertical printed circuit terminal socket, R40-S420
Hold-down spring, R40-P33
Box of 10 each, 9XR40-2 **LIST $10.00**

4PDT Chassis mount solder terminal socket, R40-S430
Hold-down spring, R40-P33 and retainer, R40-P34
Box of 10 each, 9XR40-3 **LIST $11.00**

GENERAL PURPOSE RELAYS

TYPE	COILS Input	Res. in Ohms	Nom. Power	CONTACTS Arrang.	Amp Rating	SUGG. RESALE PRICE
R40-E1-X4						
-V200	12VDC	200	720mW	4PDT	•	$5.65
-V800	24VDC	800			5*	5.65
R40-E1-Y4						
-V50	6VDC	50			•	5.40
-V200	12VDC	200	720mW	4PDT	2	5.40
-V800	24VDC	800				5.40
-V3.2K	48VDC	3.2K				5.40
R40-E1-Z4					•	
-V200	12VDC	200	720mW	4PDT	100mA	5.90
-V800	24VDC	800				5.90
R40-E1-L4					•	
-V200	12VDC	200				6.85
-V800	24VDC	800	720mW	4PDT	500μA	6.85
-V3.2K	48VDC	3.2K				6.85
R40-E2-X4					•	
-V50	6VDC	50	720mW	4PDT	5*	5.65
-V200	12VDC	200				5.65
-V800	24VDC	800				5.65
R40-E2-Y4					•	
-V200	12VDC	200	720mW	4PDT	2	5.40
-V800	24VDC	800				5.40
R40-E2-Z4					•	
V200	12VDC	200	720mW	4PDT	100mA	5.90
-V800	24VDC	800				5.90
-V3.2K	48VDC	3.2K				5.90
R40-E3-X4					•	
-V200	12VDC	200	720mW	4PDT	5*	5.65
-V800	24VDC	800				5.65
R40-E3-Y4					•	
-V200	12VDC	200				5.40
-V800	24VDC	800	720mW	4PDT	2	5.40
-V3.2K	48VDC	3.2K				5.40
R40-E3-Z4					•	
-V200	12VDC	200				5.90
-V800	24VDC	800	720mW	4PDT	100mA	5.90
-V3.2K	48VDC	3.2K				5.90
R40-E3-L4					•	
-V200	12VDC	200				6.85
-V800	24VDC	800	720mW	4PDT	500μA	6.85
-V3.2K	48VDC	3.2K				6.85

• Denotes U/L. * Use ungrounded frame for AC loads 5 amps and above.

ORDERING INFORMATION FOR R10 AND R40 SERIES RELAYS

To select your relay:

1. Decide on terminal type and mounting.
2. Choose the proper coil resistance.
3. Select rating and contact arrangement.
4. Pick a mating socket, if needed.

EXAMPLES:

R10
R10 Type Relay with Transparent Enclosure

E1
Plug-in Solder Terminals and Mounting Stud

Y4
4 Form C Contacts Rated 2 Amps

V700
700 ohm coil for 24V DC Operation
or
J2.5K
Sensitive Current Adjustment

9XR10-2 Socket
Chassis Mount Socket for a 4 Form C Relay

R40
R40 Slimline Series Relay

E2
Printed Circuit Terminals, No Stud Mounting

Z4
.100 amp Contacts 4 Form C Bifurcated

V200
200 Ohm Coil for 12V DC Operation

9XR40-1 Socket
Right Angle Printed Circuit Socket

IN STOCK AT LEADING ELECTRONIC PARTS DISTRIBUTORS

POTTER & BRUMFIELD RELAYS

AB SERIES For appliance and general purpose applications where rugged construction, long life and quiet operation are required. All equipped with terminals to fit snap-on connectors and may be applied to printed circuits using dip soldering. Snap-on screw adaptors packed with each relay. All models are recognized under the Component Program of U/L (File No. E29244) and are CSA* listed (File No. LR-15734). Mounting: Two No. 8-32 tapped holes, on 1¼" centers. Silver contacts. Weight: Approx. 5 ozs.

ABC SERIES Medium duty power relay with dust cover. For small motors, industrial control and similar applications. All equipped with terminals to fit snap-on connectors and may be applied to printed circuits using dip soldering. Snap-on screw adaptors packed with each relay. All models are recognized under the Component Program of U/L (File No. E29244) and are CSA* listed (File No. LR-15734). Mounting: One No. 8-32 threaded stud ⅜" long and locating tab on .562" centers. Contacts: Silver. Weight: Approx. 7 ozs.

GF SERIES Medium duty power relay for industrial control applications. Long contact arms have silver contacts rated at 10 amps at 120V AC or 28V DC, resistive. Contacts have excellent wipe or self-cleaning action. Tinned, pierced solder terminals. Mounting: 8-32 tapped core with locating boss. Weight: 4.75 ozs. (See GA series on page 3 for similar voltage actuated relays.)

MR SERIES A medium duty power relay that can handle small motors, transmitters, and general purpose applications. Mounting: Two .156" dia. holes on 2.250" centers for MR 3 and 11, 2.625" centers for MR2, 5 and 14. Contacts: Silver. Weight: 4 ozs.

MS/MR SERIES DUST COVER

Metal dust cover, 35D130
Similar to PM/PR shown below
Box of 1, 35D130 **LIST $2.30**

PM SERIES A compact 4PDT power relay for polyphase and heavy duty switching applications. Screw terminals. Has silver-cadmium oxide contacts rated at 25 amps at 240V, 50/60 Hz resistive AC, 1 HP per movable arm at 120V or 240V, AC single phase, U/L (File No. E22575) and CSA* listed, except 480V. Mounts by one front key-hole and two rear channel slots for 8-32 screws on 2" x 2.5" triangular centers. Weight: 14 ozs.

PM SERIES ADAPTOR PLATE

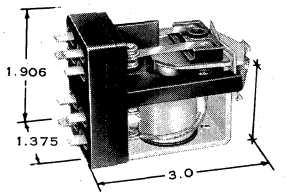
Adaptor plate, 37B370
For mounting PM on PR mounting holes
Box of 10, 9PM1 **LIST $1.80**

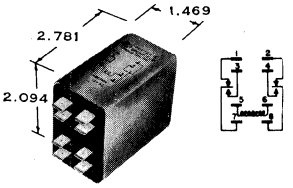
PM AND PR DUST COVERS These dust covers have a sheet metal base with knockouts for .5" dia. conduit and an aluminum cover fitted with two screws. Finished in gray hammertone. Mounting: Three No. 10 holes on 1.875" x 4.125" centers. Approx. weight: 1 lb.

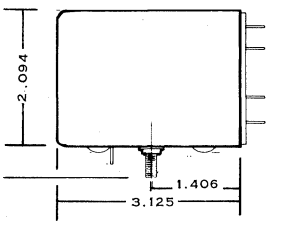
Metal dust cover, 35D227
For PM only
Box of 1, 35D227 **LIST $3.45**

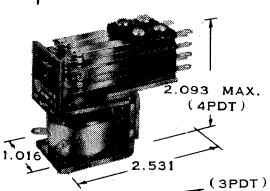
Plastic dust cover, 35D203
For PM only
Box of 4, 9PM2 **LIST $2.00**

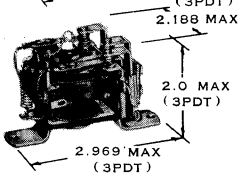
Metal dust cover, 35D013
For PR only
Box of 1, 35D013 **LIST $3.45**

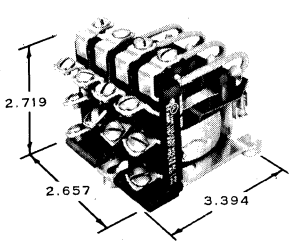


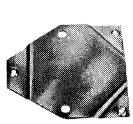






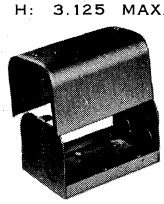






PM:
L: 5.313 MAX.
W: 3.812 MAX.
H: 3.812 MAX.

PR:
L: 5.312 MAX.
W: 3.375 MAX.
H: 3.125 MAX.



POWER RELAYS

TYPE	COILS			CONTACTS		SUGG. RESALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
AB11AY	6V	1.3	6.4VA	DPDT	•	$6.20
	24V	23			10	6.20
	120V	510				6.20
	240V	2,050				6.70
AB11DY	12V	72	2W	DPDT	•	6.15
	24V	288			10	6.15
	110V	6,050				6.65
ABC11AY	6V	1.3	6.4VA	DPDT	•	7.45
	24V	23			10	7.45
	120V	510				7.45
	240V	2,050				7.95
ABC11DY	6V	18	2W	DPDT	•	7.45
	12V	72			10	7.45
	24V	288				7.45
	110V	6,050				7.95
GF17A	12V	6.8	6VA	4PDT	10	7.65
	24V	24				7.65
	120V	690				7.65
	240V	2,950				8 10
GF17D	6V	18	2W	4PDT	10	7.65
	12V	72				7.65
	24V	288				7.65
	110V	6,050				8.20

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

MR3A	6V	2.75	3.25VA	SPST-NO-DM	10	$ 4.75
	24V	50				4.75
	120V	1,250				4.75
MR3D	6V	24	1.6W	SPST-NO-DM	10	4.30
	12V	96				4.30
	24V	360				4.30
MR5A	6V	2.75	3.25VA	SPDT	8	4.25
	12V	13.25				4.25
	24V	50				4.25
	120V	1,250				4.25
	240V	4,600				4.75
MR5D	6V	24	1.6W	SPDT	8	3.95
	12V	96				3.95
	24V	360				3.95
	110V	8,000				4.50
MR11A	6V	2.75	3.25VA	DPDT	8	6.00
	12V	13.25				6.00
	24V	50				6.00
	120V	1,250				6.00
	240V	4,600				6.45
MR11D	6V	24	1.6W	DPDT	8	5.65
	12V	96				5.65
	24V	360				5.65
	110V	8,000				6.25
MR14A	6V	2.75	3.25VA	3PDT	8	7.15
	12V	13.25				7.15
	24V	50				7.15
	120V	1,250				7.15
	240V	4,600				7.60
MR14D	6V	24	1.6W	3PDT	8	6.70
	12V	96				6.70
	24V	360				6.70
	110V	8,000				7.30
PM17AY	6V	.37	14VA	4PDT	•	14.35
	12V	1.4				14.35
	24V	5			25	14.35
	120V	120				14.35
	240V	587				14.90
PM17A	480V	1,790	14VA	4PDT	25	15.80
PM17DY	6V	8.2	4.4W	4PDT	•	13.70
	12V	33			25	13.70
	24V	132				13.70
	110V	2,760				14.30
PMT17AY	24V	5	13VA	4PDT	•	14.20
	120V	120	15VA		25	14.20

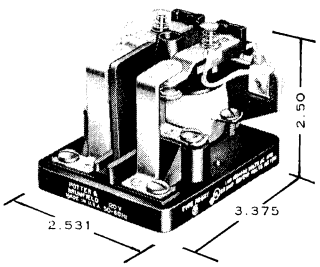
*Canadian Standards Association File No. LR-15734

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

• Denotes U/L § Enclosed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

PR SERIES Heavy duty relay for industrial control applications requiring long life and fast action. Industrial screw terminals. All AC and DC models shown carry U/L (File No. E22575) and CSA* listing. PR11AS models have U/L Component Program recognition. Mounting: Two .188" dia. holes on 1.875" centers. Weight: 11 ozs. max. Contacts: Silver. Enclosure: See "PR" Dust Cover under PM Series. The PR11AS relay has auxiliary miniature snap-action switch with SPDT silver contacts rated 5 amps @ 120V AC. Open only, relay with miniature switch will not fit inside cover.



DESIGNATOR CHANGES

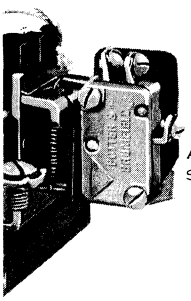
to PR relays have been made. A zero, indicating screw terminals has been added to most relays of this series.

EXAMPLE: PR11AY becomes PR11AY0

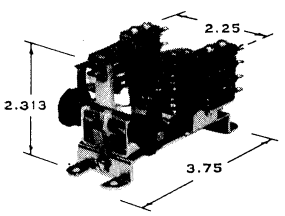
An exception applies to PR relays having an auxiliary switch:

EXAMPLE: PR11AS becomes PRA11AYA

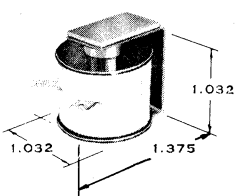
These designator changes have been made throughout the last half of 1972.



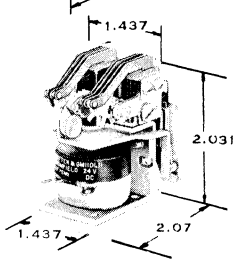
AP SERIES RATCHET, IMPULSE A reliable compact unit for applications requiring on-off or reversing action on alternate operations. Positive ratchet operation at all speeds on impulses as short as 60 ms. Intermittent operation only. Mounting: Three .156" dia. holes on 3.375" x .875" triangular centers. Contacts: Silver. Weight: 7 ozs. Coils for intermittent duty only.



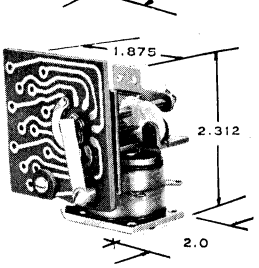
BU BUZZER AC operated coil with a spring steel armature which buzzes when coil is energized. Used extensively in test equipment, laboratories and a host of other applications where a small light weight, dependable buzzer is required. Recognized under the Component Program of Underwriters' Laboratories, Inc. (File No. S1154). Weight: 1⅝ ozs. Mounting: No. 6-32 tapped core.



GM SERIES Unusually versatile switching makes this impulse/sequencing relay especially suitable for single coil latching. The 2 Form C contact arrangement is switched alternately by cam action during drop-out of the armature. It can also be furnished with additional 2 Form C auxiliary contacts (designated by "L"). AC version operates on a 50% coil duty cycle (5 Min. max.). Mounting: 8-32 tapped core with locating boss. Weights: With aux. contacts 4¾ ozs. Without aux. contacts 4 ozs.



The **GM1N10** and **GM1N12** AC or DC use the basic GM structure with uni-directional printed circuit boards with 10 or 12-steps, respectively. The board is attached to an extension of the ratchet shaft. The movable contact arm advances one position each time the armature drops out. Contact rating: .25 amps. Contact arrangement: SP-10 pos. and SP-12 pos. Size: 2.312" x 1.875" x 2".



POWER RELAYS

TYPE	COILS Input	Res. in Ohms	Nom. Power	CONTACTS Arrang.	Amp Rating	SUGG. RESALE PRICE
PR1AY0	24V	12	9.8VA	SPST-NO	•	$ 4.75
	120V	290			25	4.75
PR3AY0	6V	.86	9.8VA	SPST-NO-DM		4.85
	12V	3.2			•	4.85
	24V	12			25	4.85
	120V	290				4.85
	208V	850				5.35
	240V	1,200				5.35
PR3DY0	6V	18	2W	SPST-NO-DM	•	4.85
	12V	71			25	4.85
	24V	288				4.85
	110V	6,050				5.55
PR5AY0	6V	.86	9.8VA	SPDT		5.10
	12V	3.2			•	5.10
	24V	12			25	5.10
	120V	290				5.10
	208V	850				5.60
	240V	1,200				5.60
PR5DY0	6V	18	2W	SPDT		5.10
	12V	71			•	5.10
	24V	288			25	5.10
	110V	6,050				5.80
PR7AG0	120V	290	9.8VA	DPST-NO	30•	6.00
PR7AY0	6V	.86	9.8VA	DPST-NO		5.70
	12V	3.2			•	5.70
	24V	12			25	5.70
	120V	290				5.70
	208V	850				6.20
	240V	1,200				6.20
PR7DY0	6V	18	2W	DPST-NO	•	5.75
	12V	71			25	5.75
	24V	288				5.75
	110V	6,050				6.45
PR11AG0	120V	290	9.8VA	DPDT	30•	7.80
PR11AY0	6V	.86	9.8VA	DPDT		7.50
	12V	3.2				7.50
	24V	12			•	7.50
	120V	290			25	7.50
	208V	850				8.00
	240V	1,200				8.00
	480V	4,500				9.00
PRA11AYA	12V	3.2	9.8VA	DPDT & SPDT	•	9.15
	24V	12			25	9.15
	120V	290				9.15
	240V	1,200				9.65
PR11DY0	6V	18	2W	DPDT		7.50
	12V	71			25•	7.50
	24V	288				7.50
	110V	6,050				8.20

SPECIAL PURPOSE RELAYS

AP11A	6V	.6	18.5VA	DPDT	5	$10.20
	12V	2.28				10.20
	24V	8.8				10.20
	120V	240				10.20
	240V	900				10.75
AP11D	6V	4.0	9W	DPDT	5	10.20
	12V	15.5				10.20
	24V	65				10.20
	110V	1,350				10.95
AP17A	24V	8.8	18.5VA	4PDT	5	12.35
	120V	240				12.35
AP17D	12V	15.5	9W	4PDT	5	12.35
	24V	65				12.35
	110V	1,350				13.10
BU	6V	2.7	4.6VA	—	—	2.10
	12V	13.2			•	2.10
	24V	50				2.10
	120V	1,250				2.10
	240V	4,600				2.55
GM11A	24V	16	9.4VA	DPDT	3	8.45
	120V	420				8.45
GM11AL11	120V	420	9.4VA	DPDT/DPDT	3	12.00
GM11D	12V	36	4W	DPDT	3	8.10
	24V	144				8.10
	110V	3,050				8.65
GM11DL11	12V	36	4W	DPDT/DPDT	3	11.75
	24V	144				11.75
GM1N10A	120V	510	9.4VA	SP-10 pos.		10.40
GM1N12A	120V	510	9.4VA	SP-12 pos.		10.55
GM1N10D	24V	144	4W	SP-10 pos.	.25	10.15
GM1N12D	24V	144	4W	SP-12 pos.		10.30

SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

*Canadian Standards Association File No. LR-15734

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**D**N

• Denotes U/L

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

GP SERIES Separate AC and DC coils to match with DPDT or 4PDT switches. AC coils (GPA) available in 6, 12, 24, 120 and 240 volts. DC coils (GPD) available in 6, 12, 24 and 110 volts; current coils: 2,500, 5,000 and 10,000 ohms. Contacts: Silver.

GP11 Switch Assembly DPDT 5 amps **$2.05**
GP17 Switch Assembly 4PDT 5 amps **$3.45**

KB SERIES LATCHING RELAY Both release and trip coils must be for the same voltage. One coil operates relay to set latch and other coil releases it. Ideal for memory work and overload applications. Operates on momentary impulse to either coil. Mounting: Two .156" dia. holes on 1.375" centers. Weight: 6 ozs. Contacts: Silver, rated 5 amps; "G" suffix indicates silver-cadmium oxide contacts on movables rated 10 amps. AC relays with 5 amp contacts are recognized under Component Program of Underwriters' Laboratories, Inc. (File No. 29244) and are CSA* listed. AC coil for intermittent duty only.

KBP SERIES LATCHING RELAY Enclosed in a translucent polypropylene dust cover, the KBP is furnished with 20-pin octal-type plugs for socket mounting. Contact arrangements of 4PDT and 5PDT are available. Otherwise all specifications are identical to the KB series described above. U/L component recognition does not apply to the KBP series. Weight: 8 ozs.

KM SERIES Subminiature relay for applications requiring unusually small relays with up to 3-poles. Contacts: Silver. Withstands 30g mechanical shock and .06" excursion from 10 to 55 Hz mechanical vibration. Used extensively in small business machines, alarm systems, automatic toys and communications systems. Mounting: One 2-56 tapped core and locating .062" dia. half-punch on .187" centers. Solder terminals. Weight: .58 ozs.

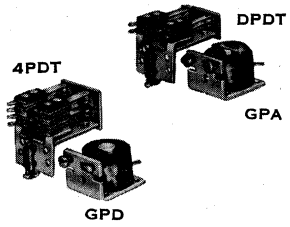
KT SERIES ANTENNA SWITCHING RELAY Glass base insulation for minimum RF loss to switch 300 ohm line. Mounting: One No. 6-32 threaded stud and locating tab on .438" centers. Contacts: Gold-flashed silver. Weight: 1.5 oz.

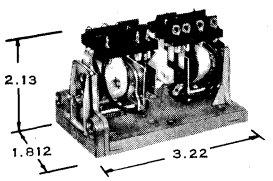
KUL SERIES Small, magnetic latching relay requiring approximately half the space needed for mechanical latching relays. Designed for continuous duty in applications demanding good memory stability, the KUL is ideal for machine tools, process controls and business machines. All AC and DC models are U/L recognized (File No. E22575) under the Component Program, and are CSA* approved. SPDT or DPDT silver-cadmium oxide contacts are rated 10 amps @ 28V DC, resistive or 120V AC, 80% PF. All AC DPDT relays include diodes inside the clear polycarbonate dust cover. Mounting: Various 10 amp rated nylon sockets available (see KU sockets pages 7 & 8). Weight: 3.4 ozs.

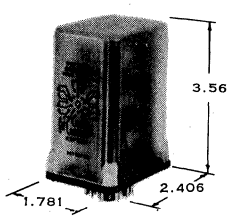
KUL SERIES SPRING

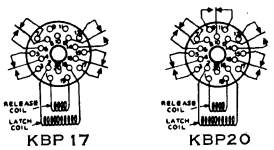
(For KUL relay, CU and CL 51 style timer relays.)

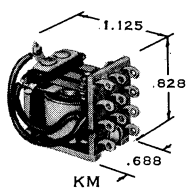
Hold-down spring, 20C247
Box of 25, 9KUL21 **LIST $4.50**

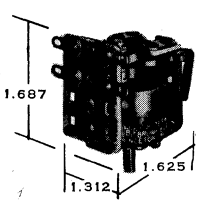


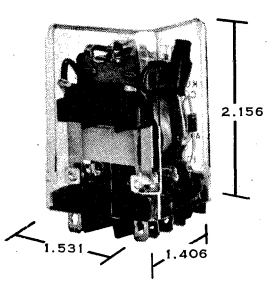












SPECIAL PURPOSE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrange.	Amp Rating	
GPA	6V	1.7				$ 2.00
	12V	6.8				2.00
	24V	24	6VA	None	—	2.00
	120V	690				2.00
	240V	2,950				2.45
GPD	—	2,500	—			1.85
	—	5,000	—			2.10
	—	10,000	—			2.45
	6V	18	2W	None	—	2.45
	12V	72	2W			2.45
	24V	288	2W			2.45
	110V	6,050	2W			3.65
KB17AY	6V	2.3				12.25
	12V	10			•	12.25
	24V	42	5VA	4PDT	5	12.25
	120V	1,030				12.25
	240V	4,100				13.15
KB17AG	6V	2.3				12.35
	12V	10				12.35
	24V	42	5VA	4PDT	10	12.35
	120V	1,030				12.35
	240V	4,100				13.25
KB17D	6V	13.1				11.00
	12V	52	2.7W	4PDT	5	11.00
	24V	230				11.00
	110V	4,560				12.45
KB17DG	6V	13.1				11.25
	12V	52	2.7W	4PDT	10	11.25
	24V	230				11.25
	110V	4,560				12.70
KB23AY	24V	27	7.8VA	6PDT	•	14.65
	120V	700			5	14.65
KB23AG	24V	27	7.8VA	6PDT		14.85
	120V	700			10	14.85
KB23D	24V	230	2.7W	6PDT	5	13.30
KB23DG	24V	230	2.7W	6PDT		13.65
	110V	4,560			10	15.10
KBP11A§	120V	1,030	5.3VA	DPDT	5	15.15
KBP11AG§	120V	1,030	5.3VA	DPDT	10	15.25
KBP17A§	120V	1,030	5VA	4PDT	5	17.20
KBP17AG§	120V	1,030	5VA	4PDT	10	17.40
KBP17D§	24V	230	2.7W	4PDT	5	15.95
KBP17DG§	12V	52	2.7W	4PDT	10	16.25
	24V	230				16.25
KBP20A§	120V	700	7.8VA	5PDT	5	17.70
KBP20AG§	120V	700	7.8VA	5PDT	10	17.95
KBP20DG§	12V	52	2.7W	5PDT	10	17.10
	24V	230				17.10
KM5D	6V	36				4.20
	12V	144	1.1W	SPDT	2	4.20
	24V	500				4.20
KM11D	6V	36				4.60
	12V	144	1.1W	DPDT	2	4.60
	24V	500				4.60
KM14D	6V	36				5.30
	12V	144	1.1W	3PDT	2	5.30
	24V	500				5.30
KT11A	6V	6	2VA	DPDT	5	4.50
	120V	2,250				4.50
KT11D	6V	32.1	1.2W	DPDT	5	4.50
	12V	120				4.50
KUL5A15S	120V	3,700	—	SPDT	•10	6.35
KUL5D15S	24V	472	1.2W	SPDT	•10	5.50
KUL11A15S	12V	37			•	7.15
	24V	176	—	DPDT	10	7.15
	120V	3,700				7.15
KUL11D15D	24V	350	2.4W	DPDT	•10	7.15
KUL11D15S	12V	120	1.2W	DPDT	•10	6.10
	24V	472	1.2W			6.10

*Canadian Standards Association File No. LR-15734

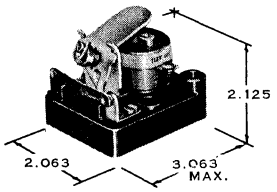
A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

• Denotes U/L

§ Enclosed Relay

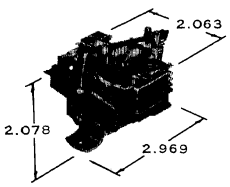
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

MS SERIES MOTOR STARTING RELAYS For starting capacitor start, induction-run motors. Operates on back EMF of start winding. Armature gap can be altered to change pick-up. Recognized under Component Program of Underwriters' Laboratories, Inc. (File No. 29245). Mounting: Two .156" dia. holes on 1.563" centers. Contacts: ¾ HP, fine silver; 3 HP, silver cadmium. Weight: 5 ozs. max.

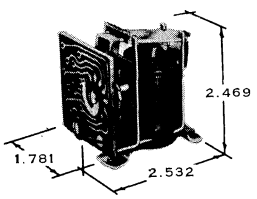


MS/MR SERIES DUST COVER
Metal dust cover, 35D130
Similar to PM/PR on page 12
Box of 1, 35D130 **LIST $2.30**

PC SERIES Single coil impulse latching relay for on-off and current reversal switching on alternate pulses. Mounting: Two .156" dia. holes on 2.625" centers. Weight: 5 ozs. Contacts: Gold-flashed silver-cadmium oxide. Coils for intermittent duty only.



SA SERIES STEPPING SWITCH For operation in vertical position only. A twelve position stepping relay with printed circuit strips to switch currents up to 250 milliamps. Armature-driven pawl operates a ratchet wheel to drive the movable contact in steps of 30 degrees over 12 positions. Used widely for audio-level switching in TV remote control units, scoreboards and process controls. Mounting: Two 6-32 holes on 1.813" centers. Weight: 4 ozs. AC coil for intermittent duty only.

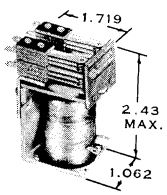


SPECIAL PURPOSE RELAYS

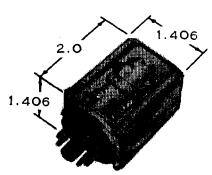
TYPE	COILS Input	COILS Res. in Ohms	COILS Nom. Power	CONTACTS Arrange.	CONTACTS Amp Rating	SUGG. RESALE PRICE
MS2AY	120V 240V	530 2,100	5.9VA	SPST-NC	• 3/4 HP	$4.25 4.75
MS4AY	120V 240V	530 2,100	5.9VA	SPST-NC-DB	• 3 HP	4.95 5.45
PC11A	6V 12V 24V 120V 240V	.6 2.28 8.8 240 900	18.5VA	DPDT	7.5	6.60 6.60 6.60 6.60 7.10
PC11D	6V 12V 24V	4 15.5 65	9W	DPDT	7.5	6.35 6.35 6.35
PC17A	24V 120V	8.8 240	18.5VA	4PDT	7.5	9.05 9.05
PC17D	24V	65	9W	4PDT	7.5	8.85
SA-1N-12A	120V	140	20VA	12 Steps	.25	7.75

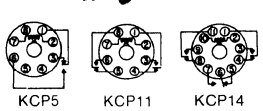
SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

GB SERIES (See GA series page 3 for similar voltage actuated relays.) Sensitivity 115 milliwatts for single pole and 275 milliwatts for 4 pole. Medium cost, high quality relay. Pick-up is not adjustable. Mounting: No. 8-32 tapped core and locating boss. Contacts: Silver. Weight: Approximately 5 ozs.

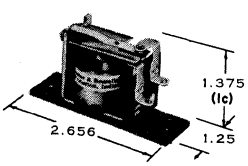


KCP SERIES Low cost DC sensitive relay enclosed in clear polycarbonate cover. Sensitivity 125 mw single pole; 250 mw double pole; 375 mw three pole. Mounting: Standard octal plug-in type. Eight pin for KCP5 and KCP11. Eleven pin for KCP14. Contacts: Gold flashed silver. Weight: Approximately 3 ozs. Use KRP hold-down spring when vibration is a factor or when using inverted or horizontal mounting. (See page 4.)

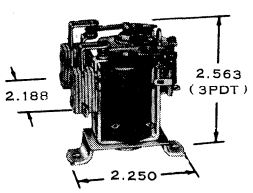




LB SERIES Designed for top performance, long life at an unusually low cost. Each coil is wound with a given coil resistance and factory adjusted to operate on minimum current requirements. Mounting: Two .188" holes on 2.219" centers. Contacts: Silver. Weight: Approximately 2 ozs.



LM SERIES (See KL page 5 for similar voltage actuated relays.) Sensitivity: 100 milliwatts for single pole and 200 milliwatts for double pole. Medium cost, high quality relay with gold-flashed silver contacts. Pick-up adjustable by tail spring adjusting screw. Mounting: Two No. 6-32 tapped holes on 1.813" centers. Weight: Approximately 5 ozs. DC Coils only.



SENSITIVE RELAYS

TYPE	COILS Input	COILS Res. in Ohms	COILS Nom. Power	CONTACTS Arrange.	CONTACTS Amp Rating	SUGG. RESALE PRICE
GB5D	6.8 mA 4.8 mA 3.4 mA	2,500 5,000 10,000	115mW	SPDT	5	$4.15 4.35 4.90
GB11D	7 mA 5 mA 3.53mA	2,500 5,000 10,000	125mW	DPDT	5	5.80 6.05 6.55
GB17D	10.5 mA 7.4 mA 5.25mA	2,500 5,000 10,000	275mW	4PDT	5	6.95 7.15 7.65
KCP5§	7.2 mA 5.0 mA 3.6 mA	2,500 5,000 10,000	125mW	SPDT	2	6.90 7.00 7.45
KCP11§	10 mA 7.2 mA 5.0 mA	2,500 5,000 10,000	250mW	DPDT	2	7.35 7.45 7.90
KCP14§	12.3 mA 8.7 mA 6.1 mA	2,500 5,000 10,000	375mW	3PDT	2	9.05 9.15 9.60
LB5	9.0 mA 6.3 mA 4.5 mA	2,500 5,000 10,000	200mW	SPDT	5	3.15 3.35 3.55
LM5	6.3 mA 4.5 mA 3.2 mA	2,500 5,000 10,000	100mW	SPDT	5	4.80 5.05 5.40
LM11	9.0 6.3 mA 4.5 mA	2,500 5,000 10,000	200mW	DPDT	5	6.90 7.10 7.75

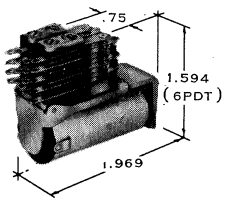
A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

• Denotes U/L § Enclosed Relay

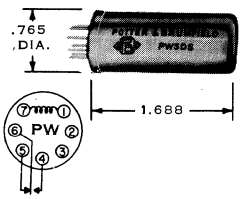
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

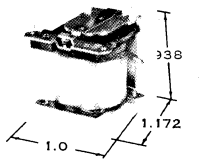
ML SERIES A small telephone type relay having excellent sensitivity and outstanding switching capabilities. Ideal for transistorized computer networks, telephone systems and battery powered communications equipment. Single contact arms have gold-flashed silver contacts rated at 3 amps for 100,000 operations. Pierced solder terminals. Mounting: Four 3-48 holes on .375" centers. Weight: 2.5 ozs.



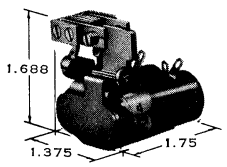
PW SERIES (In both voltage and current actuated models.) Sensitivity: 40 mw for current actuated models, 180 mw for voltage actuated models. Precision, lightweight, hermetically sealed relay for aircraft and missile applications. Will withstand 10g vibration to 500 Hz. Mounting: Standard 7-pin miniature tube base. Weight: Approx. 1 oz.



RS SERIES (In both voltage and current actuated models.) 60 mw sensitivity. Low-cost, small, lightweight, sensitive relay for radiosonde, light dimmer and model applications. Mounting: Two No. 4-40 tapped holes on diagonal .75" x .625" centers. Contacts: Bar palladium. Weight: 1½ ozs.



SS SERIES Ultra sensitive precision relay. 10 mw sensitivity. Dual series-connected coils with balanced armature on needle-point bearings for all low energy circuits such as instruments and bridge balancing. May also be used as a differential relay by connecting the two coils in separate circuits. Mounting: Two No. 6-32 tapped holes on .719" centers. Contacts: Silver. Weight: Approx. 3½ ozs.

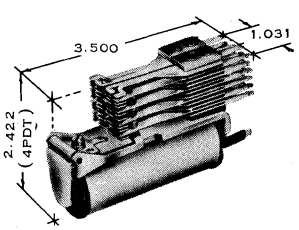


SENSITIVE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrang.	Amp Rating	
ML11D	4.0mA 2.83mA 2.0mA	2,500 5,000 10,000	40mW	DPDT	3	$ 7.70 7.90 8.25
ML17D	5.65mA 4.0mA 2.83mA	2,500 5,000 10,000	80mW	4PDT	3	9.15 9.35 9.70
ML23D	6.93mA 3.4mA	2,500 10,000	120mW	6PDT	3	10.35 10.90
PW5DS†	6V 12V 24V	202 810 3,240	180mW	SPDT	2	13.05 13.05 13.05
PW5LS†	2.8mA 2.0mA	5,000 10,000	40mW	SPDT	2	13.55 14.00
RS5D	6V 12V 5mA 3.5mA 2.5mA	335 1,350 2,500 5,000 10,000	110mW 110mW 60mW 60mW 60mW	SPDT	2	3.10 3.25 3.35 3.65 4.25
SS5D	1mA	10,000	10mW	SPDT	2	16.85

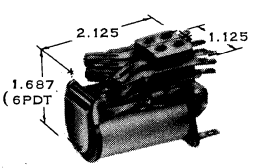
SPECIFY COIL VOLTAGE OR RESISTANCE WHEN ORDERING

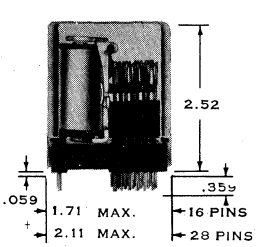
BS SERIES Long coil telephone type. Suited for computer and automatic test equipment applications requiring large numbers of poles. Tinned, pierced solder terminals for rear panel wiring. Mounting: Two No. 8-32 NC 2B tapped holes on .75" centers. Contact arms: Bifurcated with twin palladium contacts. Weight: Approximately 9 ozs.



LS SERIES Short springs and lightweight armature provide fast action without sacrificing reliability and long life. Stainless steel hinge bearing designed to give 100 million operations. Tinned, pierced solder terminals. Mounting: Two No. 6-32 tapped holes on .75" centers. Bifurcated contact arms with twin palladium contacts. Weight: Approx. 4 ozs.

The LSP version has identical specifications as the LS, except that it is enclosed in a clear polycarbonate cover and is provided with a rectangular socket with combination taper tab or solder terminations. Enables plug-in like any other plug-in component. Two sizes of sockets and covers are available: 16-pin for 4 Form C (4PDT) or 28-pin for 6 Form C (6PDT). Dimensions: LSP17D: 1.71" x 1.39" x 2.52" seated; weight 4 ozs. LSP23D: 2.11" x 1.39" x 2.52" seated; weight 4½ ozs.





TELEPHONE TYPE RELAYS

TYPE	COILS			CONTACTS		SUGG. RE-SALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrange.	Amp Rating	
BS17A	120V	103	16.5VA	4PDT	4	$11.20
BS17D	24V 110V	1,000 6,500	576mW 1.8W	4PDT	4	9.20 9.90
BS17L	5.5mA	10,000	300mW	4PDT	4	9.90
BS23A	120V	103	16.5VA	6PDT	4	13.00
BS23D	24V 110V	1,000 6,500	576mW 1.8W	6PDT	4	11.15 11.85
LS17D	24V 48V 110V	300 1,300 8,000	1.9W 1.8W 1.5W	4PDT	4	6.85 7.05 7.30
LS23D	24V 110V	300 8,000	1.9W 1.5W	6PDT	4	8.25 8.70
LSP17D§	24V 48V 110V	300 1,300 8,000	1.9W 1.8W 1.5W	4PDT	4	8.85 9.00 9.30
LSP23D§	24V 48V 110V	300 1,300 8,000	1.9W 1.8W 1.5W	6PDT	4	11.05 11.15 11.45

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**D**N

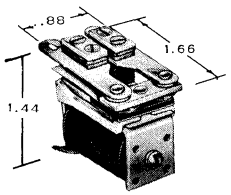
§ Enclosed Relay † Sealed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

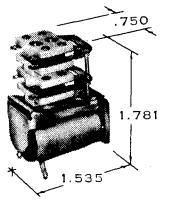
POTTER & BRUMFIELD RELAYS

Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

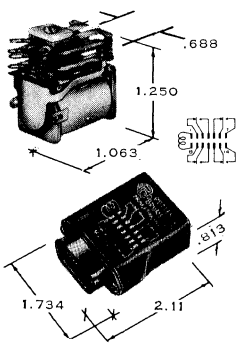
MB SERIES Miniature DC contactor. Designed for very high current applications. Extra rugged construction ensures long life. Contact arms: Stationary, heavy brass, silver contacts pierced solder terminals. Movable, silver bar contact. Mounting: Four No. 3-48 tapped holes on .375" x .375" centers. Weight: 2 ozs.



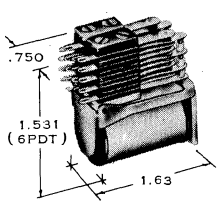
MC SERIES Built with ceramic contact spacer for RF switching to minimize losses at high frequencies. Intercontact capacitance 1.5 mmfd. max. Tinned, pierced solder type terminals. Mounting: Four No. 3-48 tapped holes on .375" x .375" centers. Contacts: palladium. Weight: 2 ozs.



MG SERIES Sub-miniature telephone type relay can be furnished open, sealed or in nylon dust cover. Mounting: Open model has four No. 3-48 tapped holes on .375" x .375" centers. Sealed model has three No. 4-40 threaded studs on 1" x .50" centers. Dust cover model has plug-in header that fits Amphenol receptacle 57-20140 or similar. Contacts: Silver. Weight: Open 1.2 ozs.; Dust cover 2.0 ozs.; Sealed 2.75 ozs.



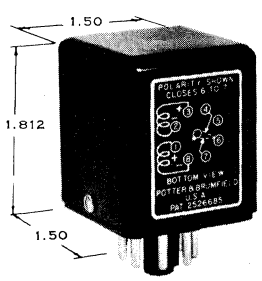
MH SERIES MINIATURE TYPE Ideal for applications where space and weight are factors. Mounting: Open model, MH11L, one No. 6-32 threaded stud .344" long plus locating boss. All other open models have four No. 3-48 holes on .375" x .375" centers. Sealed models, M enclosures, three 6-32 NC 2 threaded studs on 1.250" x .50" centers. D enclosures, three 6-32 threaded studs on 1.188" x .938" centers. All sealed models have hook solder terminals.
All models have gold-flashed silver contacts. Weight: Open models 2½ ozs. max. Sealed models 5 ozs. max.



TELEPHONE TYPE RELAYS

TYPE	COILS Input	COILS Res. in Ohms	COILS Nom. Power	CONTACTS Arrange.	CONTACTS Amp Rating	SUGG. RE-SALE PRICE
MB3D	6V 12V 24V 110V	13.3 62.3 245 5,000	2.7W	SPST-NO-DM	60	$ 6.55 6.70 6.70 7.15
MC5A	6V	2.5	4.6VA	SPDT	1	6.40
MC5D	12V 24V	96 365	1.6W	SPDT	1	5.60 5.60
MC11A	120V	680	4.6VA	DPDT	1	8.80
MC11D	24V	365	1.6W	DPDT	1	8.10
MG11D	12V 24V 110V	90 365 7,560	1.6W	DPDT	2	6.30 6.30 6.75
MG17D	12V 24V	90 365	1.6W	4PDT	2	8.45 8.45
MG17DP§	12V 24V 110V	90 365 7,560	1.6W	4PDT	2	14.05 14.05 14.75
MG17DT†	24V 110V	365 7,560	1.6W	4PDT	2	15.35 16.00
MH11L	4.5mA	10,000	.2W	DPDT	3	7.25
MH11LM†	4.5mA	10,000	.2W	DPDT	3	12.30
MH17D	6V 12V 24V	23 96 365	1.6W	4PDT	5	7.30 7.30 7.30
MH17DM†	12V 24V	96 365	1.6W	4PDT	5	14.65 14.65
MH17AMR†	120V	6,200	2VA	4PDT	5	23.95
MH23D	6V 12V 24V 110V	13.3 62.3 245 5,000	2.5W	6PDT	5	9.15 9.15 9.15 9.70
MH23DD†	12V 24V	62.3 245	2.5W	6PDT	5	19.50 19.50

MDP SERIES Small size, ultra-sensitive, polarized relays are characterized by high speed switching and efficient, bounce-free contact action. Their operation depends on both the magnitude and direction of the coil current. Two types of contact arrangements provide the following action when coils are de-energized; Bi-Stable—armature remains in its last energized position; Center-Stable—armature remains in center-off position with contacts open. Contact material as listed. Temperature: −60° C to +85° C. Relays are enclosed in a plastic dust cover and equipped with 8-pin plugs for mounting. MDP relays measure: 1.500" square by 1.812" high (when seated). Weight: 4.25 ozs.



SPECIAL RELAYS

TYPE	COILS Pick-up in mA	COILS Res. in Ohms*	COILS Pick-up Power in μW	CONTACTS Arrange.	CONTACTS Rating in Amps Resist.	SUGG. RE-SALE PRICE
Bi-stab. **MDP** -300-1	1.5	150 (2)	338	1 Form C ②	.01-1A** 25-150V	$24.70
Cen. stab. **MDP**						
-1006	0.32	330 (1)	33.8			28.25
-1007	0.27	480 (1)	35.0			28.25
-1011	0.10	3500(1)	35.0	1 Form K	3A @	28.25
-1013	0.067	7200(1)	32.3	①	28V DC	28.25
-2009	0.32	1000(2)	102.0			28.25
-2011	0.17	2300(2)	66.5			28.25

*Each coil. Number of coils in () parentheses.
**With suitable arc suppression.
Contact material shown in circle.
① Silver ② Tungsten and Paliney

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**D**N

§ Enclosed Relay † Sealed Relay

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

FC SERIES withstands 150g shock, 400g linear acceleration, 30g vibration to 2,000 Hz. Range −65°C to +125°C. Bifurcated contacts. Plugs in on a .2" grid. Meets applicable specifications of MIL-R-5757 and MSFC-SPEC-339. Weight: .75 oz.

FL SERIES Dual-coil latching relay has same specs as above, except operates by pulsing each coil alternately (observing coil polarity); or connecting the coils in series from a reversing (polarized) source. Remains latched without coil power.

HC SERIES is non-polarized, non-latching. Has gold-plated silver DPDT contacts rated dry circuit to amps @ 28 VDC resistive. Range −65° to +125°C. HC11DA has hook-end solder terminals and shoulder brackets; HC11D has plug-in plain case; HC11DB has hook-end solder terminals and flat mounting plate with 2 holes. The HC series meets or exceeds all applicable sections of MIL-R-5757 and complies with MSFC-SPEC-339. Size: Plain case .8" x .4" x .4" (seated). Weight: .5 oz.

HCM SERIES Military version of HC. Meets or exceeds appropriate sections of MIL-R-5757. Straight pins or hook solder terminals. Shoulder bracket available. HCM has same mountings as HC Series above. Weight: .5 oz.

HP SERIES is recommended for applications such as TV cameras, dictating machines, desk top computers, copying machines, etc. Circuit board or socket mounting. Encased in a nylon heat-sealed (non-hermetic) cover. Terminals on a .2" grid. Weight: .3 oz.

HPS SERIES Hermetically sealed HP above. HPS is designed for reliable performance in logic circuits or where prolonged submersion of pc boards in cleaning solvents may be required. Recommended for use in applications requiring more critical specifications than HP relay provides. HP socket may be used for mounting. Sealed metal enclosed relay weighs .25 oz.

HP SERIES SOCKETS
(For HP, HPS and HCM relays)
DPDT Solder terminal socket, 27E062 with socket retainer, 24A051
Box of 10, 9HP1 **LIST $4.80**

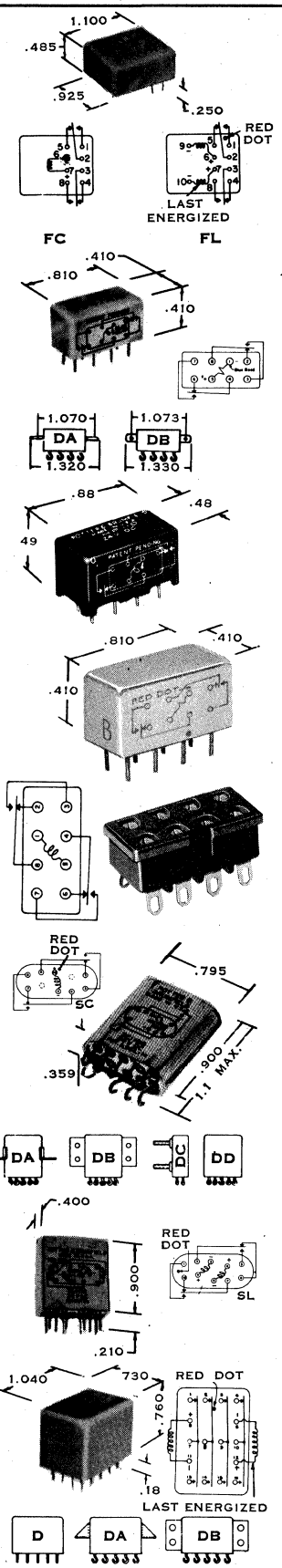
SC SERIES Miniature permanent magnet relay for low power, high shock/vibration applications. 200g shock, 30g vibration to 2000 Hz with no contact opening. Ambient temperature range: −65°C to +125°C. Mounting: SC11D**, -DA, -DB, DC and DD correspond to similarly designed SL mountings. SCG11D has rectangular header with terminals on .2" grid. Weight: ¾ oz.

**Armel No. HRK-1, 8-pin receptacles available from distributors for plug-in applications.

SL SERIES Dual coil miniature magnetic latching relay with same shock/vibration, resistance and ambient temperature range as SC. Coils may be connected in series for polar operation. Mounting: SL11D* for plug-in applications: -DA has shoulder flanges with two .104" x .136" holes on a 1.062" center; -DB has a welded bracket with four .125" dia. holes on 1.062" x .281" centers; -DC has two No. 4-40 NC 2A threaded studs on .488" x .220" diagonal centers; -DD has plain case with hook-end solder terminals. SLG11D has plug-in terminals on .2" grid. Weight: 2 ozs.

*Armel No. KRKB-1, 10-pin receptacles available from distributors for plug-in applications.

TL SERIES High reliability 4PDT miniature magnetic latching relay for severe environments. Hermetically welded. Approx. 0.5 ms transfer time. Temperature range: −65° to +125°C. Meets or exceeds applicable sections MIL-R-5757 and MSFC-SPEC-339. Weight: Approx. 1¼ ozs. Mountings: D-plain case, plug-in header. DA=shoulder bracket. 300" from base, hook-end solder. DB=flat plate, .593" wide x 1.60" long, 4 - .125" dia. holes on .281" x 1.30" centers, hook-end solder.



HIGH RELIABILITY RELAYS

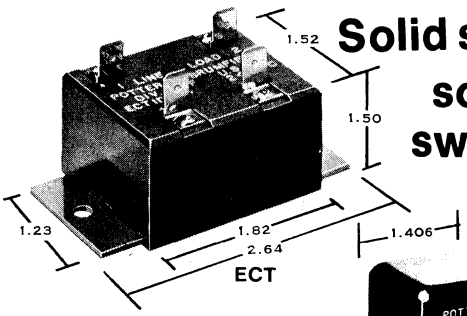
TYPE	COILS: Input	COILS: Res. in Ohms	COILS: Nom. Power	CONTACTS: Arrangement	CONTACTS: Amp Rating	SUGG. RESALE PRICE
FC11D	6V 12V 24V	60 210 900	.65W	DPDT	3	$20.35 20.35 20.35
FL11D	6V 12V 24V	67.5 230 1,000	.65W	DPDT	3	22.85 22.85 22.85
HC11D HC11DA HC11DB	24V	814	.72W	DPDT	2	20.25 20.25 20.25
HCM11D HCM11DA HCM11DB	24V	814	.72W	DPDT	2	13.55 14.20 14.20
HP11D§	6V 12V 24V 48V	55 218 870 3,480	.662W	DPDT	2	8.40 8.40 8.40 8.95
HPS11D†	12V 24V	218 870	.662W	DPDT	2	10.15 10.15
SC11D	6V 12V 24V	35 135 550	1W	DPDT	2	20.60 20.60 20.60
SC11DA	12V 24V	135 550	1W	DPDT	2	20.60 20.60
SC11DB	6V 12V 24V	35 135 550	1W	DPDT	2	20.60 20.60 20.60
SC11DC	24V	550	1W	DPDT	2	20.60
SC11DD	24V	550	1W	DPDT	2	20.60
SCG11D	24V	550	1W	DPDT	2	20.60
SC7141	26.5V		MIL-R-5757/10C-141 or RY4NA3B3L01			20.75
SL11D	6V 12V 24V	40 160 630	1W	DPDT	2	22.50 22.50 22.50
SL11DA	6V 12V 24V	40 160 630	1W	DPDT	2	22.50 22.50 22.50
SL11DB	6V 12V 24V	40 160 630	1W	DPDT	2	22.50 22.50 22.50
SL11DC	24V	630	1W	DPDT	2	22.50
SL11DD	24V	630	1W	DPDT	2	22.50
SLG11D	24V	630	1W	DPDT	2	22.50
TL17D	12V 24V	150 600	1W	4PDT	3	33.35 33.35
TL17DA	24V	600	1W	4PDT	3	33.35
TL17DB	24V	600	1W	4PDT	3	33.35

A—Alternating Current, e.g. KL17**A**
D—Direct Current, e.g. KRP14**DN**

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

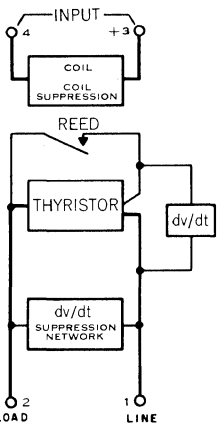
Solid state hybrid relays solve many critical switching problems

EBT SERIES combines input/output isolation of reed relay with inrush switching capabilities, long life of triac switch. Switches 7 amps, 60 Hz @ 25°C ambient with nominal load voltage of 120 VAC. Rated 5 amps rms 60 Hz @ 55°C ambient. Minimum operating current: 200 mA, 60 Hz. Expected life greater than 10 million operations. Bounce free. Operate time: 2 msec. maximum. Release time: 10 msec. maximum. Typical "Closed contact" voltage drop is 1.1 V. Octal terminals fit standard 8-pin socket on page 7. Weight 5.5 ozs. approx.

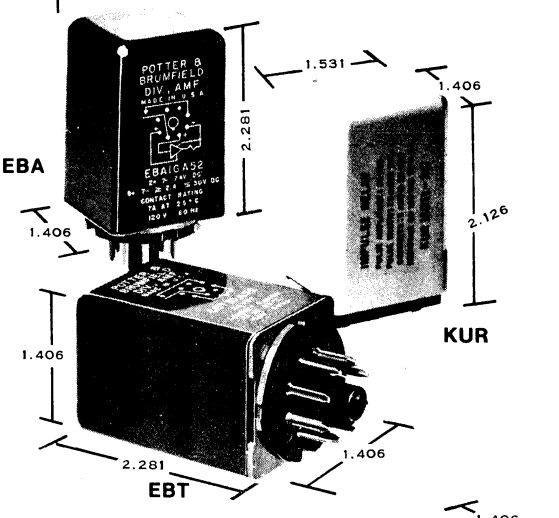


ECT SERIES is a medium power triac controlled and isolated by a reed relay. Input power is 290 mw for a 120V, 50-60 Hz line. Expected life is in excess of 10 million operations. Operate time is 2 ms, maximum; release time, 10 ms, maximum @ 25°C. Steady-state rms U/L current ratings (at 25°C) range from 7-20 amps. When used with the factory recommended heatsink area the ECT is rated 20 amps; without heatsink, 7 amps. Standard models have .250" quick-connect termination (.187" and .205" quick-connect terminals available on request). Adaptor is available to convert the .250" terminals to 6-32 screw terminals. Approx. wt. 4.5 oz.

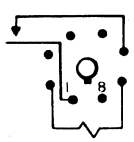
ECT OPERATING DIAGRAM

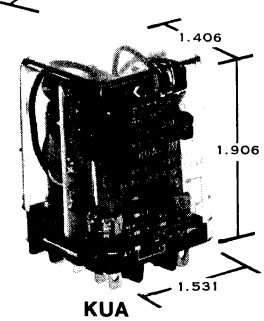


EBA SERIES has output switching characteristics, package, mounting of EBT, plus control signal amplifier. Operates from current sourcing output mode of DTL, TTL logic circuits, 60 microwatt. Contacts are rated 7A at 120V, 60 Hz. Must Operate voltage: 2.4 V DC @ approx. 25 μamp at 24V DC supply. Maximum input is 30 V DC or 1 mA. Release occurs at 0.5 V DC or less. Rate of control voltage change: 1V/msec. min. Polarity protection provided. Operate Time: 2 msec. max. @ Must Operate control voltage: Release time: 10 msec. max. @ Must Release control voltage; both rated at nominal supply voltage.



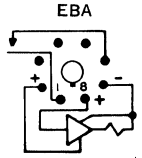
EBT





KUA SERIES Amplifier-driven KUP relay, offers standard input sensitivity of 60 microwatts. Operated from low power signals associated with integrated circuits: DTL and TTL logic outputs in the current sourcing mode. Control signal of 2.4 V DC @ approx. 25μA controls relay, at specified supply voltage. Control voltage change must exceed 1 V/ms to meet intended operate conditions. Maximum control signal: 30 V DC or 1 ma. Must Release control voltage: 0.5 V DC. Polarity protection provided. Gold-flashed fine silver contacts switch 5 A @ 28 V DC. res. or 120 V 60 Hz. 80% P.F. Terminals: .187" Q.C./solder fit standard KU sockets on page 7. Clear polycarbonate case. Weight: 3.5 ozs. approx.

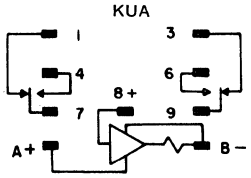
EBA



CONTROL: PINS 8+7-
SUPPLY: PINS 2+7-

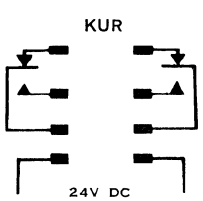
KUR SERIES Alternate direct-action, impulse relay employs permanent magnet latching relay plus flip-flop circuit that switches on leading edge of applied pulse. Recommended for pulse operation or alternate energizing of two loads, has permanent memory, alternate action features. Transfers DPDT contacts when specified input pulse (25 msec. min. duration and 1200 PPM max.) is received. Holds mode with or without power. Controlled from single DC source. Contacts: gold-flashed fine silver rated 5A @ 28 V DC, or 120 V AC, 80% P.F. Terminals: .187" Q.C./solder, fit standard KU sockets on page 7. Has yellow plastic dust cover. Weight: 3.5 ozs. approx.

KUA



CONTROL: 8+ B-
SUPPLY: A+ B-

KUR



24V DC
INPUT SIGNAL

HYBRID RELAYS

TYPE	COILS			CONTACTS		SUGG. RESALE PRICE
	Input	Res. in Ohms	Nom. Power	Arrange.	Amp Rating	
EBT1DA52§	6V 12V 24V 48V	125 500 2000 8000	290mW	SPST-NO	7	$16.65 16.65 16.65 17.05
ECT1DC72§	5V	87	290mW	SPST-NO	7*•	14.60
ECT1DB44§	24V	2000	290mW	SPST-NO	7*•	14.35
KUR11D11§	24V	350	1.2W	DPDT	5	$15.05

TYPE	COIL				CONTACTS		SUGG. RESALE PRICE
	Control		Supply				
	DC Volt.	Nom. Pwr.	DC Volt.	Nom. Pwr.	Arr.	Amp Rating	
EBA1GA52§	2.4V	60μW	24V	290mW	SPST-NO	7	$23.45
KUA5G11§	2.4V	60μW	24V	1.2W	SPDT	5	13.75
KUA11G11§	2.4V	60μW	24V	1.2W	DPDT	5	14.20

• Denotes U/L

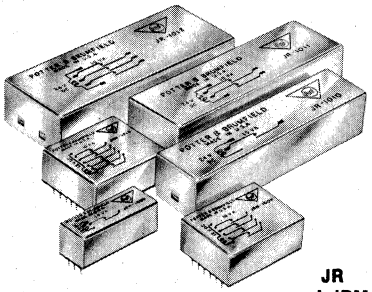
§Enclosed Relay
*20 amps with factory recommended heatsink area.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

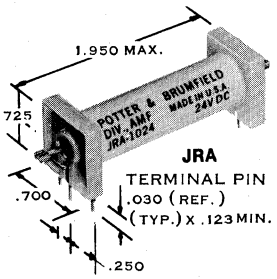
POTTER & BRUMFIELD RELAYS

DRY REED

JR STANDARD/JRA LOW COST/JRM MINIATURE



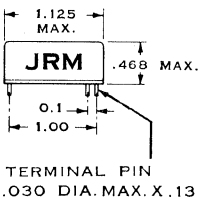
JR and JRM

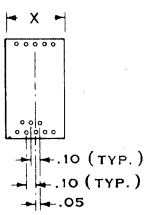


Fast response, reliable performance, high sensitivity and long life are characteristic of the JR Series dry reed relays. JR standard and JRM miniature relays are especially suited for data processing applications, computer equipment, logic circuitry and various other sophisticated control circuits. The JRA Series low cost relays are limited to applications where stray magnetic fields and interaction of coils will not interfere with their operation. Adequate spacing (not less than .75" separation) is recommended.

TWO TYPES OF CAPSULES

The JRA Series is available only in a Form A (SPST-NO) contact arrangement. Both JR and JRM relays have reed switches with either Form A (SPST-NO) or Form C (SPDT) contact configuration. Biasing with a permanent magnet changes Form A to a Form B (SPST-NC). This arrangement requires that coil polarity be observed. Combining one Form A with one Form B results in a single Form C (SPDT) break-before-make. A "true" Form C (SPDT) uses a reed switch with two stationary and one movable contact. The movable contact is normally closed until the coil is energized.





JRM 3 CAVITIES

SPECIFICATIONS

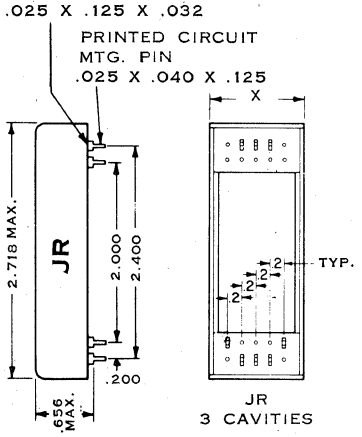
Pick-up: 75% of nominal @ 25° C.
Typical Operate Time: At nominal voltage @ 25° C.: JR: 3 ms. JRA: 1.5 ms. JRM: 1 ms.
Release Time: At 25° C: JR: .5 ms. JRM: .05 ms.
Coil Power: Based on nominal voltage and resistance.
JR: 1 capsule — 240 mw; 2 capsules — 360 mw; 3 capsules — 720mw; 4 capsules — 960mw; 5 capsules — 1.5w. **JRA:** 1 capsule — 550 mw. **JRM:** 1 capsule — 180 mw; 2 capsules — 275mw; 3 capsules — 420mw; 4 capsules — 540mw; 5 capsules — 720mw. For additional specifications see columnar listings and drawings.

OUTLINE DIMENSIONS

JR Standard Relays		Weights
X = 1 Cavity = .687"	max. — 1.50	ozs.
X = 2 Cavities = .890"	max. — 2.00	ozs.
X = 3 Cavities = 1.094"	max. — 2.50	ozs.
X = 4 Cavities = 1.297"	max. — 3.00	ozs.
X = 5 Cavities = 1.516"	max. — 3.50	ozs.

JRM Miniature Relays		
X = 1 Cavity = .437"	max. — .366	oz.
X = 2 Cavities = .562"	max. — .395	oz.
X = 3 Cavities = .703"	max. — .530	oz.
X = 4 Cavities = .813"	max. — .620	oz.
X = 5 Cavities = .968"	max. — .781	oz.

PRINTED CIRCUIT STANDOFF .025 X .125 X .032



JR 3 CAVITIES

JR STANDARD SERIES

TYPE	COILS: Contact Arrangement	COILS: Number of Cavities	COILS: Sugg. Nom. Volt.	COILS: Resistance in Ohms	COILS: Reed Rating Watts	SUGG. RE-SALE PRICE
JR1000	1A	1	6	150	15	$3.25
JR1001	2A	2	6	100	15	4.35
JR1020	1A	1	6	150	50	4.55
JR1040	1C*	1	6	150	10	8.10
JR1041	2C*	2	6	100	10	8.85
JR1060	1B	2	6	100	15	4.35
JR1005	1A	1	12	600	15	3.25
JR1006	2A	2	12	400	15	4.35
JR1008	4A	4	12	150	15	6.05
JR1025	1A	1	12	600	50	4.55
JR1045	1C*	1	12	600	10	8.10
JR1046	2C*	2	12	400	10	8.85
JR1063	1B	2	12	400	15	4.35
JR1086	1A+1B	3	12	200	15	5.35
JR1010	1A	1	24	2,400	15	3.80
JR1011	2A	2	24	1,600	15	4.60
JR1013	4A	4	24	600	15	6.35
JR1030	1A	1	24	2,400	50	4.90
JR1031	2A	2	24	1,600	50	7.30
JR1050	1C*	1	24	2,400	10	8.45
JR1051	2C*	2	24	1,600	10	8.95
JR1066	1B	2	24	1,600	15	4.40
JR1088	1A+1B	3	24	800	15	5.70
JR1089	2A+2B	5	24	384	15	8.80

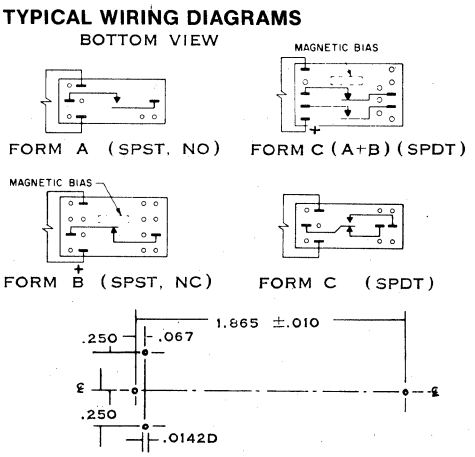
JRM MINIATURE SERIES

JRM1000	1A	1	6	200	10	$3.50
JRM1001	2A	2	6	130	10	5.10
JRM1003	4A	4	6	67	10	8.10
JRM1036*	1B	2	6	130	10	4.45
JRM1037	2B	3	6	86	10	5.95
JRM1048	1A+1B	3	6	86	10	5.95
JRM1049	2A+2B	5	6	50	10	9.10
JRM1006	1A	1	12	800	10	3.50
JRM1007	2A	2	12	520	10	5.10
JRM1009	4A	4	12	268	10	8.10
JRM1040	1B	2	12	520	10	4.45
JRM1041	2B	3	12	344	10	5.95
JRM1050	1A+1B	3	12	344	10	5.95
JRM1051	2A+2B	5	12	200	10	9.10
JRM1012	1A	1	24	3,200	10	3.85
JRM1013	2A	2	24	2,080	10	5.25
JRM1015	4A	4	24	1,072	10	8.20
JRM1044	1B	2	24	2,080	10	4.55
JRM1045	2B	3	24	1,376	10	6.10
JRM1052	1A+1B	3	24	1,376	10	6.10
JRM1053	2A+2B	5	24	800	10	9.25

JRA LOW COST SERIES

JRA1006	1A	1	6	74	25VA	$1.50
JRA1012	1A	1	12	290	25VA	1.50
JRA1024	1A	1	24	1,200	25VA	1.50

TYPICAL WIRING DIAGRAMS

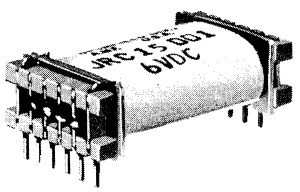


See ordering information on page 29.

OPEN STYLE DRY REED RELAYS

FOR .100" x 1.00" GRID LAYOUTS

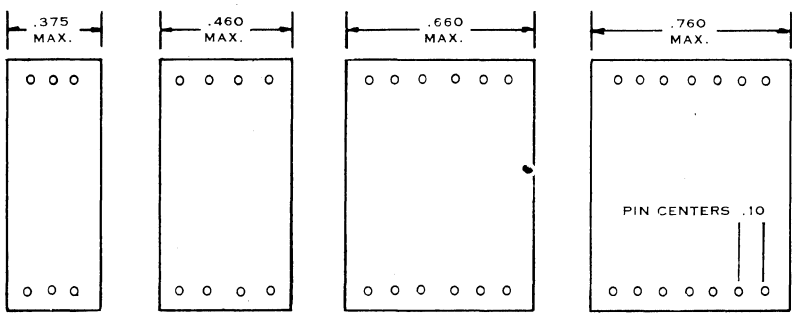
JRC SERIES open style dry reed relays have P/C terminals arranged to fit popular .100" x 1.00" grid layout. Available in 1 to 5 cavity packages, these small modules provide an array of switching choices including Form A (SPST-NO), Form B (SPST-NC), and combinations of both. Rhodium is the standard contact material rated 10 watts max., .5 amp max., and 200 volts max. for DC resistive loads. Typical operate speeds are 1 millisecond (including bounce) for pick-up and .05 millisecond for drop-out.
Contact protection is recommended to assure long operating life. Approximate Weight: .3 to 1.0 ozs.



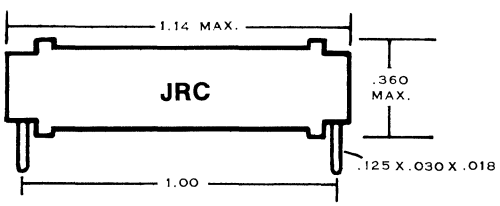
JRC MINIATURE OPEN RELAYS

TYPE	Contact Arrangement	Number of Cavities	COILS Sugg. Nominal Voltage	COILS Resist. in Ohms	COILS Reed Rating Watts	SUGG. RE-SALE PRICE
	1A	1	6	240	10	$3.55
JRC1DA1	1A	1	12	960	10	3.55
	1A	1	24	3,840	10	4.20
	2A	2	6	155	10	4.50
JRC7DB1	2A	2	12	625	10	4.50
	2A	2	24	2,500	10	5.20
	4A	4	6	80	10	6.60
JRC15DD1	4A	4	12	320	10	6.60
	4A	4	24	1,280	10	7.10
	1B	2	6	155	10	3.95
JRC2DB1	1B	2	12	625	10	3.95
	1B	2	24	2,500	10	4.25
	1A + 1B	4	6	80	10	5.20
JRC50DD1	1A + 1B	4	12	320	10	5.20
	1A + 1B	4	24	1,280	10	5.35
	2A + 2B	6	6	45	10	6.50
JRC60DF1	2A + 2B	6	12	180	10	6.50
	2A + 2B	6	24	720	10	6.65

JRC MOUNTING DIMENSIONS

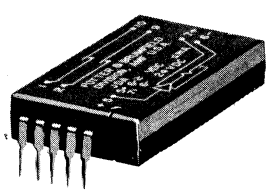


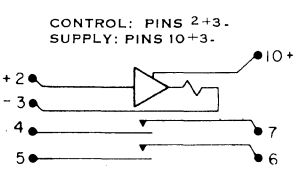
1 CAVITY 2 CAVITIES 4 CAVITIES 5 CAVITIES



SOLID STATE/REED HYBRID RELAYS

JDA SERIES Sensitive, amplifier-driven reed relay features same 0.275" low profile, Dual Thin-Line design as JDT reed relays series. Control signal is amplified by solid state driver circuit with sensitivity of 100 microwatts. Designed to operate from output of DTL and TTL logic circuits in current sourcing mode. Control signals between 2.4 and 30 volts DC will operate the JDA relay when specified supply voltage is applied. Release occurs when control signal is reduced to 0.5V DC, or less. Nominal supply power requirement approximately 490 mW in the activated state. The control voltage change for these amplifier-driven reed relays must exceed 1v/ms to meet intended operating conditions. Contacts are 2 Form A (DPDT-NO) rated 10 watts maximum resistive (50V DC or 0.5 amp max. switching) per contact. Terminals are spaced on 0.1" grid centers for printed circuit board mounting. Approximate weight: 0.4 oz.





JDA7GB1

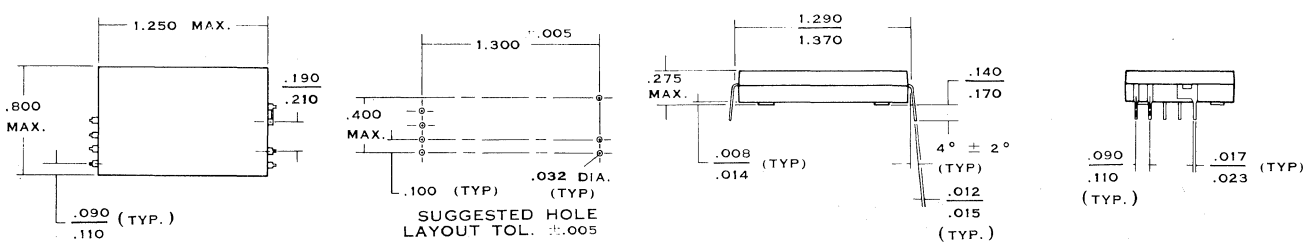
HYBRID RELAYS

TYPE	INPUT Control DC Volt.	INPUT Control Nom. Power	INPUT Supply DC Volt.	INPUT Supply Nom. Power	CONTACTS Arrange.	CONTACTS Amp Rating	SUGG. RE-SALE PRICE
JDA7GB1	2.4V	100μW	24V	490mW	DPST-NO	10W (0.5A MAX.)	$15.30

ORDERING INFORMATION

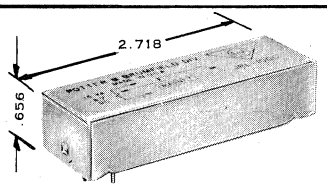
Select the desired nominal operating voltage and contact arrangement. Specify the corresponding P&B type number indicated under TYPE in the columnar listing.

DIMENSION DRAWINGS JDA7GB1



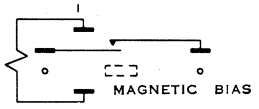
POTTER & BRUMFIELD RELAYS

DRY REED

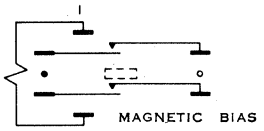


JRL LATCHING

This bi-stable dry reed latching relay requires no coil current to maintain contact in either position. Reversing the polarity of the coil causes the contacts to transfer. Designed for reliable memory work, JRL latching relays mount on p.c. board and are not position sensitive. 1 Form A and 2 Form A contacts are rated 15 watts, resistive. Operate time at 25°C is 1.0 millisecond (including bounce). Weight: 2.0 ozs.



JRL 1A
SINGLE WOUND LATCH



JRL 2A
SINGLE WOUND LATCH

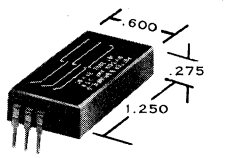
JRL LATCHING SERIES

TYPE	Contact Arrangement	Number of Cavities	COILS: Sugg. Nominal Voltage	COILS: Resist. in Ohms	COILS: Reed Rating Watts	SUGG. RE-SALE PRICE
JRL1000	1A	2	6V DC	400	15	$4.80
JRL1001	1A	2	12V DC	1,600	15	4.80
JRL1002	1A	2	24V DC	6,400	15	5.30
JRL1012	2A	3	6V DC	300	15	6.80
JRL1013	2A	3	12V DC	1,200	15	6.80
JRL1014	2A	3	24V DC	4,800	15	7.15

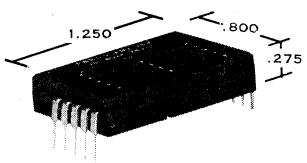
ORDERING INFORMATION
Select the desired nominal operating voltage and contact arrangement. Specify the corresponding P&B type number indicated under TYPE in the columnar listing.

JDT DUAL THIN-LINE

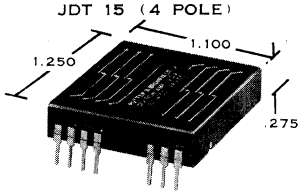
Low profile (only 0.275" max. height) JDT Dual Thin-Line reed relays are ideal for high density packaging applications. Feature hermetically sealed glass capsules epoxy-encapsulated in four package sizes: JDT7 (2 pole), JDT15 (4 pole), JDT21 (6 pole), and JDT27 (8 pole). All have dual in-line terminals on .100" centers for pc board mounting. Contacts will switch 10 watts maximum, resistive (50V DC or 0.5 amp. max.). Operate time is 3.5 milliseconds including bounce. Release time is 3.5 milliseconds maximum. Approximate weights: JDT7-, .35 oz.; JDT15-, .55 oz.; JDT21-, .65 oz.; JDT27-, .70 oz.



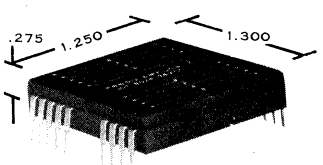
JDT 7 (2 POLE)



JDT 15 (4 POLE)



JDT 21 (6 POLE)

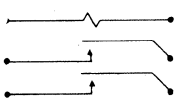


JDT 27 (8 POLE)

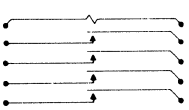
JDT DUAL THIN-LINE SERIES

TYPE	Contact Arrangement	Cavities	COILS: Sugg. Nominal Voltage	COILS: Res. in Ohms	COILS: Reed Rating Watts	SUGG. RE-SALE PRICE
JDT7DA1	2A	2	6V DC	115	10	$ 5.80
			12V DC	460		5.80
			24V DC	1840		6.45
JDT15DB1	4A	4	6V DC	115	10	7.70
			12V DC	460		7.70
			24V DC	1840		8.35
JDT21DC1	6A	6	6V DC	100	10	11.00
			12V DC	400		11.00
			24V DC	1600		11.65
JDT27DD1	8A	8	6V DC	60	10	13.00
			12V DC	240		13.00
			24V DC	960		13.75

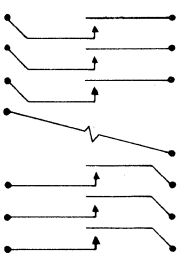
WIRING DIAGRAMS



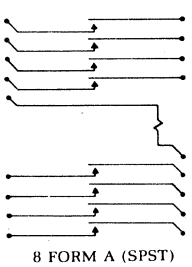
2 FORM A (SPST)



4 FORM A (SPST)

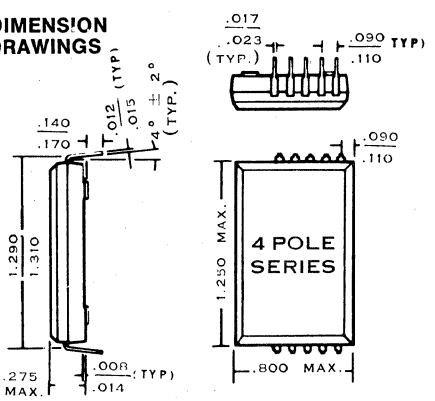


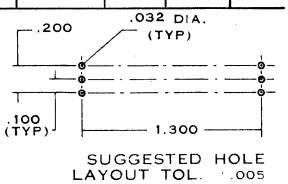
6 FORM A (SPST)



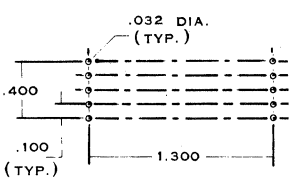
8 FORM A (SPST)

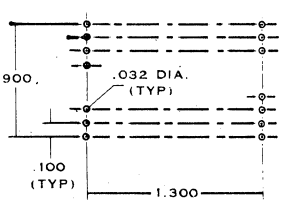
DIMENSION DRAWINGS

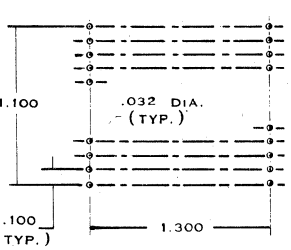




SUGGESTED HOLE LAYOUT TOL. .005







AMF | POTTER & BRUMFIELD RELAYS
Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

MERCURY-WETTED CONTACT RELAYS

Rare long life, high speed, and unvarying dependability—all are the result of the basic component of these relays: a hermetically sealed glass capsule. It contains the contact arrangement and a small reservoir of mercury sealed in a high pressure hydrogen atmosphere. A film of mercury is renewed for every operation—that's why you can think in terms of billions of operations without contact bounce, pits or welds.

TWO TYPES OF CAPSULES

The capsule used in JMF and JMF2 (with 2 capsules) modules, JML and JMS relays has a SPDT, break-before-make (Form C), non-bridging contact arrangement. Each capsule used in JMD, JMP and JM1 to JM4 relays has a SPDT, make-before-break (Form D), bridging contact arrangement. JMF, JMF2, JML, JMP and JMS Series achieve a high rate of sensitivity by factory-adjusted magnet biasing.

All JM Series mercury-wetted contact relays except the JMF2 relays may be operated up to 5 times the Must Operate current shown in the columnar listings. The JMF2 may be operated up to a maximum voltage of twice the Suggested DC Voltage shown.

Mounting Position: Upright mounting required, but deviation from upright to 30° causes only minor deviation in operating characteristics.

CONTACT RATINGS

JMF, JMF2, JML and JMS: 500V max., and 2 amps max., 100VA max.* JMP, JMD and JM1 to JM4: 500V max., and 5 amps max., 250 VA max.

*With contact protection unless used in a low level circuit. Details of a simple protection circuit consisting of resistor and capacitor in series are packed with each relay.

TERMINATIONS

FIG. 11

FIG. 12

FIG. 21

FIG. 22

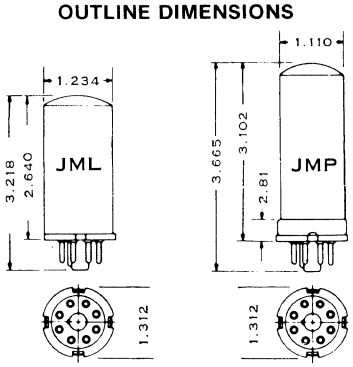
FIG. 31

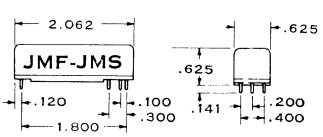
FIG. 41
14 PIN MINI. PLUG

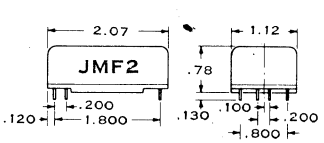
FIG. 81

FIG. 82

OUTLINE DIMENSIONS







APPROXIMATE WEIGHTS:

JMF - 1.25 OZS.

JMF2 - 3.25 OZS.

JMS - 1.25 OZS.

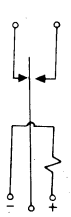


FIG. 61
JMF

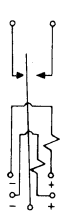


FIG. 62
JMS

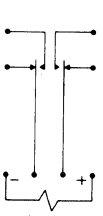


FIG. 71
JMF2

JM MERCURY-WETTED CONTACT RELAY SERIES

	SERIES TYPE	Coil	Term.* Fig. No.	COIL CHARACTERISTICS Res. in Ohms ±10% @25°C	Sugg. Min. Operate mA DC	Soak† mA DC	Must Operate DC	Must Release DC	SUGG. RE-SALE PRICE
JMF Printed Circuit Module Sensitive Form C Non-Bridg.	SINGLE-SIDE-STABLE								
	JMF	1070	—61	450	16.13	—	12.9	2.1	$11.40
	JMF	1080	—61	675	14.50	—	11.6	1.9	11.40
	JMF	1120	—61	1425	10.50	—	8.4	1.4	11.40
	JMF	1150	—61	2400	9.75	—	7.8	1.3	11.40
	JMF	1160	—61	4000	5.00	—	4.0	0.67	11.95
	BI-STABLE								
	JMF	5080	—61	675	+6.75	—	±5.4		11.40
JMF2 Dual Capsule Form C Non-Bridg.	SINGLE-SIDE-STABLE								
	JMF2	1000	—71	130	6V DC	—	3V DC	0.5V DC	21.80
	JMF2	1001	—71	520	12V DC	—	6V DC	1.0V DC	21.80
	JMF2	1002	—71	2200	24V DC	—	12V DC	2.0V DC	22.35

	SERIES TYPE	Coil	Term.* Fig. No.	COIL CHARACTERISTICS Res. in Ohms ±10% @25°C	Must Operate DCmA	Max. Volts DC @25°C	SUGG. RE-SALE PRICE
JMS Sensitive Form C Non-Bridg.	20 Milliwatts (per winding), Bi-Stable, Dual-Wound Coil						
	JMS	5040	—62	325/325	±7.0	24	$11.40
	JMS	5070	—62	1250/1250	±3.6	47	11.95
	40 Milliwatts, Single-Side-Stable, Single-Wound Coil						
	JMS	1070	—61	34	32	7.7	11.40
	JMS	1130	—61	620	7	33	11.40
	JMS	1160	—61	2430	3.6	65	11.95
	JMS	1190	—61	8600	2.0	122	11.95

	SERIES TYPE	Coil	Term.* Fig. No.	COIL CHARACTERISTICS Res. in Ohms ±10% @25°C	Sugg. Min. Operate mA DC	Soak† mA DC	Must Operate mA DC	Must Release mA DC	SUGG. RE-SALE PRICE
JML Sensitive Form C Non-Bridg.	SINGLE-SIDE-STABLE								
	JML	1061	—81	40	12.19	36.0	9.75	1.68	$14.05
	JML	1110	—81	350	4.45	13.1	3.56	0.61	14.05
	JML	1160	—81	1,000	2.76	8.1	2.21	0.38	14.05
	JML	1190	—81	2,500	1.79	4.0	1.43	0.17	15.00
	JML	1200	—81	4,000	1.56	3.4	1.25	0.25	15.00
	JML	1240	—81	11,000	.90	2.6	0.72	0.12	15.00
	JML	1260	—81	25,000	.65	1.9	0.52	0.09	15.00
	BI-STABLE								
	JML	5200	—81	4,000 (1) 1,100	+ .66	—	±0.53		15.00
	JML	5430	—82	(2) 1,100	+2.20	—	±1.76		16.45
	CHOPPER						Voltage RMS 60 Hz		
	JML	8130	—81	600		—	6.3V		14.65
JMP Polarized Form D Bridging	SINGLE-SIDE-STABLE								
	JMP	1160	—11	1,000	7.0	16.2	5.60	0.40	18.45
	JMP	1200	—11	4,000	3.70	8.55	2.96	0.24	19.75
	BI-STABLE								
	JMP	5200	—11	4,000	+1.88	—	±1.5		19.75

* See Termination figures on this page.

† Current to be applied to the coil winding for at least 2 seconds just prior to current flow tests.

See ordering information on page 22.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

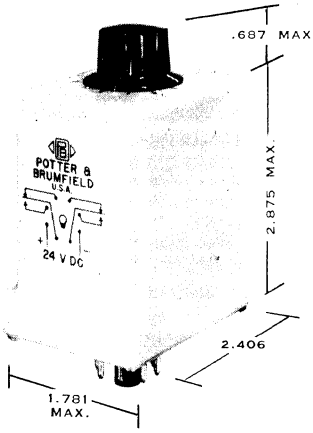
COMPARISON OF GENERAL SPECIFICATIONS OF TIME DELAY RELAYS

TYPE	DIAL SCALE (IF USED)	TEMP. RANGE	TOLERANCE* AND DELTA TIME	TRANSIENT PROTECTION	TIMING CYCLE INTERRUPT TRANSFER	RECYCLE AND RELEASE TIME	REPEAT-ABILITY	POLARITY PROTECTION	APPROX. WEIGHT IN OZS.
CD	Time, in seconds, calibrated	−40° to +55°C	Tolerance: ±5% Delta Time: ±5%	1000V (on all 120V AC models)†	None	CD-38 45 milli-seconds typical	CD-38 ±1% ±2%	Yes	CD-21 4.3 CD-31 2.0 CD-38 8.0 CD-45 9.0
CH	Reference only	−10° to +55°C	Tolerance: ±5% Delta Time: ±10%	1000V (on all 120V AC models)	Contacts may transfer momentarily if timing interval is interrupted	125 milli-seconds typical	±2%	Yes	6.0
CK	Reference only	−10° to +55°C	Tolerance: ±5% Delta Time: ±10%	1000V (on all 120V AC models)	None	50 milli-seconds typical	±2%	Yes	6.0
CU	Reference only	Norm. Room Temp.	Tolerance: Fixed ±5% Adjustable ±10%	Twice rated input voltage	Contacts may transfer momentarily if timing interval is interrupted	150 milli-seconds typical	±3%	Yes	3.5
CL	Reference only	Norm. Room Temp.	Tolerance: Fixed ±5% Adjustable ±10%	Twice rated input voltage	None	100 milli-seconds typical	±3%	Yes	3.5
CJ	Not appli-cable	−10° to +55°C	Tolerance: Fixed ±5% Adjust. ±10% Delta Time: ±10%	Twice rated input voltage	None	50 milli-seconds typical	±2%	No	CJC & CJH 01 1.3 02 1.4 03 1.6 04 1.8 05 1.9
JT	Not appli-cable	−10° to +55°C	Tolerance: Fixed ±5% Adjust. ±10% Delta Time: ±5%	±200 volts	None	50 milli-seconds typical	±2%	Yes	1.0
PT	Time, in seconds, calibrated	−10° to +55°C	Tolerance: See Dial Scale specs. Delta Time: ±5%	1000V (on all 120V AC models)	None	45 milli-seconds typical	±1%	Yes	17.0
R12	Not appli-cable	−10° to +55°C	Tolerance: ±5% Delta Time: ±5%	100 volts for 100 microseconds	None	100 milli-seconds typical	±2%	Yes	1.5
CR	Reference only	−40°C to +55°C	Tolerance: adjust. ±20% Delta time: ±10%	Twice rated input voltage for 1 ms.	Contacts may transfer momentarily if timing interval is interrupted	60 milli-seconds typical	±2%	Yes	6.0
R13	Not appli-cable	−10°C to +55°C	Tolerance: ±20% total over temp. range	None	Contacts may transfer momentarily if timing interval is interrupted	150 milli-seconds typical	±3%	Not required	1.5
R14	Not appli-cable	−10°C to +55°C	Tolerance: Fixed ±5% Adjust. ±10% ±5% Delta time	100V for 100μs	None	100 milli-seconds typical	±2%	Yes	1.5
R15	Not appli-cable	−10°C to +55°C	Tolerance: Fixed ±5% Adjust. ±10% ±5% Delta time	100V for 100μs	Contacts may transfer momentarily if timing interval is interrupted	100 milli-seconds typical	±2%	Not appli-cable	1.5

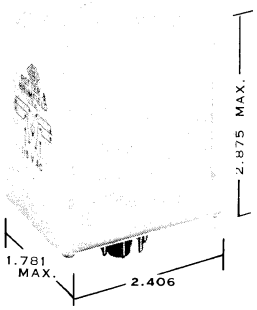
**For tolerance on dial type time delays, see individual specifications. †Except 31 style.*

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

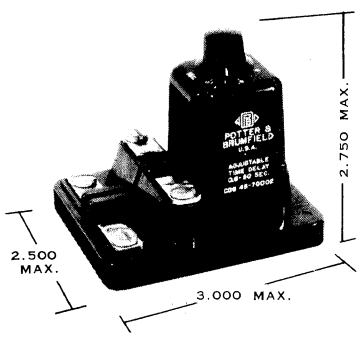
CHOOSE FROM A WIDE SELECTION OF TIME DELAYS



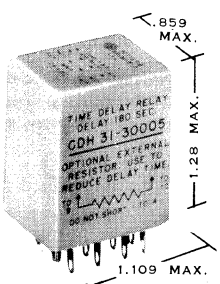
CD-38, CH-38, CK-38



CD-38, CH-38, CK-38

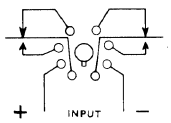


CD-45

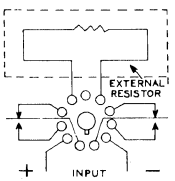


CD-31

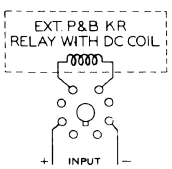
WIRING DIAGRAMS
(Disregard DC polarity for AC relays)



Dia. 1



Dia. 2



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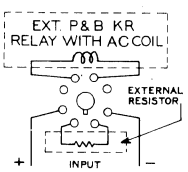

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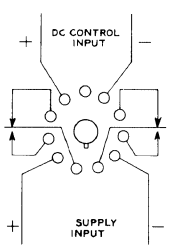

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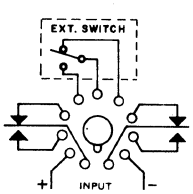

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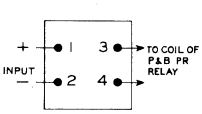


Dia. 7

(Diagrams cont'd. next page)

TYPE	Time Delay in Seconds	Method of Control	Input Voltage	Dia. No.	Notes	SUGG. RE-SALE PRICE
			DELAY ON OPERATE			
CDB38-30001	0.1-10	Knob	24VAC	1	1	$44.30
CKB38-30010	0.1-10	Knob	24 VAC	1	1	23.00
CLB51-30010	0.1-10	Knob	24 VAC	10	1	19.90
CDB38-30002	0.6-6	Knob	24 VAC	1	1	44.30
CHB38-30001	1.0-10	Knob	24 VAC	1	1	20.00
CUF41-30010	1.0-10	Resistor	24 VAC	11	200K*•	15.05
CUF42-30010	1.0-10	Resistor	24 VAC	11	200K*•	15.05
CHB38-30003	1.0-180	Knob	24 VAC	1	1	20.00
CUA41-30010	10	Fixed	24 VAC	10	1•	14.25
CUA42-30010	10	Fixed	24 VAC	10	1•	14.25
CDB38-70001	0.1-1	Knob	120 VAC	1	1	$44.30
CDB38-70002	0.1-5	Knob	120 VAC	1	1	44.30
CDB21-70003	0.1-10	Knob	120 VAC	4	2	39.20
CDB38-70003	0.1-10	Knob	120 VAC	1	1	44.30
CKB38-70010	0.1-10	Knob	120 VAC	1	1	23.00
CKF38-70010	0.1-10	Resistor	120 VAC	2	1 & 8*	22.10
CLB51-70010	0.1-10	Knob	120 VAC	10	1	19.90
CLF41-70010	0.1-10	Resistor	120 VAC	11	200K*	18.90
CLF42-70010	0.1-10	Resistor	120 VAC	11	200K*	18.90
CDB38-70004	0.6-60	Knob	120 VAC	1	1	44.30
CDB45-70002	0.6-60	Knob	120 VAC	7	6	37.55
CKB38-70060	0.6-60	Knob	120 VAC	1	1	23.00
CHB38-70001	1.0-10	Knob	120 VAC	1	1	20.00
CUB51-70010	1.0-10	Knob	120 VAC	10	1	16.35
CUF41-70010	1.0-10	Resistor	120 VAC	11	200K*•	15.05
CUF42-70010	1.0-10	Resistor	120 VAC	11	200K*•	15.05
CUF41-70030	1.0-30	Resistor	120 VAC	11	600K*•	15.55
CHB38-70002	1.0-60	Knob	120 VAC	1	1	20.00
CUB51-70120	1.0-120	Knob	120 VAC	10	1	17.90
CUF41-70120	1.0-120	Resistor	120 VAC	11	2.4Meg*•	16.35
CUF42-70120	1.0-120	Resistor	120 VAC	11	2.4Meg*•	16.35
CHB38-70003	1.0-180	Knob	120 VAC	1	1	20.00
CKB38-70120	1.2-120	Knob	120 VAC	1	1	23.00
CLB51-70120	1.2-120	Knob	120 VAC	10	1	21.20
CDB21-70001	1.8-180	Knob	120 VAC	4	2	39.20
CDB38-70005	1.8-180	Knob	120 VAC	1	1	44.30
CDA38-70012	1.0	Fixed	120 VAC	1	1	40.05
CUA41-70001	1.0	Fixed	120 VAC	10	1•	14.25
CDF38-70001	1 max.	Resistor	120 VAC	2	1 & 9*	41.20
CDF38-70002	5 max.	Resistor	120 VAC	2	1 & 10*	41.20
CDF31-70003	10 max.	Resistor	120 VAC	8	11 & 12*	39.40
CDF38-70003	10 max.	Resistor	120 VAC	2	1 & 12*	41.20
CHA38-70001	10	Fixed	120 VAC	1	1	18.95
CKA38-70010	10	Fixed	120 VAC	1	1	21.95
CLA41-70010	10	Fixed	120 VAC	10	1	17.40
CUA41-70010	10	Fixed	120 VAC	10	1•	14.25
CUA42-70010	10	Fixed	120 VAC	10	1•	14.25
CUA41-70120	120	Fixed	120 VAC	10	1•	15.80
CUA42-70120	120	Fixed	120 VAC	10	1•	15.80
CHB38-80001	1.0-10	Knob	240 VAC	1	1	$21.00
CJH01-20010	0.1-10	Resistor	12 VDC	12	750K*	$19.85
CJH02-20010	0.1-10	Resistor	12 VDC	13	750K*	20.50
CJH03-20010	0.1-10	Resistor	12 VDC	14	750K*	21.75
CKD38-20010	0.1-10	Knob	12 VDC	1	1	22.00
CJH01-20120	1.0-120	Resistor	12 VDC	12	1.8 meg*	22.60
CJH02-20120	1.0-120	Resistor	12 VDC	13	1.8 meg*	23.25
CJH03-20120	1.0-120	Resistor	12 VDC	14	1.8 meg*	24.50
CJC01-20003	3	Fixed	12 VDC	12	5 & 7	19.35
CJC02-20003	3	Fixed	12 VDC	13	5 & 7	20.00
CJC03-20003	3	Fixed	12 VDC	14	5 & 7	21.25
CDD21-30003	0.1-10	Knob	24 VDC	3	3	$38.85
CDD38-30003	0.1-10	Knob	24 VDC	1	1	42.05
CKH38-30010	0.1-10	Resistor	24 VDC	2	1 & 8	21.10
CJH01-30010	0.1-10	Resistor	24 VDC	12	750K*	19.85
CJH02-30010	0.1-10	Resistor	24 VDC	13	750K*	20.50
CJH03-30010	0.1-10	Resistor	24 VDC	14	750K*	21.75
CLH41-30010	0.1-10	Resistor	24 VDC	11	160K*	18.90

(Time-delay series cont'd. next page)

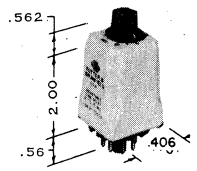
Socket information on pg. 29
Ordering information on pg. 29

• Denotes U/L *External resistor (not furnished) for maximum time. Recommend ¼ watt minimum resistor.

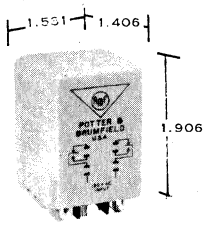
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

POTTER & BRUMFIELD RELAYS

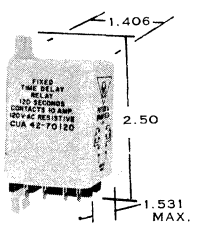
SOLID STATE TIME DELAYS



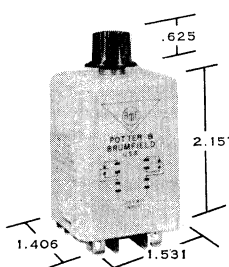
CD-21



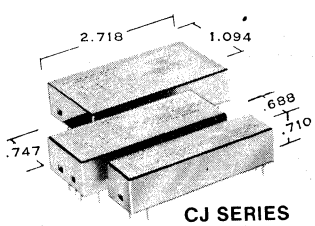
CU-41, CL-41



CU-42, CL-42

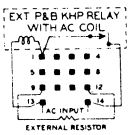


CU-51, CL-51

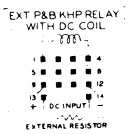


CJ SERIES

WIRING DIAGRAMS
(Disregard DC polarity for AC relays)

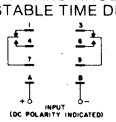


Dia. 8

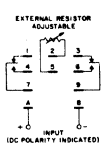


Dia. 9

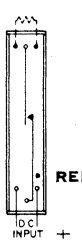
FIXED AND KNOB ADJUSTABLE TIME DELAY



Dia. 10



Dia. 11



Dia. 12

Dia. 13

TYPE	Time Delay in Seconds	Method of Control	Input Voltage	Dia. No.	Notes	SUGG. RESALE PRICE
		DELAY ON OPERATE				
CDD38-30004	0.6-60	Knob	24 VDC	1	1	42.05
CHD38-30001	1.0-10	Knob	24 VDC	1	1	19.00
CUH41-30010	1.0-10	Resistor	24 VDC	11	160K*•	15.05
CUH42-30010	1.0-10	Resistor	24 VDC	11	160K*•	15.05
CJH01-30120	1.0-120	Resistor	24 VDC	12	1.8 meg*	22.60
CJH02-30120	1.0-120	Resistor	24 VDC	13	1.8 meg*	23.25
CJH03-30120	1.0-120	Resistor	24 VDC	14	1.8 meg*	24.50
CUH41-30120	1.0-120	Resistor	24 VDC	11	2 meg*•	16.35
CUH42-30120	1.0-120	Resistor	24 VDC	11	2 meg*•	16.35
CHD38-30003	1.0-180	Knob	24 VDC	1	1	19.00
CDD21-30001	1.8-180	Knob	24 VDC	3	3	38.85
CDD38-30005	1.8-180	Knob	24 VDC	1	1	42.05
CDH31-30010	5 max.	Resistor	24 VDC	9	4 & 14	39.40
CDH31-30005	180 max.	Resistor	24 VDC	9	4 & 5	39.40
CJC01-30003	3.0	Fixed	24 VDC	12	5 & 7	19.35
CJC02-30003	3.0	Fixed	24 VDC	13	5 & 7	20.00
CJC03-30003	3.0	Fixed	24 VDC	14	5 & 7	21.25
CKC38-30010	10	Fixed	24 VDC	1	1	20.95
CLC41-30010	10	Fixed	24 VDC	10	1	17.40
CUC41-30010	10	Fixed	24 VDC	10	1•	14.25
CUC42-30010	10	Fixed	24 VDC	10	1•	14.25
CUC41-30120	120	Fixed	24 VDC	10	1•	15.80
CUC42-30120	120	Fixed	24 VDC	10	1•	15.80
CDD38-40002	0.6-60	Knob	48 VDC	1	1	$42.05
		INTERVAL ON				
CHB38-70021	1.0-10	Knob	120 VAC	1	1	$24.00
CHB38-70022	1.0-60	Knob	120 VAC	1	1	24.00
CHB38-70023	1.0-180	Knob	120 VAC	1	1	24.00
CHD38-30021	1.0-10	Knob	24 VDC	1	1	$22.00
		DELAY ON RELEASE				
CHB38-30011	1.0-10	Knob	24 VAC	6	1 & 13	$24.00
CDB38-70012	0.6-60	Knob	120 VAC	5		$52.95
CDB38-70014	0.1-10	Knob	120 VAC	5		52.95
CDB38-70015	1.8-180	Knob	120 VAC	5		52.95
CHB38-70011	1.0-10	Knob	120 VAC	6	1 & 13	24.00
CHB38-70012	1.0-60	Knob	120 VAC	6	1 & 13	24.00
CHB38-70013	1.0-180	Knob	120 VAC	6	1 & 13	24.00
CDD38-30012	0.6-60	Knob	24 VDC	5	1	$50.00
CDD38-30014	0.1-10	Knob	24 VDC	5	1	50.00
CDD38-30008	1.8-18	Knob	24 VDC	5	1	50.00
CHD38-30011	1.0-10	Knob	24 VDC	6	1 & 13	22.00
CHD38-30013	1.0-180	Knob	24 VDC	6	1 & 13	22.00
		DELAY ON OPERATE AND ON RELEASE (RECYCLE TIMER)				
CRB48-30180	1.8-180	Knob	24 VAC	1	1	$43.30
CRB48-70180	1.8-180	Knob	120 VAC	1	1	43.30
CRD48-30180	1.8-180	Knob	24 VDC	1	1	$37.85

NOTES: 1. Has internal relay with DPDT contacts rated at 10 amperes, 120V AC. 2. Use with Potter & Brumfield relay KRP5AG-120V AC, KRP11AG-120V AC or KRP14AG-120V AC. 3. Use with KRP5DG -24 V DC, KRP11DG-24V DC, or KRP14DG-24V DC relay. 4. Use with Potter & Brumfield KHP17D11-24V DC relay. 5. Resistor shown in diagrams 12, 13 and 14 applies to CJH series only. 6. Use with Potter & Brumfield PR11AY-120V AC relay. 7. Internal relay contacts rated at 10 VA. 8. Use 750K resistor for maximum time. 9. Use 40K resistor for ½ maximum time. 10. Use 200K resistor for ½ maximum time. 11. Use with Potter & Brumfield KHP17A11-120V AC relay. 12. Use 400K resistor for ½ maximum time. 13. An external switch or relay is required. See diagram 6. 14. Use 1.6 meg. resistor for ½ maximum time.

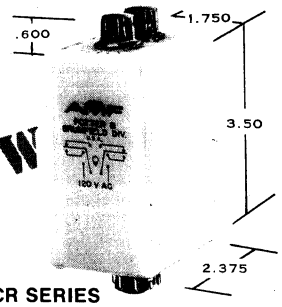
• Denotes U/L

*External resistor (not furnished) for maximum time. Recommend ¼ watt minimum resistor.

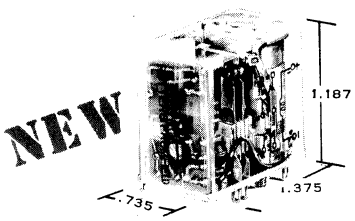
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

AMF | POTTER & BRUMFIELD RELAYS
Princeton, Indiana 47670 (812) 385-5251 TWX: 810-350-2343

SOLID STATE TIME DELAYS



CR SERIES



R12, R13, R14, R15

Diagram 7: No socket used.

Diagrams 8-9: Use KH series sockets, Pg. 4.

Diagrams 10-11: Use KU series sockets, Pg. 7.

Diagrams 1-6 incl: Use KR series sockets, Pg. 7.

Diagrams 12-14 incl: Pin terminations for P/C board mounting.

Diagrams 15-18 incl: See R12-R15 below.

R12-R13 SERIES SOCKETS

DPDT solder terminal socket with grounding strip, R10-A10-30T
Hold down spring, R10-P28-3
Box of 10 each, 9XR12-1 LIST $9.00

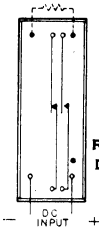
DPDT printed circuit terminal socket with grounding strip, R10-A11-30T
Hold down spring, R10-P28-3
Box of 10 each, 9XR12-2 LIST $9.00

R13 4PDT solder terminal socket with grounding strip, R10-A10-110T
Hold down spring, R10-P28-4
Box of 10 each, 9XR13-1 LIST $14.00

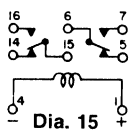
R14-R15 SERIES SOCKETS

DPDT and 4PDT solder terminal socket with grounding strip, R14-A10-SO28
Hold down spring, R10-P28-4
Box of 10 each, 9XR14-1 LIST $14.00

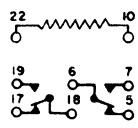
WIRING DIAGRAMS
(Disregard DC polarity for AC relays)



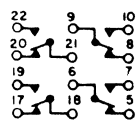
Dia. 14



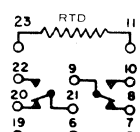
Dia. 15



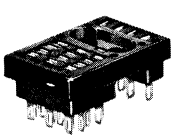
Dia. 16



Dia. 17



Dia. 18



R12-R15 SOCKETS

TYPE	Time Delay in Seconds	Input Voltage	CONTACTS Arrange.	CONTACTS Amp Rating	Diagram Number	SUGG. RE-SALE PRICE
DELAY ON OPERATE						
R12-2-12-X2-E1	0.1-2	12V DC	DPDT	5	15	$18.15
R12-2-24 X2-E1	0.1-2	24V DC	DPDT	5	15	18.15
R12-30-12 X2-E1	1.0-30	12V DC	DPDT	5	15	18.65
R12-30-24-X2-E1	1.0-30	24V DC	DPDT	5	15	18.65
R12-120-12-X2-E1	5.0-120	12V DC	DPDT	5	15	20.15
R12-120-24-X2-E1	5.0-120	24V DC	DPDT	5	15	20.15
R13-1F-24 -X2-E1	1.0	24 VDC	DPDT	5	15	$10.85
-X4-E1	1.0	24 VDC	4PDT	5	17	12.25
R13-5F-24 -X2-E1	5.0	24 VDC	DPDT	5	15	10.85
-X4-E1	5.0	24 VDC	4PDT	5	17	12.25
R13-10F-12 -X4-E1	10	12 VDC	4PDT	5	17	12.25
R13-10F-24 -X2-E1	10	24 VDC	DPDT	5	15	10.85
-X4-E1	10	24 VDC	4PDT	5	17	12.25
R13-60F-48 -Y2-E1	60	48 VDC	DPDT	2	15	12.30
R13-120F-12 -X4-E1	120	12 VDC	4PDT	5	17	14.25
R13-300F-12 -X4-E1	300	12 VDC	4PDT	5	17	15.25
R13-300F-24 -X4-E1	300	24 VDC	4PDT	5	17	15.25
R14-2A-12 -X2-E1	.25-2	12 VDC	DPDT	5	16	$14.60
-X4-E1	.25-2	12 VDC	4PDT	5	18	15.75
R14-30A-24 -X2-E1	.5-30	12 VDC	DPDT	5	16	15.35
-X4-E1	.5-30	12 VDC	4PDT	5	18	16.50
R14-120A-24 -X2-E1	5-120	24 VDC	DPDT	5	16	16.10
-X4-E1	5-120	24 VDC	4PDT	5	18	17.25
R14A-30A-24 -X4-E1	.5-30	24 VDC	4PDT	5	18	17.50
R14A-300A-12 -X4-E1	10-300	12 VDC	4PDT	5	18	19.25
R14A-300A-24 -X4-E1	10-300	24 VDC	4PDT	5	18	19.25
R14A-600A-24 -X4-E1	30-600	24 VDC	4PDT	5	18	20.25
R15-10A-24 -W2-E1	.5-10	24 VAC	DPDT	10	16	$16.65
-W4-E1	.5-10	24 VAC	4PDT	10	18	18.25
R15-30A-115 -X2-E1	.5-30	115 VAC	DPDT	5	16	16.60
-X4-E1	.5-30	115 VAC	4PDT	5	18	17.75
R15-60A-115 -Y2-E1	1-60	115 VAC	DPDT	2	16	16.50
-Y4-E1	1-60	115 VAC	4PDT	2	18	17.50
R15A-30A-24 -X4-E1	.5-30	24 VAC	4PDT	5	18	18.75
R15A-300A-115 -X4-E1	10-300	115VAC	4PDT	5	18	21.25

ORDERING INFORMATION AND CODE EXPLANATION

EXAMPLE: ① **CD** ② **C** ③ **38** — ④ **6** ⑤ **0** ⑥ **003** = CD type, with fixed time value, DC input, 38 style enclosure, 110 volts, standard item, for 10 second delay.

PRODUCT DESIGNATION:
① TYPE (CD, CH, CK, CU, CL, CJ, or CR)

OPERATION
② A — Fixed Value ..... AC Input
B — Knob Adjustable ..... AC Input
C — Fixed Value ..... DC Input
D — Knob Adjustable ..... AC Input
F — Resistor Adj. ..... DC Input
H — Resistor Adj. ..... DC Input

ENCLOSURE STYLES:
③ CD — 21, 31, 38, 45 CJ — 01, 02, 03, 06 and 10
CH and CK — 38 CU and CL — 41, 42, 43, 44, 45,
CR — 48

INPUT VOLTAGE VALUE
④ 0 ..... Special DC
1 ..... Special AC
2 ..... 12 VAC or DC
3 ..... 24 or 28 VAC or DC
4 ..... 48 VDC
5 ..... 90 VDC
6 ..... 110 VDC
7 ..... 120 VAC
8 ..... 240 VAC
9 ..... Blank

DESIGNATION
⑤ 0 ..... Standard
1 ..... Special

TIMES:
⑥ Numbers assigned by manufacturer.

Please see Table

(Time-delay series cont'd. next page)

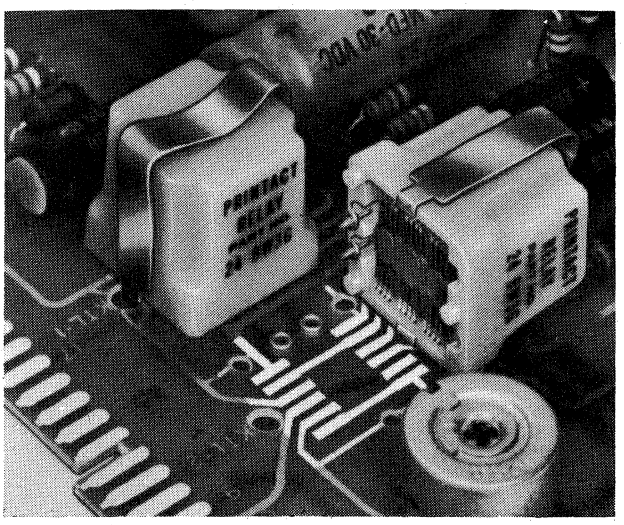
NEW

NO SOCKETS • NO SOLDERING • NO WIRING NO SPRINGS • NO MECHANICAL LINKAGE

Printact®

LATCHING AND NON-LATCHING MAGNETIC RELAYS

Plugs into your PC board . . . mates with plated conductors



The Printact relay, which combines printed circuit board technology with advanced electromagnetic design, offers custom features and economies.

Unlike conventional relays adapted for PC board use with terminal pins or sockets for solder mounting, the Printact relay plugs directly into the PC board, reducing costs and production time. The plated pads on the board become the fixed contacts. They mate with the shorting-bar contacts on the pivoting armature assembly, which is the single moving part in the relay. Held by a permanent magnet, this assembly eliminates return springs, pigtails, electrical and mechanical interconnections, which are prone to breakdown and wear, assuring reliable performance for millions of cycles.

The shorting-bar swinger contacts provide for isolated switching between break (NC) and make (NO) pads. Thus, each blade can perform a two-pole function equivalent to one SPSTNC and one SPSTNO. Common switching SPDT (form C) is achieved by bridging one NC pad to one NO pad.

Illustrated above is a Printact 3 blade relay which has its conductor pattern printed to perform a four-pole function consisting of 1A-1B-2C.

CATALOG NUMBERS

Volts	Coil Res.	2 Blades	3 Blades	4 Blades
Series "G" Standard Non-Latching — Gold Contacts				
6VDC	75Ω	6-BW2-G	6-BW3-G	6-BW4-G
12VDC	300Ω	12-BW2-G	12-BW3-G	12-BW4-G
24VDC	1200Ω	24-BW2-G	24-BW3-G	24-BW4-G
Series "LD" Dual Coil Magnetic Latch — Gold Contacts				
6/6VDC	30/30 Ω	6-BW2-LD	6-BW3-LD	6-BW4-LD
12/12VDC	150/150Ω	12-BW2-LD	12-BW3-LD	12-BW4-LD
24/24VDC	550/550Ω	24-BW2-LD	24-BW3-LD	24-BW4-LD

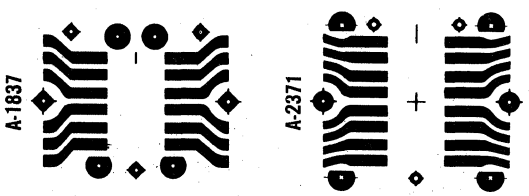
For Palladium Contacts Substitute BP for BW

SPECIFICATIONS AT 25°C

Coil Power — 0.5 watt "G" Series, 1.0 watt "LD" Series.
Contact Rating — dry circuit or low level with gold contacts; up to 2 amps 24v d-c res. with palladium contacts.

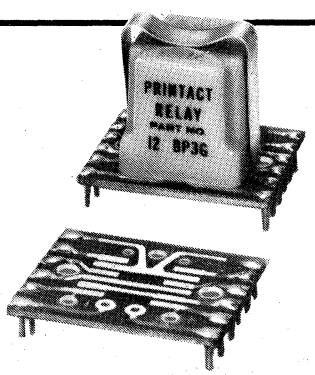
Cont. Res. — .050 ohm initial
Insulation — 1000 megohms
Operate Time — 10 ms or less
Pick-up max. — 75% of rated
Mech. Life — 100x10⁶ cycles
45db Isolation at 220 Mhz
60db Isolation at 40 Mhz
Dielectric — 1000 Vrms
Temp. −30°C to +80°C
Release Time — 5ms or less
Drop-out min. — 10% of rated
Thermal EMF — 10 microvolts
Size — ⅞ x ⅞ x 1" h
Weight — 0.8 ounces

SEND FOR PC BOARD DESIGN AIDS



The above patterns, available in 2:1 and 4:1 size, when positioned on the layout, provide the artwork for the contact pads and also locate the coil clamp and relay positioning holes. Thus no layout to dimensions is required. These patterns, when used in conjunction with the PC board fabrication and area plating procedures, detailed in Tech-Notes PR-262D, assure accurate mating of the Printact swinger blades to the conductor pattern.

Design aids, complete catalog and sample with wired test board available upon request.



GENERAL PURPOSE MODULES AVAILABLE

Where a custom board is not planned, send for catalog illustrating a variety of general purpose PC boards with etched and plated switching patterns to accommodate single or multiple relays. Can be chassis mounted with standoff bushings. Solder pads for point-to-point wiring or edge-connector terminals are available.

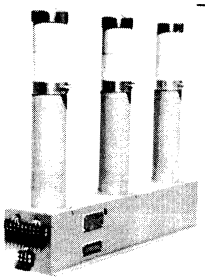
Printact **Relay Division Executone, Inc.**
P.O. Box 1430EM • Long Island City, N. Y. 11101 • (212) EX 2-4800

ROSS ENGINEERING CORPORATION

HIGH VOLTAGE DEVICES

SWITCHES, RELAYS, MEASUREMENT, CONTROL, ENERGY STORAGE SYSTEMS, SAFETY, AND ACCESSORIES.

DC, 60 CYCLES, RF, PULSE, FOR ELECTRONIC AND POWER. 1,000 VOLTS TO 600,000 VOLTS.

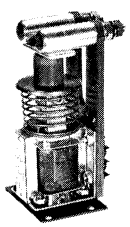


VACUUM POWER INTERRUPTING CONTACTORS AND CIRCUIT BREAKERS

5 to 38 KV RMS operate
50 to 1200 amps continuous
2,000 to 12,000 amps interrupt
10,000 to 40,000 amps momentary

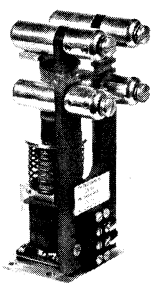
Hi-Z TM HIGH VOLTAGE VOLTMETER

High Impedance
Portable
Instrumentation
.001V to 120 KV



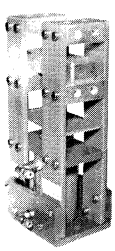
HV RELAYS

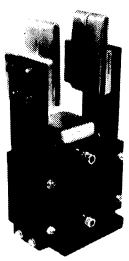
E SERIES
Open style
50 to 100 amps
12 to 300 KV PK



SPDT RELAYS

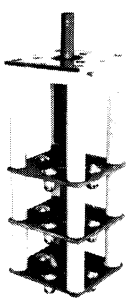
E SERIES
Economical
Open Style
12 to 70 KV
50 to 100 amps





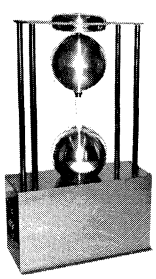
HIGH CURRENT SWITCH

G SERIES
100 to 4,000 amps
Continuous
Small size
to 100 KV, PK test
Air solenoid operated



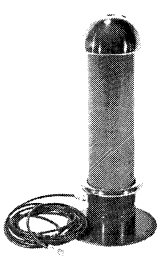
HV ROTARY SWITCHES

R SERIES
To 100 KV PK
10 to 100 amps
Multi-Pole
Multi-Position



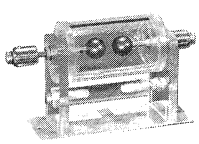
GROUNDING RELAYS LOW CORONA

D SERIES
Spring or Gravity operated
to 600 KV, 100 amps



VOLTAGE DIVIDERS

VD SERIES
Compensated
DC to RF
to 450 KV, PK



SPHERE GAPS

SG SERIES
Enclosed
Adjustable
to 600 KV, PK

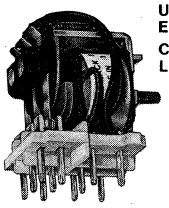
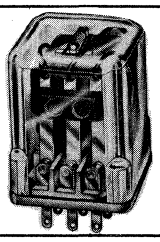
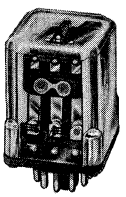
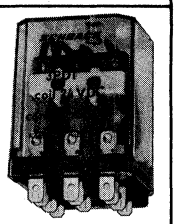
HV SAFETY GROUNDING INTERLOCKS, SAFETY DEVICES, SPECIALTIES. Models pictured are examples of a related series. Currents are RMS continuous ratings. Voltages listed are Peak 60 Cycle Test values. Operating values are generally 1/3 to 2/3 that of peak test values. Spark-over is generally 10% to 30% higher than peak test listed. Let us quote on specific items since most models are available NO, NC, SPDT, and latching, with 115 AC actuators. Many items are not listed and prices and models can change without notice.

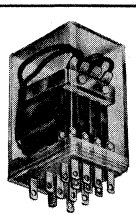
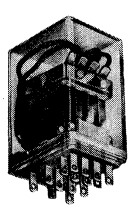
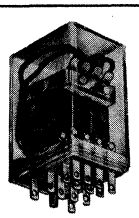
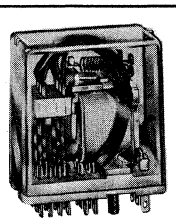
WRITE FOR CATALOG EM

ROSS ENGINEERING CORPORATION:

559 WESTCHESTER DRIVE, CAMPBELL, CALIF. 95008
PHONE (408) 377-4621
PHONE AFTER HOURS (408) 253-1572

SCHRACK RELAYS

RELAY	GENERAL PURPOSE	GENERAL PURPOSE	GENERAL PURPOSE	POWER
TYPE	CA	CAF	CAD	RM
ILLUSTRATION	 U.L. File E38891 CSA File LR31000		 CSA File LR31000	U.L. File E38891 CSA File LR31000 
DESIGN	Open Type	Enclosed with clear Dust Cover or Open Frame	Enclosed with Clear Dust Cover	Enclosed with Clear Dust Cover (available with or without flanges)
TERMINALS	Pierced terminals – soldering or .110 faston or printed circuit. Also mates with socket RD78700.	Same as CA terminals also for plug-in socket No. RD78700	8 or 11 Pin Base to mate with standard tube sockets	Pierced .187 faston terminals for plug-in soldering or quick connect disconnect application
CONTACTS Number & Form	1, 2, or 3 form "C" (change over)	1, 2, or 3 form "C" (change over)	1, 2, or 3 form "C" (change over)	2 form "C" at 15 amp. 3 form "C" at 10 amp.
Contact Rating	5 or 10 amp.	5 or 10 amp.	5 or 10 amp.	
Contact Material	AgCdO, Hard Silver	AgCdO, Hard Silver	AgCdO, Hard Silver	AgCdO 90/10
COIL Coil Voltage	6-230 VAC 6-110 VDC	6-230 VAC 6-110 VDC	6-230 VAC 6-110 VDC	6-380 VAC 6-220 VDC
For more technical data, request catalog No.	GP	GP	GP	S 418

RELAY	MIDGET RELAY	OPPOSITE POLARITY MIDGET RELAY	SINGLE COIL MINI-MAGNETIC LATCHING	MINI-SIX
TYPE	RA	RAX	RR	RE
ILLUSTRATION	 U.L. File E38891 CSA File LR31000	 U.L. File E38891 CSA File LR31000	 U.L. File E38891 CSA File LR31000	
DESIGN	Enclosed with dust cover	Same as RA	Plastic dust cover plug in	Enclosed with clear dust cover
TERMINALS	Plug-in relay Solder lugs Printed circuit	Same as RA	Same as RA	Plug in relay Solder lugs
CONTACTS Number & Form	4 form "C" contacts (change over)	4 form "C" contacts (change over) Plastic barrier between movable arms	4 form "C"	6 form "C" contacts (change over)
Contact Material	Fine silver Gold flashed	Same as RA	Same as RA	Fine silver Gold flashed
Rated Contact Voltage	110 VDC (220 VAC)	Same as RA	Same as RA	60 VAC
Rated Continuous Current	3A @ rated E	Same as RA	Same as RA	2A
Max. Rated Contact Load	350 V. 90 W	Same as RA	Same as RA	120 VA (60 VAC) 90 W (30 VDC)
Special Contact Materials	AgCdO, AuNi/3 PdAg 60/40 PdAg 30/70	Same as RA	Same as RA	—
COIL Coil Voltage	6-110 VDC 6-220 VAC	Same as RA	24-220 VAC 12-110 VDC	6-60 VDC 6-60 VAC
For more technical data, request catalog No.	S404	S404	S404	S408

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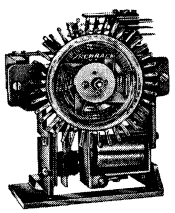
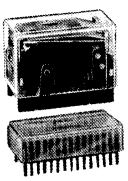
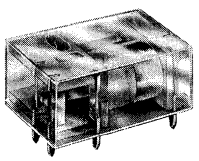
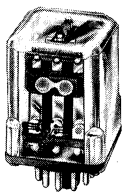
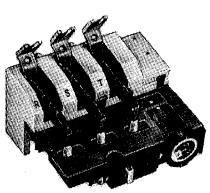
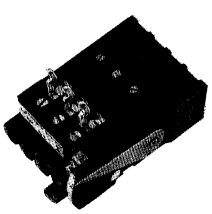
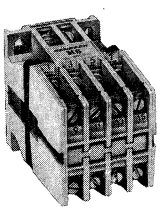
FOR FURTHER INFORMATION ASK FOR CATALOG

SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N. Y. 10001

SCHRACK RELAYS

RELAY	ROTARY STEPPING	MINIATURE STEPPING	REED RELAY	SENSITIVE
TYPE	RT	RTM	RU110	CMD/CSD
ILLUSTRATION				
DESIGN	Plastic dust cover die cast metal frame	Plastic dust cover	Enclosed with clear dust cover	Enclosed with Clear Dust Cover or Open Frame (CA)
TERMINALS	Pierced terminals suitable for soldering or .110 faston	Complete relay plugs into pc board or socket Other sockets available	Complete relay plugs into pc board	Same as CA or CAD
CONTACTS Number & Form	1 pole – 40 or 48 positions 2 pole – 20 or 24 positions 4 pole – 10 or 12 positions	2 pole – 10 position 2 pole – 12 position	1 form "C" contact (change over)	1, 2, or 3 form "C" (change over)
Contact Material	—	Gold alloy wiper tips. Gold plated bank & socket contacts	AgCdO	Gold-flashed Silver
Max. Rated Cont. Voltage	110 VDC-115 VAC	60 VDC 60 VAC	250 VAC	—
Max. Rated Cont. Current	.5A	1 amp, continuously	10 amps	2A
COIL Coil Voltage	6-110 VDC	6-110 VDC	6-110 VDC	5-200 VAC 4.9-100 VDC
For more technical data, request catalog No.	S401	S413	S420	GP

RELAY	SINGLE COIL MAGNETIC LATCHING	OVERLOAD WITH SINGLE PHASING PROTECTION		LIGHT DUTY CONTACTORS
TYPE	CRD/CRF	FA	FK	M
ILLUSTRATION				
DESIGN	Enclosed with clear dust cover	Open frame	Open frame	Open frame 2 screw mounting
TERMINALS	Plug-in relay CRD for Octal or 11 pin CRF pierced for Solder or .110 Faston or pc board	—	—	—
CONTACTS	2 or 3 form "C"	3 pole	3 pole	up to 8 pole
Max. Rated Cont. Voltage	250 VAC	500 VAC/220 VDC	230 VAC	500 VAC
Max. Rated Cont. Current	5 amps 10 amps	.35 amps-100 amps	.12 amps-9.0 amps	10-15 amps
Max. Rated Contact Load	1250A 2500 VA	—	—	1.5-5.5
COIL Coil Voltage	24-220 VAC 12-110 VDC	—	—	48, 110, 220, 440 VDC 110, 220, 380, 500 VAC
Voltage Range	80-110%	—	—	AC 80%-110% of rated DC 80%-110% of rated
For more technical data, request catalog No.	S405	HD 70	HD 70	HD 70

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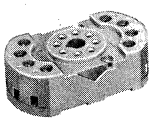
FOR FURTHER INFORMATION ASK FOR CATALOG

SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N. Y. 10001

SCHRACK RELAYS



RELAY SOCKETS WITH SCREW TYPE TERMINALS

No. RN 78724-8 Pin No. RN 78725-11 Pin

For surface type installations and prototype work where screw terminals are convenient. Adequate barriers for hi-voltage installations.
Body Material: Noryl SE1
Special attachment for snap-on mounting of socket available.

STANDARD SOLDER LUG SOCKET

No. RN 78710 — 8 Pin

No. RN 78711 — 11 Pin

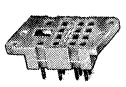
Conventional type molded socket with numbered pins — screw mounting.

PRINTED CIRCUIT LUG SOCKET

No. RN 78712 — 8 Pin

No. RN 78713 — 11 Pin

Standard type for conventional circuit board assemblies — black molded with numbered pins.

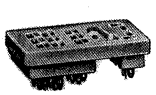


MINIATURE SOCKETS FOR RA RELAYS

No. RA 78700 — for screw mounting, made specially for mounting Schrack RA type relays but may be used for miniature modular circuitry with plug base and dust cover available on request. Precision type with spring-hold grounding terminal.

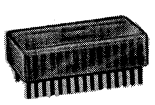
No. RA 78701 — for spring mounting.

No. RA 78702 — for printed circuit mounting.



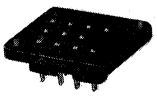
SOCKETS AND ACCESSORIES FOR RE RELAYS

No. RE 78700 Standard Socket
RE 78702 Printed Circuit Socket
RE 28800 Hold-down Spring



SOCKET FOR TYPE RTM

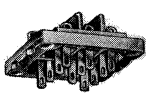
No. RT 78704 for printed circuits
RT 78701 — w/solder lugs
RT 78703 — Screw type term



SPECIAL SOCKET FOR CAF SERIES

No. RD 78700 — 8 or 11 Pin

Exclusive with Schrack. This socket accommodates either 8 or 11 pin base. Its small size and design provides for strip mounting with no loss of space.

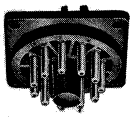


BASE FOR SCHRACK CAF SERIES

No. RD 78600 — 11 Pins

May be used with above socket and dust cover for building modular component requiring U. L. specs for spacing.
for 8 or 11 wiring

No. RD 78601 — same as above but with printed circuit pins.

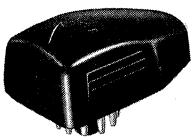


STANDARD MOLDED PLUG

No. RN 78600 — 8 Pin

No. RN 78704 — 11 Pin

Accommodates RN 16035 or RN 16019 Dust Covers for building plug is modular circuitry.

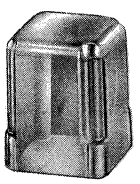


SCHRACK TYPE HOODED PLUG

No. RN 78714 — 8 Pin

No. RN 78715 — 11 Pin

Permits any relay or component to be mounted remotely and to be plugged into standard socket in circuitry.



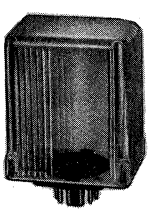
DUST COVER FOR CAD & CAF SERIES

No. RN 16035 POLYSTYRENE
with holes in base for screw mounting.

No. RN 16019 — Same as above but molded of Macralone*.

METAL DUST COVER FOR CAF SERIES ONLY

No. RD 10701 on request.



LARGE DUST COVER FOR METAL PLATE

No. RN 16022 Polystyrene

Internal grooves provide means for mounting circuit boards with components.

No. RN 16034

Same as No. RN 16022 but made of Macralone*.

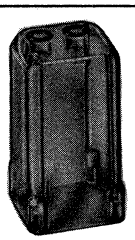
No. RN 16039

Same as No. RN 16022, but grey opaque.

PLUG MOUNTED ON METAL PLATE

No. RN 74221 — 8 Pin
No. RN 74104 — 11 Pin

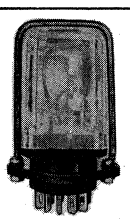
Metal plate provides base for oversize dust cover in order to install components for modular circuitry.



HIGH POLYSTYRENE DUST COVER

No. RN 16020

May be used with CAD Series.
Two holes in top for ventilation.



HOLD DOWN SPRING — **No. RN 28623**

HOLD DOWN CLIP — **No. RN 28611**

Provides quick removal of dust cover — fastens to mounting screws of standard type socket.

*Macralone is a polycarbonate resistant to high temperatures.

Self tapping screws for dust covers available on order.

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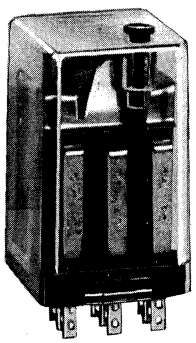
SCHRACK ELECTRICAL SALES CORPORATION 1140 BROADWAY, NEW YORK, N. Y. 10001

General Purpose Relays

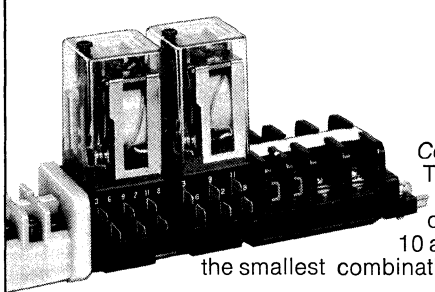
Type K

Extended relay life.
New standard of reliability.

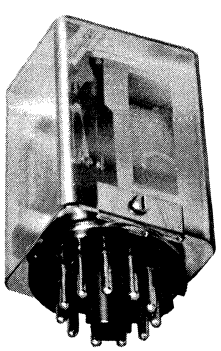


Variety of terminations. 2PDT or 3PDT. AC or DC operation. 10 amp contacts. Options include pilot light and manual operator.

Socket Mounted Version
The Type K general purpose relay is designed for multi-pole switching below 150 volts. Its small size makes it perfect for industrial or commercial control equipment. Troublesome solder connections and pigtail wires have been eliminated to give you an extremely reliable device.



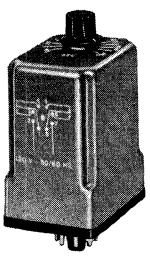
Compact Mounting
Takes up less than 3 square inches of panel space . . . 10 amp relay/socket the smallest combination on the market.



Tube-Type Version
Designed to fit all standard 8 or 11 pin sockets. Interchangeable with other tube-type general purpose relays.

Type J Timing Relay

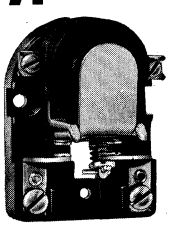
Integral Type K relay and solid state timing circuit.



Solid state timing relays give ±1% accuracy. .05 to 180 sec. knob adjustable, factory fixed or external resistor adjustable. 150 volt. 10 amp DPDT output contacts. Plug-in tube-type mount.

Type C

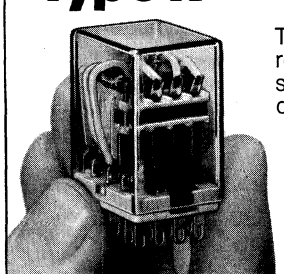
Most available relay.
Low cost.



600 volts maximum. Rated up to 1½ HP. 1 or 2 poles. Stocked by over 400 distributors.

Type R

the dependable miniature relay.



The new Type R miniature relay from Square D is very small, but very superior. It is designed to deliver reliable performance over an extremely long life.

It is the only one to offer all this:

1. Quality inspection and testing before shipment for dependable operation from the start.
2. A standard polarity barrier between each pole which allows the relay to be used where opposite polarity is present on adjacent poles.
3. A complete line of relays and sockets—and we mean complete—which makes the Type R ideal in a wide variety of applications.

In addition you get: 4 poles; double-throw contacts; 5 amp rating at 120VAC; an optional manual operator to speed circuit testing.

World Wide Distribution

For complete listings, prices and application data, contact your nearby Square D field office. Or, write Square D Company, Dept. SA, Milwaukee, Wisconsin 53201.

SQUARE D COMPANY

Wherever Electricity is Distributed and Controlled

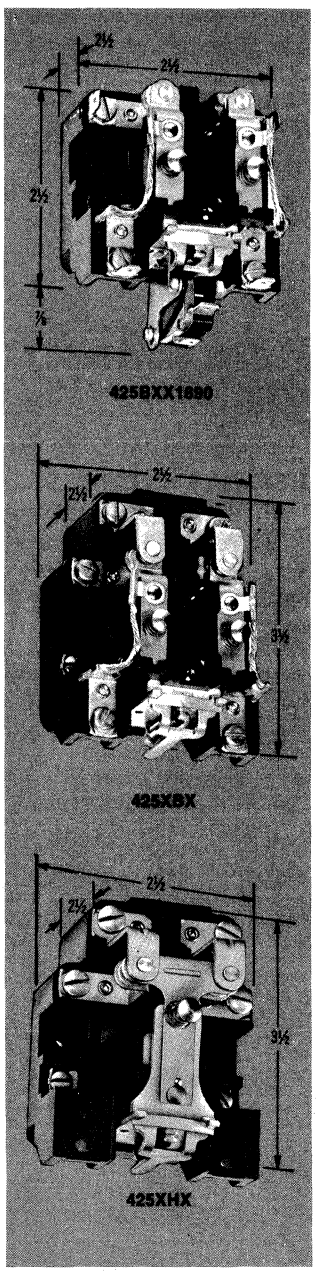
STRUTHERS-DUNN, INC., Pitman, N.J. 08071 • (609) 589-7500

Commercial Relays: General Purpose

30-AMP POWER RELAYS, U.L. & C.S.A. LISTED

Frame 425 power relays are modern, low-cost replacements for P & B type PR, Deltrol series 900, Guardian series 2100, Magnecraft class 99 and others. Their full floating movable contacts with excellent wiping action are designed for over 100,000 operations at rated loads. Mechanical life exceeds 10 million operations. High impact molded phenolics are used for bases and moving contact insulations. All magnetic parts are high grade electromagnetic steels, hydrogen annealed and nickel plated for long, troublefree life. Enclosed, snap-action auxiliary contacts are available as standard options.

U.L. & C.S.A. Status: U.L. file E13224. C.S.A. file LR9494. Basic types are U.L. and C.S.A. Listed (U.L. white card). Types with features 18 and/or 90 are C.S.A. Listed and U.L. Recognized (U.L. yellow card).



Standard Coils

(all for continuous duty)

AC Coils, 50/60 Hz. 9.8 VA, approx.		
VOLTAGE (nominal)	**CURRENT (mA)**	**RESISTANCE (Ohms)**
6	1600	.86
12	820	3.2
24	410	12
120	85	290
240	43	1200
480	22	4500
DC Coils. 2.0 Watts, approx.		
VOLTAGE (nominal)	**CURRENT (mA)**	**RESISTANCE (Ohms)**
6	333	18
12	169	71
24	84	288
110-125	18-21	6050

NOTE: For 220 Vdc, use 6,000 ohm 5-watt resistor in series with coil of 110 Vdc relay.

"Hot Armature" Types have movable contacts electrically common to the armature and magnetic structures.

Contact Ratings: Resistive—30 amps @ 28 Vdc or 120-240 Vac; 10 amps @ 125 Vdc for types with pm blowouts.

Motor—1 hp @ 120-240 Vac (80% PF).

Insulated Armature Types have movable contacts electrically isolated from armature and magnetic structures. Rated for up to 600 volts ac.

Contact Ratings: Resistive—30 amps @ 28 Vdc, 120-240 Vac; 10 amps @ 600 Vac, 125 Vdc for types with pm blowouts.

Motor—1 hp @ 120-240 Vac (80% PF).

Optional Features—consult factory for prices and availability of the following:

Feature No.	
18	Quick-connect terminals, ¼" tabs.
90	SPDT auxiliary switch; 10 A, 250 Vac.
1890	Q-C terminals & SPDT aux. switch.
69	Permanent magnet blowouts on 425HXX & 425BXX.

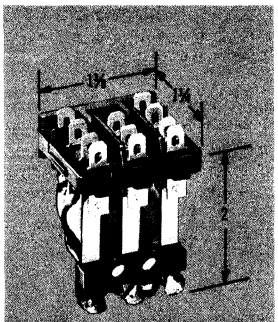
Type	Contacts	Base Size	Coils	Price
"HOT ARMATURE" TYPES				
425XAX	SPDT	2½ x 2½	6, 12, 24, 120 Vac	$4.60
425XAX	SPDT	2½ x 2½	208, 240 Vac	5.05
425XAX	SPDT	2½ x 2½	6, 12, 24 Vdc	4.60
425XAX	SPDT	2½ x 2½	110-125 Vdc	5.25
425HXX	SPST-NO-DM	2½ x 2½	6, 12, 24, 120 Vac	4.60
425HXX	SPST-NO-DM	2½ x 2½	208, 240 Vac	5.05
425HXX	SPST-NO-DM	2½ x 2½	6, 12, 24 Vdc	4.60
425HXX	SPST-NO-DM	2½ x 2½	110-125 Vdc	5.25
INSULATED ARMATURE TYPES (600 Volt Ratings)				
425HXX2	SPST-NO-DM	2½ x 2½	6, 12, 24, 120 Vac	5.20
425HXX2	SPST-NO-DM	2½ x 2½	208, 240 Vac	5.70
425HXX2	SPST-NO-DM	2½ x 2½	6, 12, 24 Vdc	5.20
425HXX2	SPST-NO-DM	2½ x 2½	110-125 Vdc	5.90
425BXX	DPST-NO	2½ x 2½	6, 12, 24, 120 Vac	5.20
425BXX	DPST-NO	2½ x 2½	208, 240 Vac	5.70
425BXX	DPST-NO	2½ x 2½	6, 12, 24 Vdc	5.20
425BXX	DPST-NO	2½ x 2½	110-125 Vdc	5.90
425XBX	DPDT	2½ x 3½	6, 12, 24, 120 Vac	6.90
425XBX	DPDT	2½ x 3½	208, 240 Vac	7.55
425XBX	DPDT	2½ x 3½	480 Vac	8.40
425XBX	DPDT	2½ x 3½	6, 12, 24 Vdc	6.90
425XBX	DPDT	2½ x 3½	110-115 Vdc	7.55
425XBX90*	DPDT	2½ x 3½	24, 120 Vac	8.90
425XBX90*	DPDT	2½ x 3½	208, 240 Vac	9.55

*Has SPDT auxiliary switch extending ⅞" beyond base; 10A, 250 Vac.

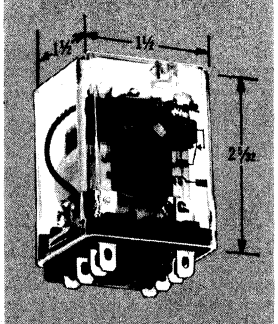
Always specify coil voltage and frequency.

Open & Enclosed Plug-In Relays

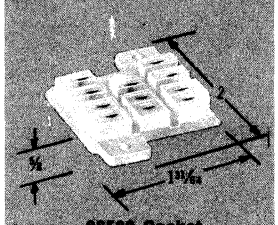
10-AMP, 1 TO 3 POLES, U.L. RECOGNIZED



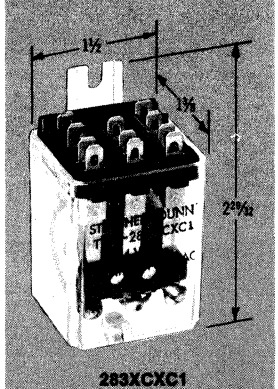
283XCX



283XBXC



36580 Socket



283XCXC1

Frame 283 relays have rugged, gold diffused, silver-cadmium oxide contacts with excellent wiping action permitting these relays to be used on a variety of loads ranging from instrument and logic circuits to the control of heaters, solenoids, small motors, and other relays. Diverse applications such as machine tools, elevator controls, office machines, copy and vending machines are among the many products suitable for these relays.

One, two, or three pole contact combinations are available in many standard open and enclosed styles. Clear polycarbonate covers are used on enclosed types.

All 283 frame relays have 0.187" flat male terminals of the quick-connect type. Terminals are properly spaced for standard plug-in mounting, and are pierced to accommodate solder wiring. For plug-in applications, sockets are available with printed circuit, quick-connect, or solder terminals.

U.L. Recognized: File E 13224

Standard Coils—all for continuous duty

AC Coils, 50/60 Hz

VOLTAGE (Nominal)	1 and 2 Pole—2 VA	
	Current in mA	Resistance in Ohms
6	335.	6
12	168.	21
24	84.	75
120	17.5	2250
240	8.75	9110
	3 Pole—2.7 VA	
6	460	4.2
12	230	18.
24	115	72.
120	24	1700.
240	12	7200.

DC Coils—1.2 Watts

VOLTAGE (Nominal)	Current in mA	Resistance in Ohms
6	188	32.1
12	100	120.
24	51	472.
48	26.6	1800.
110-125	10.5-12.5	10000.

NOTE: For 220-250 Vdc use 10,000 ohm, 5 watt resistor in series with coil of 110-125 Vdc relay.

Contact Ratings:

10 amps resistive, 28 Vdc
10 amps resistive, 120-240 Vac
⅓ hp motor, 120 Vac
½ hp motor, 240 Vac

Optional Relay Features—consult factory for price and availability of the following:

Feature No.	
L	Neon lamp across coil, 120 or 240 volt.
M	Manual actuator for enclosed plug-in types.
#37067	Hold down wire for sockets.

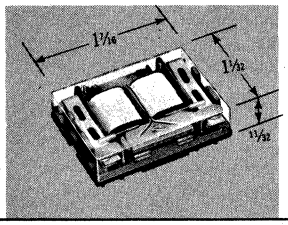
Always specify coil voltage and frequency.

Type	Contacts	Coils	Price
OPEN, WITH TAPPED 6-32 HOLE			
283XAX	SPDT	6, 12, 24, 120 Vac	$3.50
283XAX	SPDT	240 Vac	3.95
283XAX	SPDT	6, 12, 24 Vdc	3.35
283XAX	SPDT	110 Vdc	4.00
283XBX	2PDT	6, 12, 24, 120 Vac	4.40
283XBX	2PDT	240 Vac	4.85
283XBX	2PDT	6, 12, 24 Vdc	3.90
283XBX	2PDT	110 Vdc	4.60
283XCX	3PDT	6, 12, 24, 120 Vac	5.00
283XCX	3PDT	240 Vac	5.45
283XCX	3PDT	6, 12, 24 Vdc	4.55
283XCX	3PDT	110 Vdc	5.00
ENCLOSED, PLUG-IN			
283XAXC	SPDT	6, 12, 24, 120 Vac	$3.80
283XAXC	SPDT	240 Vac	4.25
283XAXC	SPDT	6, 12, 24 Vdc	3.65
283XAXC	SPDT	110 Vdc	4.30
283XBXC	2PDT	6, 12, 24, 120 Vac	4.70
283XBXC	2PDT	240 Vac	5.15
283XBXC	2PDT	6, 12, 24 Vdc	4.20
283XBXC	2PDT	110 Vdc	4.90
283XCXC	3PDT	6, 12, 24, 120 Vac	5.30
283XCXC	3PDT	240 Vac	5.75
283XCXC	3PDT	6, 12, 24 Vdc	4.85
283XCXC	3PDT	110 Vdc	5.30
SOCKETS, FOR ABOVE PLUG-INS			
36579		P.C. TERMINALS	$0.75 List
36580		.187 QUICK CONNECT	0.75 List
36581		SOLDER TERMINALS	0.75 List
ENCLOSED, BRACKET-MOUNTED			
283XAXC1	SPDT	6, 12, 24, 120 Vac	$3.80
283XAXC1	SPDT	240 Vac	4.25
283XAXC1	SPDT	6, 12, 24 Vdc	3.65
283XAXC1	SPDT	110 Vdc	4.30
283XBXC1	2PDT	6, 12, 24, 120 Vac	4.70
283XBXC1	2PDT	240 Vac	5.15
283XBXC1	2PDT	6, 12, 24 Vdc	4.20
283XBXC1	2PDT	110 Vdc	4.90
283XCXC1	3PDT	6, 12, 24, 120 Vac	5.30
283XCXC1	3PDT	240 Vac	5.75
283XCXC1	3PDT	6, 12, 24 Vdc	4.85
283XCXC1	3PDT	110 Vdc	5.30

STRUTHERS-DUNN, INC., Pitman, N.J. 08071 • (609) 589-7500

Sensitive & Enclosed Plug-in Relays

DC SENSITIVE FOR P/C MOUNTING

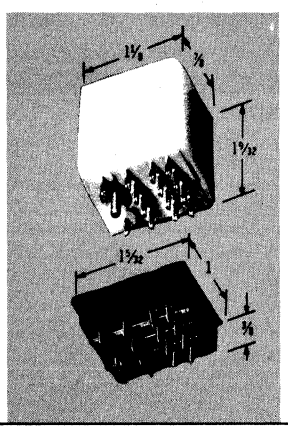


Type 412XBX operates on about 50 mW to provide DPDT switching directly from the transistor stages of ICs. Load life, 1 million operations at 3 amps 120 Vac, 250,000 operations at 3 amps 28 Vdc. Snap-on dust cover, flat pack for boards on ½" centers, pin terminals for soldering or plug-in using AMP Z-332-0270-2 inserts.

COIL DATA: continuous duty

Nominal, 25°C Ambient			"Must Operate" 70°C Ambient			Price
Volts	Ohms	mW	Volts	mA	mW	
5	250	100	4.0	13.	52	**$9.00**
6	360	100	4.8	11.2	54	**9.00**
12	1440	100	9.6	5.6	54	**9.00**
24	5760	100	19.2	2.8	54	**9.50**

SOLDER OR PLUG-IN MINIATURE 3 AMP



Type 281XDX relays feature high contact packaging density for applications requiring large banks of closely mounted relays. Nylon cover keeps out dust. Basic relay has solder-tab terminals and single mounting stud for directly wired applications. The same relay—without alteration—becomes a plug-in relay when provided with a socket.

U.L. Recognized Component—File No. E-7104

Contact Ratings:
3 amperes @ 30 Vdc
3 amperes @ 115 Vac

Sockets

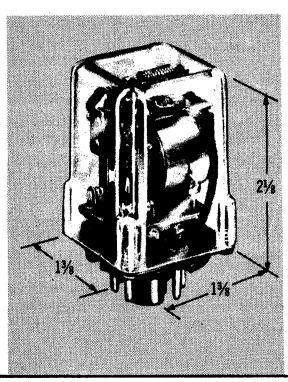
Type 32884
with solder tab terminals—**Net $0.60**

Type 32885
with printed circuit terminals—**Net $0.60**

For further data: Bulletin B/4121

Type	Contacts	No. of Terminals	Coil Voltage dc	Coil Voltage 60 Hz ac	Price
281XDX	4PDT	14	6, 12, 24	—	**$4.50**
281XDX	4PDT	14	48	—	**4.65**
281XDX	4PDT	14	110	—	**4.80**
281XDX	4PDT	14	—	6, 12, 24	**5.20**
281XDX	4PDT	14	—	115	**5.60**

LOW COST, 1 TO 3 POLE



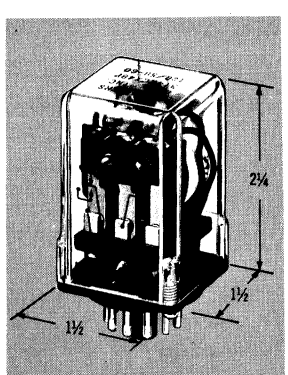
Frame 214 relays are inexpensive, compact units that fill many general-purpose, moderate-load applications. All are enclosed by dust-tight, flame-resistant, clear plastic covers. Types with 115 Vac coil are available with integral neon lamps wired across the coil to indicate when coil is energized.

Contact Ratings:
10 amperes to 30 Vdc
10 amperes to 115 Vac

For further data: Bulletin B/4210

214XAX48P	SPDT	octal	6, 12, 24	6, 12, 24, 120, 240	**4.70**
214XAX48P	SPDT	octal	115	—	**5.10**
214XBX48P	DPDT	octal	6, 12, 24	6, 12, 24, 120, 240	**5.30**
214XBX48P	DPDT	octal	115	—	**5.80**
214XCX48P	3PDT	11	6, 12, 24	6, 12, 24, 120, 240	**6.30**
214XCX48P	3PDT	11	115	—	**7.00**
With NEON LAMP ACROSS COIL					
214XAX48PL	SPDT	octal	—	120	**6.20**
214XBX48PL	DPDT	octal	—	120	**6.80**
214XCX48PL	3PDT	11	—	120	**7.80**

INDUSTRIAL 1 TO 3 POLE, WITH U.L. RECOGNITION



Frame 314 relays are examined under the U.L. Recognition Program, and are considered general-purpose industrial-type devices with a mechanical life expectancy of over 10 million operations. Gold plated silver-cadmium oxide contacts on flexing arms give maximum life. Dust-tight, clear polycarbonate covers provide mechanical protection. Types with 115 Vac coils are also available with integral neon lamps to signal coil operation.

U.L. Recognition: File No. E13224

Contact Ratings:

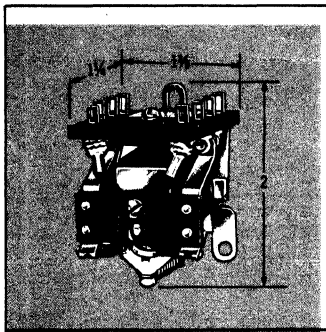
ac Voltage	Amps	hp
120	10	⅙
240	5	⅓

For further data: Bulletin B/5314

314XAX48P	SPDT	octal	6, 12, 24, 48	6, 12, 24, 120, 240	**5.60**
314XAX48P	SPDT	octal	115	—	**6.10**
314XBX48P	DPDT	octal	6, 12, 24, 48	6, 12, 24, 120, 240	**6.00**
314XBX48P	DPDT	octal	115	—	**6.50**
314XCX48P	3PDT	11	6, 12, 24, 48	6, 12, 24, 120, 240	**7.80**
314XCX48P	3PDT	11	115	—	**8.20**
With NEON LAMP ACROSS COIL					
314XAX48PL	SPDT	octal	—	120	**$6.60**
314XBX48PL	DPDT	octal	—	120	**7.00**
314XCX48PL	3PDT	11	—	120	**8.80**

Low Cost, Open Type Relays

S-D



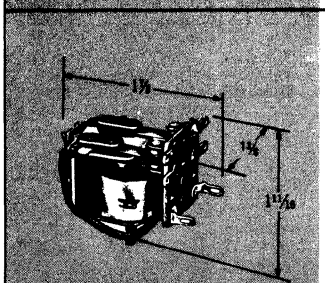
5 AMP CONTROL

Type 119XBX relays provide highly reliable DPDT switching from low level to 5 amperes. Fine silver contacts on long flexing arms are individually adjusted for more than adequate gap, pressure and overtravel. Full insulation spacing for 150 volts. Three mounting feet with clearance holes are integral with relay base. Pierced solder tab terminals. Phenolic block contains both coil and contact terminals.

U.L. Recognized Component—File No. E-13224

Contact Ratings:
5 amps resistive, 115 Vac
⅛ hp motor, 115 Vac

Type	Contacts	Coil Voltages ac (60 Hz)	Coil Voltages dc	Price
119XBX	DPDT	115	—	**$7.50**

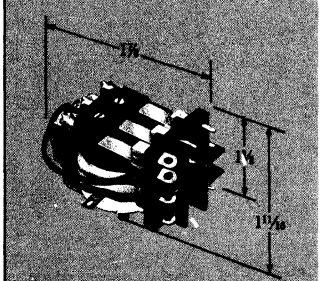


COMPACT 10 AMP

Frame 214 Relays provide reliable 1, 2 and 3-pole switching of resistive loads to 10 amperes in minimum space and at minimum cost. Metal frame has non-twist tab and single mounting stud. Solder tab terminals.

Contact Ratings: 10 amps, 115 Vac, non-inductive

Type	Contacts	Coil Voltages ac (60 Hz)	Coil Voltages dc	Price
214XAX	SPDT	6, 12, 24, 120, 240	6, 12, 24	**3.00**
214XAX	SPDT	—	115	**3.30**
214XBX	DPDT	6, 12, 24, 120, 240	6, 12, 24	**3.30**
214XBX	DPDT	—	115	**3.60**
214XCX	3PDT	6, 12, 24, 120, 240	6, 12, 24	**3.70**
214XCX	3PDT	—	115	**4.10**



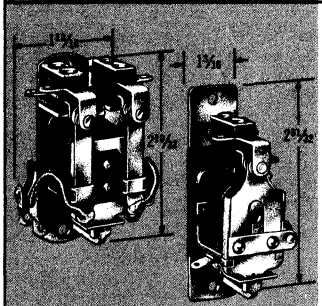
INDUSTRIAL 10 AMP

Frame 314 U.L. recognized relays have gold-plated, silver cadmium oxide moveable and stationary contacts. Solder lug terminals are aligned in a molded support with integral insulating barriers. Mount with single 6-32 threaded stud and turn-resistant tab.

U.L. Recognized Component—File No. E-13224

Contact Ratings:
10 amps, 120 V non-inductive (⅛ hp motor)
5 amps, 240 V non-inductive (½ hp motor)

Type	Contacts	Coil Voltages ac (60 Hz)	Coil Voltages dc	Price
314XAX	SPDT	6, 12, 24, 120, 240	6, 12, 24, 48	**3.20**
314XAX	SPDT	—	115	**3.70**
314XBX	DPDT	6, 12, 24, 120, 240	6, 12, 24, 48	**3.90**
314XBX	DPDT	—	115	**4.40**
314XCX	3PDT	6, 12, 24, 120, 240	6, 12, 24, 48	**4.40**
314XCX	3PDT	—	115	**4.70**

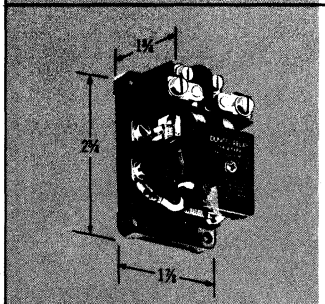


15 AMP SOLDER TERMINAL

Frame 215 Relays are inexpensive single and double pole relays for handling high current loads to 15 amperes in minimum space. Heavy pierced solder-type terminals; two-hole metal mounting bracket; 150V insulation spacing.

Contact Ratings:
15 amps, 24 Vac or Vdc
13 amps, 115 Vac
0.25 amps, 115 Vdc

Type	Contacts	Coil Voltages ac (60 Hz)	Coil Voltages dc	Price
215XAX	SPDT	6, 12, 24, 115, 230	6, 12, 24, 115	**6.00**
215XBX	DPDT	6, 12, 24, 115, 230	6, 12, 24, 115	**8.40**



15 AMP, INSULATING BASE

Type 415 molded base relays provide reliable, low-cost, long-life, compact power switching on DPDT silver cadmium oxide contacts. Insulation spacing 300V. Epoxy encapsulated coils. Screw/hex terminals accommodate up to two #14 wires.

*U.L. White Card Listed—File No. E-13224

Contact Ratings:
15 amps, 120 V non-inductive (½ hp motor)
10 amps, 240 V non-inductive (½ hp motor)

Terminals:
Type 415XBX: Screw/hex, accommodate two #14 wires
Type 415XBX18: ¼" quick-disconnect

Type	Contacts	Coil Voltages ac (60 Hz)	Coil Voltages dc	Price
415XBX*	DPDT	6, 12, 24, 115, 230	6, 12, 24, 48, 115	**8.40**
415XBX18	DPDT	6, 12, 24, 115, 230	6, 12, 24, 48, 115	**8.40**

STRUTHERS-DUNN, INC., Pitman, N.J. 08071 • (609) 589-7500

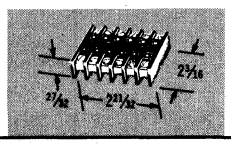
Industrial Plug-in

Simplify panel design and save wiring time with this complete line of matched relays that fill the majority of industrial control needs. Most fit the same standard 12-pin socket; new 4-pole double-throw models below take a slightly larger 14-pin socket. Front-connected socket wiring is on one level with terminals easily accessible for installation and check-out.

All relays have clear, burn-resistant plastic covers. Keyed plugs insure correct insertion. All units have 150 V electrical spacing and withstand 1500 V dielectric test and normal machine vibration.

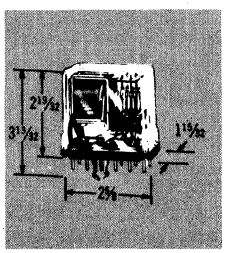
Standard contacts are gold diffused silver-cadmium oxide, nominally rated at 10 amperes when handling resistance type loads.

Standard optional features are listed in the 219 frame tables below. Relays combining several of these features are also available on special order. Many can also be applied to the other plug-in relay types on these two pages. Refer to nearest sales office, or write Struthers-Dunn, Inc., Pitman, New Jersey, for recommendation or quotation.



SOCKET FOR ALL 12-PIN PLUG-IN RELAYS

Type 27390 twelve-terminal socket accepts all 219 frame 12-pin relays shown immediately below and all 211, 236, 237, A255, 349, and RSX alarm relays on page 17. Front-connect screws with captive clamp plates hold up to two #14 wires. Mounted to panel with two 6-32 screws. **Price $2.50.**



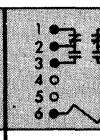
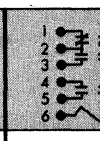
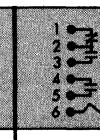
GENERAL PURPOSE

Frame 219 twelve pin relays offer three standard contact arrangements for signal load-switching circuits, and are designed for reliability through 20 million operations.

U. L. Recognition: All 12-pin #219 types, except those with 230 Vac coils.

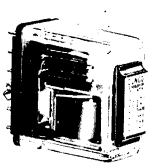
Contact Rating: 10 amps, 115 Vac resistive

Standard Coils:
ac, 60 Hz (5 VA)—6, 12, 24, 115, 230 V
dc (1.8 W) —6, 12, 24, 115-125 V

Internal wiring—corresponding numbers appear on plugs & sockets			
Contact Configuration	DPDT	DPDT & 2 NO	DPDT, 1NO & 1NC
	Relay Type and Price	Relay Type and Price	Relay Type and Price
Basic types	219XBXP **$15.50**	219BBXP **$18.50**	219ABAP **$18.50**
With indicator lamp	219XBXPL **$17.00**	219BBXPL **$20.00**	219ABAPL **$20.00**
With manual actuator	219XBXPM **$17.00**	219BBXPM **$20.00**	219ABAPM **$20.00**
With lamp and actuator	219XBXPLM **$18.50**	219BBXPLM **$21.50**	219ABAPLM **$21.50**
Bifurcated contacts	219XBXP33 **$20.50**	219BBXP33 **$23.50**	219ABAP33 **$23.50**

NOTE: Most of the features listed above are also available on relays with 230 volt, 60 Hz coils, but the type designation will change.

Optional Features



Indicator lamp wired across coil indicates coil energized. Available from stock with 115 Vac coils only.

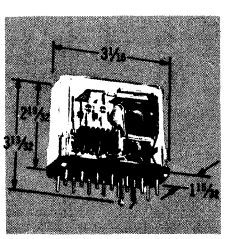
Manual Actuator on cover allows manual operation of relay contacts; spring returns contacts to normal. Available on all models.

Both lamp and actuator can be furnished on 115 Vac or dc coil relays.

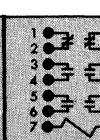
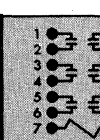
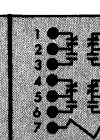
For further data: Bulletin B/5219 & B/5219-S1

Bifurcated contacts can be provided on all standard coil and contact combinations for low-level (milliwatt) to 5-ampere loads. Twin contacts of gold diffused fine silver, with adequate pressure and overtravel, assure continuity and reliability.

NEW 4PDT & 6 POLE



These new 219 frame relays provide 4-pole double-throw or 6-pole single-throw switching in a rugged plug-in module that is compatible in design and appearance with the rest of the S-D industrial plug-in line shown on these pages. Same easy installation and check-out; same dependable movement good for 20,000,000 operations. The relays use a slightly larger 14-pin socket to accommodate the two additional terminals. Coil and contact ratings are the same as shown above.

Internal wiring—corresponding numbers appear on plugs & sockets				Price
Contact Configuration	4P NO + 2P NC	6 P NO	4PDT	
	Relay Type	Relay Type	Relay Type	
Basic types	219DXBP	219FXXP	219XDXP	**$21.00**
With indicator lamp	219DXBPL	219FXXPL	219XDXPL	**22.50**
With manual actuator	219DXBPM	219FXXPM	219XDXPM	**22.50**
With lamp and actuator	219DXBPLM	219FXXPLM	219XDXPLM	**24.00**
With bifurcated contacts	219DXBP33	219FXXP33	219XDXP33	**26.00**

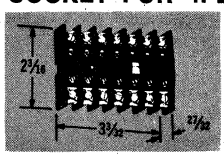
Options: The new relays are available with the same optional features as the standard twelve-pin 219's shown above.

Contact Rating: 10 amps, 115 Vac resistive

Standard Coils: ac, 60 Hz (5 VA): 6, 12, 24, 115, 230 V
dc (1.8 W): 6, 12, 24, 115-125 V

For further data: Supplementary Bulletin S/5219-2

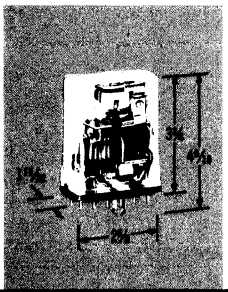
SOCKET FOR 4PDT & 6-POLE RELAYS



Type 33377 14 terminal socket accepts all Frame 219 4P-DT and 6 pole models. Front-connected screws with captive clamp plates hold two #14 wires. Construction same as 12 terminal versions above except for 2 additional terminals and ½" greater length. **Price $2.80**

S-D

Relays



LATCH

Frame A255 relays are mechanically-latched, electrically-reset versions of the basic 219 relay. Unique latching frame assures contact reliability for 10 million operations. All contacts operate from common armature to avoid overlapping.

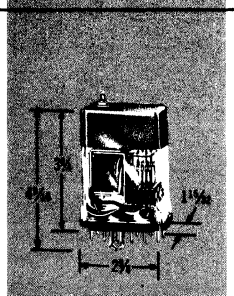
Standard Coils:
ac, 60 Hz (5 VA): 6, 12, 24, 115, 230 V
dc (1.8 W) : 6, 12, 24, 115-125 V

Contact Rating:
10 amps, 115 Vac resistive

For further data: Bulletin B/5255

Internal wiring—corresponding numbers appear on plugs & sockets			
Type	A255XBXP	A255XCXP	A255BXBP
Contact arrangement	DPDT	3PDT	2 NO & 2 NC
Price	**$30.50**	**$33.00**	**$33.00**

Specify coil voltage when ordering.

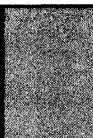


TIME DELAY

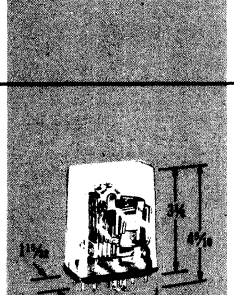
Encapsulated solid-state timing network operates 219 frame relay after a preset delay. Time lapse adjustable over 90:1 range. External resistance across terminals 8 and 9 provides remote adjustment of delay period.

Frame 236 "ON DELAY" network energizes relay at a preset timing period after power is applied.

Frame 237 "OFF DELAY" network supplies power to relay coil for a preset period of time after signal circuit is deenergized. Auxiliary power source must be continuously available to network during operate and delay period.

Internal wiring—corresponding numbers appear on plugs & sockets		
Type	236ABXP	237XBXP
Contact arrangement	DPDT + 1 NO	DPDT
Delay Ranges, specify one.	"ON" delay: 0.2 to 12 sec., or 0.2 to 20 sec. or 2.0 to 200 sec.	"OFF" delay: 0.2 to 20 sec. or 2.0 to 200 sec.
Price	**$71.50**	**$84.00**

Contact Ratings: 10 amps, 115 Vac resistive.
Standard Coils: ac, 60Hz: 24, 115V; dc, : 24, 115V



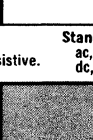
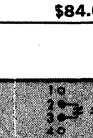
SEQUENCE

Frame 211 relays contain a rugged 8-tooth ratchet operating two contact cams. Contacts change position on each impulse; hold last position until next impulse. Cam position (but not necessarily contact position) changes each time coil is energized, and again when coil is de-energized.

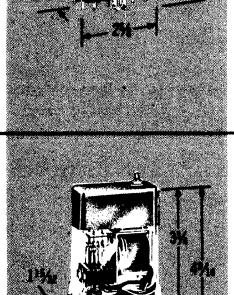
Contact Ratings:
5 amps., 115 Vac resistive

Standard Coils:
ac, 60 Hz: 6, 12, 24, 115, 230 V
dc : 6, 12, 24, 115 V

For further data: Bulletin B/5261

Internal wiring—corresponding numbers appear on plugs & sockets		
Contact arrangement	DPDT	1 NO + 1 NC
Type	211XBXP	211AXAP
Price	**$31.50**	**$28.50**
	(Contacts transfer when coil is energized)	
Type	211XBXPR	211AXAPR
Price	**$31.50**	**$28.50**
	(Contacts transfer when coil is de-energized)	

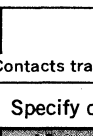
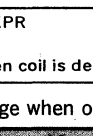
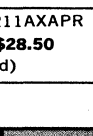
Specify coil voltage when ordering.

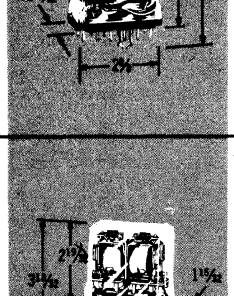


OVER AND UNDER-VOLTAGE

Frame 349 relays contain an adjustable solid-state voltage sensing module in the same case with the relay. A potentiometer shaft extends through the cover for setting pick-up voltage. Principal use is in overvoltage or undervoltage sensing in engine-generator starting systems.

Contact Ratings: 10 amps, 115 Vac, resistive
Standard Coils: 85 to 135 Vac adjustable pull-in range.
For further data: Bulletin B/5249

Internal wiring—corresponding numbers appear on plugs & sockets			
Type	349BBXP Single-phase	349ABXP Single-phase	349XBXP Three-phase
Contact arrangement	DPDT + 2 NO	DPDT + 1 NO	DPDT
Differential	3 ± 1 V, fixed	2 to 14 V, Adjustable	
Price	**$95.50**	**$95.50**	**$108.00**



ALARM

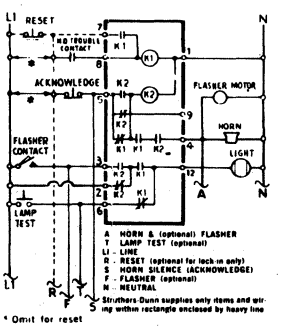
These units combine the functions of two interwired relays. Alarms operate from sustained or momentary contacts. Relay will operate both alarm and light. Operator silences alarm with external pushbutton. Signal may be turned off manually, or turned off automatically when alarm initiating condition clears.

Type RSX1440Z is initiated by a momentary, intermittent, or sustained closure of NO trouble contacts; circuit permits testing of signal light. **Price $24.00** (Circuit at right.)

Type RSX1440S is similar to RSX1440Z except initiated by NC trouble contact. **Price $24.00** (See Bulletin B/5274 for circuit.)

RSX1440Z	K1	K2	Flasher	Horn	Light
Normal	Off	On	Off	Off	Off
Alarm	On	On	On	On	Flashing
Acknowledge	On	Off	Off	Off	On
Trouble Contact Re-opens without reset	Off	On	Off	Off	Off
with reset	On	Off	Off	Off	On
Reset	Off	On	Off	Off	Off
Lamp Test	Off	On	Off	Off	On

Contacts: 10 amps, 115 Vac resistive
Coil: 115 Vac, 60 Hz
For further data: Bulletin B/5274



Use 12-pin socket type 27390 for all types shown above.

S-D **STRUTHERS-DUNN, INC.,** Pitman, N.J. 08071 • (609) 589-7500

Dry Reed

BASIC CHARACTERISTICS

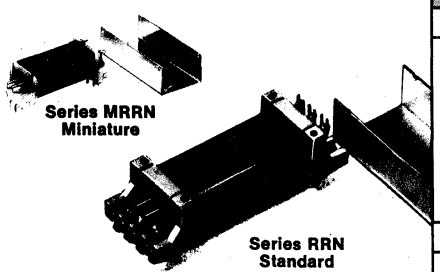
One of the first to produce dry reed relays on a production-line basis, Struthers-Dunn offers the greatest variety of package designs available. All feature contamination-proof, glass-sealed reed switches, non-critical mounting, and complete magnetic shielding for exceptionally fast low-level and light-duty switching.

Most designs are available with either miniature or standard size reed switches, in a wide selection of Form A (SPST-NO), Form B (SPST-NC), or Form C (SPDT) contact arrangements.

	MINIATURE SWITCHES			STANDARD SWITCHES		
	Form A	Form B	Form C	Form A	Form B	Form C
Maximum Ratings (1)—ac or dc resistive loads without inrush						
Volts	250	250	100	250	250	250
Amperes	0.500	0.500	0.250	1.0	1.0	0.5
Volt-Amperes	10	10	3	15	15	10
Performance Time—milliseconds, max						
Operate Time (2)	0.5—1.5	0.5—1.5	0.5—1.5	1.5—2.0	1.5—2.0	1.5—2.0
Release Time (2)	0.5—1.5	0.5—1.5	0.5—1.5	0.5—1.5	0.5—1.5	0.5—1.5
Bounce on Operate	0.5	—	0.5	0.5	—	4.0
Bounce on Release	—	0.5	2.0	—	0.5	4.0
Life Expectancy—millions of operations						
Dry circuit	200	200	50	200	200	200
Half rating	20	20	20	100	100	50
Full rating	10	10	10	20	20	20

NOTES: (1) Voltage current, & power ratings are independent maximums and no single value is to be exceeded.
(2) Operate & Release Times do not include bounce time which is shown separately.
Dielectric Strength: Miniature types, 250 volts rms. Standard types, 400 volts rms
Operating Ambient Range: −20° to +60°C. **Insulation Resistance:** 1,000 megohms, min.

OPEN TYPES FOR P/C MOUNTING



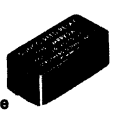
Series MRRN Miniature

Series RRN Standard

Compact inexpensive units for minimum cost applications. Coils and reed-switch capsules are protected by snap-on metal cans that also provide magnetic shielding. Reed switch leads connect to "in-line", non-magnetic printed circuit terminals. Terminal spacing: MRRN types: 0.1"; RRN types: 0.2".

TYPE	CONTACTS No. & FORM	DIMENSIONS (less terminals)	COIL RESISTANCE—Ohms dc @ 6 Vdc	@ 12 Vdc	@ 24 Vdc	PRICE 6 & 12 Volt	24 Volt
With MINIATURE Reed Switches							
MRRN1A	1A	1.125 x .406 x .375	70	300	1,100	**$3.30**	**$3.70**
MRRN2A	2A	1.125 x .535 x .375	70	300	1,100	**4.70**	**5.00**
MRRN3A	3A	1.125 x .609 x .375	50	220	850	**6.40**	**6.40**
MRRN4A	4A	1.125 x .706 x .375	40	160	640	**8.00**	**8.00**
MRRN1B	1B	1.125 x .535 x .375	70	300	1,100	**3.70**	**4.10**
MRRN2B	2B	1.125 x .609 x .375	50	220	850	**5.30**	**5.60**
MRRN1C	1C	1.125 x .406 x .375	70	300	1,100	**6.50**	**6.50**
MRRN2C	2C	1.125 x .609 x .375	50	220	850	**9.50**	**9.50**
MRRN3C	3C	1.125 x .706 x .375	40	160	640	**12.50**	**12.50**
With STANDARD SIZE Reed Switches							
RRN1A	1A	2.500 x . 740 x .641	70	250	1,000	**$3.00**	**$3.00**
RRN2A	2A	2.500 x .958 x .641	70	250	1,000	**4.60**	**4.60**
RRN3A	3A	2.500 x 1.188 x .641	50	175	750	**5.30**	**5.30**
RRN4A	4A	2.500 x 1.418 x .641	40	150	600	**7.00**	**7.00**
RRN1B	1B	2.500 x .958 x .641	70	250	1,000	**3.40**	**3.40**
RRN2B	2B	2.500 x 1.188 x .641	50	175	750	**5.20**	**5.20**
RRN1C	1C	2.500 x .740 x .641	70	750	1,000	**5.80**	**5.80**
RRN2C	2C	2.500 x 1.188 x .641	50	175	750	**8.30**	**8.30**
RRN3C	3C	2.500 x 1.418 x .641	40	150	600	**11.30**	**11.30**

PLASTIC CASE TYPES FOR P/C MOUNTING



Series MRRK Miniature

Combine the low cost of "open" relays with the mechanical protection of molded or encapsulated units. Ultrasonically welded thermoplastic case with high insulation characteristics has standoff pads near terminations to facilitate production-line soldering and easy cleaning when mounted on P/C boards. Internal magnetic shields. Terminal spacing: 0.1" grid.

With MINIATURE Reed Switches							
MRRK1A	1A	1.290 x .660 x .445	100	400	1,600	**$3.60**	**$4.00**
MRRK2A	2A	1.290 x .660 x .445	100	400	1,600	**5.20**	**5.40**
MRRK3A	3A	1.290 x .660 x .445	100	400	1,600	**7.00**	**7.00**
MRRK1A1B	1A & 1B	1.290 x .660 x .445	100	400	1,600	**5.60**	**5.60**
MRRK1B	1B	1.290 x .660 x .445	100	400	1,600	**4.00**	**4.20**
MRRK2B	2B	1.290 x .660 x .445	100	400	1,600	**5.80**	**5.80**
MRRK1C	1C	1.290 x .660 x .445	100	400	1,600	**7.00**	**7.00**
MRRK2C	2C	1.290 x .660 x .445	100	400	1,600	**10.00**	**10.00**

LOW-PROFILE EPOXY-MOLDED TYPES FOR P/C MOUNTING

Series MRRS Miniature

Standing only 0.350" high, these 1, 2, and 4-pole reeds are for use on printed-circuit boards. All are molded into rigid, homogeneous structures with internal magnetic shielding. In-line P/C terminals are on 0.172" grid spacing.

With MINIATURE Reed Switches							
MRRS1A	1A	1.300 x .500 x .350	144	576	2,300	**$4.40**	**$4.40**
MRRS2A	2A	1.300 x .625 x .350	95	380	1,440	**6.10**	**6.10**
MRRS4A	4A	1.300 x 1.00 x .350	31	125	500	**7.70**	**7.70**
MRRS1A1B	1A1B	1.300 x 1.00 x .350	31	125	500	**8.40**	**8.40**
MRRS1B	1B	1.300 x .625 x .350	95	380	1,440	**6.10**	**6.10**

Specify coil voltage when ordering.

Relays

MOLDED CASE "DIP" REEDS FOR P/C MOUNTING

Series MRR-D Special

Fully compatible with 14-terminal dual-in-line ICs, these highly sensitive relays need little or no buffering with DTL & TTL computer logic, or HNIL solid state industrial control. Terminal spacing, standard 0.1" dual-in-line grid. All are 0.750" l by 0.300" w by 0.275" h (.350" h for MRR2ADLX) above P/C board.

Max. Switch Ratings (non-inductive)

Contacts	Volts	mA	VA
Form A	100	250	10
Form C	28	250	3

Optional Features: Consult factory for price and availability of electrostatic shields (feature E), and clamping diodes (feature V).

TYPE	CONTACTS	COIL DATA						PRICE
		NOMINAL AT 25°C AMBIENT			"MUST OPERATE" AT 70°C MAX.			
		Vdc	mW	Ohms	Vdc	mA	mW	
With SPECIAL Reed Switches (see ratings at left)								
MRR1AD†	1 Form A	5	70	360	4.0	9.3	37	$3.50
MRR1ADSR	1 Form A	5	50	500	4.5*	9.8*	40*	4.50
MRR1ADS	1 Form A	5	70	360	4.0	9.3	37	3.50
MRR1ADS	1 Form A	6	100	360	4.8	11.2	54	3.50
MRR1ADS	1 Form A	12	100	1440	9.6	5.6	54	3.50
MRR1ADS	1 Form A	24	100	5760	19.2	2.8	54	3.50
MRR1CDL	1 Form C	5	250	100	4.0	33	132	7.00
MRR1CDL	1 Form C	6	290	125	4.8	32	154	7.00
MRR1CDL	1 Form C	12	290	500	9.6	16	154	7.00
MRR1CDL	1 Form C	24	290	2000	19.2	8	154	8.00
MRR2ADLX	2 Form A	5	200	125	4.0	37	108	5.50
MRR2ADLX	2 Form A	6	290	125	4.8	32	154	5.50
MRR2ADLX	2 Form A	12	290	500	9.6	16	154	5.50
MRR2ADLX	2 Form A	24	290	2000	19.2	8	154	6.50

*25°C Max. ambient
†Contact wired to pins 1-8 only

METAL CAN TYPES FOR P/C MOUNTING

Series MRR - M Miniature

Series RR - M Standard

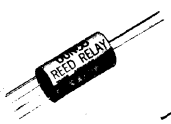
Steel cases provide magnetic shielding and complete mechanical protection. Wide selection of single and multipole contact configurations in both miniature and standard sizes. Certain standard-size switch packages also accommodate bistable magnetic latching types and flip-flop assemblies. Terminal spacing: MRR-M types: 0.1", RR-M types: 0.2".

TYPE	CONTACTS No. & FORM	DIMENSIONS (less terminals)	COIL RESISTANCE—Ohms dc @ 6 Vdc	@ 12 Vdc	@ 24 Vdc	PRICE 6 & 12 Volt	24 Volt
With MINIATURE Reed Switches							
MRR1AM	1A	1.125 x .500 x .500	144	576	2,304	$5.70	$5.70
MRR2AM	2A	1.125 x .500 x .500	72	288	1,152	6.80	6.80
MRR3AM	3A	1.125 x .500 x .500	72	288	1,152	7.90	7.90
MRR1BM	1B	1.125 x .500 x .500	144	576	2,304	5.90	5.90
MRR2BM	2B	1.125 x .500 x .500	72	288	1,152	7.00	7.00
MRR1CM	1C	1.125 x .500 x .500	144	576	2,304	10.60	10.60
MRR1A1BM	1A & 1B	1.125 x .500 x .500	72	288	1,152	7.70	7.70
MRR2A2BM	2A & 2B	1.795 x .795 x .495	40	135	800	14.30	14.30
With STANDARD SIZE Reed Switches							
RR2BM	2B	2.938 x .800 x .550	36	144	576	$7.00	$7.00
RR1CM	1C	2.938 x .600 x .550	288	1,152	4,600	12.70	12.70
RR1A1BM	1A & 1B	2.938 x .800 x .550	36	144	576	7.00	7.00
RR2A2BM	2A & 2B	2.938 x 1.200 x .550	18	72	288	12.30	12.30
RRLM1CM	1C (1)	2.938 x .600 x .550	288	1,152	4,600	11.80	11.80
RRLM1CM102	1C (2)	2.938 x .600 x .550	120	480	1,920	12.70	12.70
RRFF4A2BM	(3)	2.938 x 2.100 x .650	22 / 45	90 / 180	360 / 720	24.20	24.20

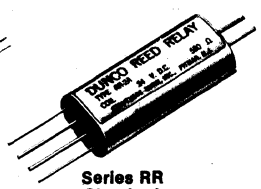
Specify coil voltage when ordering.

NOTES:
(1) Single coil, bistable, magnetic latching type. Reversing coil polarity transfers contacts.
(2) Double coil, bistable, magnetic latching type.
(3) Flip-flop logic module for 1 or 2 inputs and total of 4 Form A and 2 Form B contacts, of which 2 Form A and 1 Form B contacts are available for load handling.

EPOXY MOLDED TYPES WITH AXIAL LEADS



Series MRR Miniature



Series RR Standard

Reed switches, coils, and axial terminal leads are rigidly epoxy-molded into one-piece units that provide maximum mechanical protection. Leads may be soldered directly to terminal studs or supporting wiring—or bent at right angles for printed-circuit use. Wrap-around metal cans provide magnetic shielding. Terminal grid spacing: MRR types: 0.115", RR types: 0.2".

With MINIATURE Reed Switches							
MRR1A	1A	1.062 x .425 dia.	288	1,152	4,600	$4.20	$6.20
MRR2A	2A	1.062 x .430 x .515	144	576	2,300	6.20	7.70
MRR4A	4A	1.062 x .535 x .810	72	288	1,152	10.60	10.60
MRR12A	12A	1.062 x .635 x 1.805	24	94	384	27.30	27.30
With STANDARD SIZE Reed Switches							
RR1A	1A	1.875 x .655 dia.	90	360	1,440	$3.20	$3.20
RR2A	2A	1.875 x .670 x .840	36	145	580	5.00	5.00
RR4AF	4A	1.875 x .810 x 1.385	24	95	380	8.60	8.60
RR1B	1B	1.875 x .655 dia.	90	360	1,440	4.10	4.10

Specify coil voltage when ordering.

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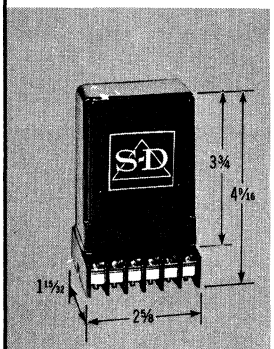
Solid State and Hybrid



SS96BXB and 27390 Socket

100% SOLID STATE RELAYS—total input/output isolation

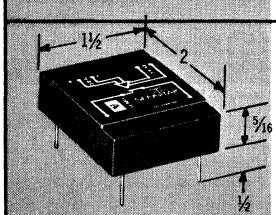
Model SS96* solid state relays offer almost unlimited life in difficult industrial applications such as the high inrush loads of solenoid valves. They may be intermixed with electro-mechanical relays. Contacts handle 1 amp continuously, 25 amps inrush, 6 to 240 Vac rms. Opto-isolated inputs and continuously gated transformer-coupled triac outputs assure total input/output isolation.

90 to 132 Vac 50/60 Hz primary voltage must be applied continuously in addition to the external 120 Vac control signal. Contacts continue to carry load with voltage at 65 Vac min. These general-purpose relays may be connected for latching by using one NO relay contact. However, "memory" is lost if power fails.

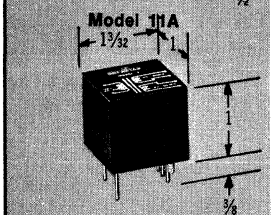
Relays have plastic covers, 12-pin industrial-grade plugs.

*Patent protected

Model	Contacts	Price
SS96BXB	2 NO + 2 NC	$42.50
SS96DXX	4 NO	42.50
27390	Socket	2.50



Model 11A



Model 13 Power Supply

DC METERING RELAYS—Under and Over Voltage Sensing

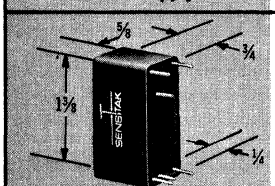
Models 11 & 12: Used for precise monitoring of dc voltages and currents. Standard units operate at 1 volt and/or 1 mA dc. Add series resistors for higher voltages and parallel resistors for higher currents. Require 8 Vac primary power, 50 to 400 Hz. Model 13 primary power supply has 120 Vac primary and two isolated 8 Vac secondary windings for powering two model 11's or 12's.

Model 11's are latching types reset by removing primary ac power. Model 12's are ON-OFF types, operating and releasing according to dc signal with approximately 1% differential.

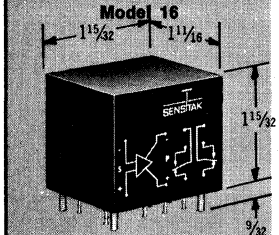
Load contacts on all models are single pole, Form A dry reed switches rated 10 watts maximum at 250 volts maximum or 500 mA maximum non-inductive.

Further Data: 1973 Relay Catalog

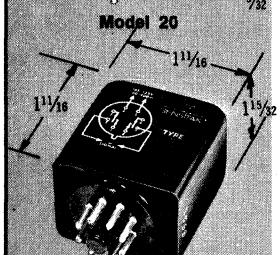
Model	Function	Price
11A	Overvoltage Latching	$18.10
11B	Undervoltage Latching	19.80
12A	Overvoltage On-Off	18.10
12B	Undervoltage On-Off	19.80
13	Transformer 120 V to 8 V, 50 to 400 Hz.	12.50



Model 16



Model 20



Model 22 (11-Pin Tube style base)

DC SENSITIVE RELAYS—Ultra Sensitive, 50 µA & Micro Sensitive, 1 µA

Models 16, 20 & 22: Highly sensitive, low power ON-OFF relays operating from low level dc signals. All models also require dc primary power supply as indicated in tabulation below.

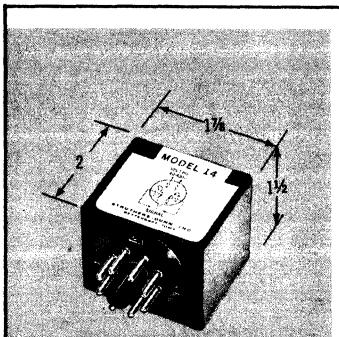
Models 16 and S16 have two Form A dry reed load contacts rated 10 watts at 250 volts maximum or 500 mA maximum non-inductive. Models 20 and 22 have DPDT relay load contacts rated 5 amps at 120 Vac non-inductive. Latching load contacts are available on special order.

Model 22 relays are mounted on 11 pin octal style plugs. All others have solder terminals.

Further Data: 1973 Relay Catalog

Model	D C Signals			Add'l Res. Ohm/Volt	CONTACTS	Primary Voltage dc	Price
	Nominal		Max. Voltage				
	Volts	µA					
16AA1	+0.7	50	+7	10K	DPST 10W	6	$ 8.60
16AA2						12	8.60
16AA3						24	9.20
S16AA1	+1.4	1	+35	10K	DPST 10W	6	8.80
S16AA2						12	8.80
S16AA3						24	9.40
20-2	+0.7	1	+35	1K	DPDT 5A	12	10.90
20-3						24	10.90
22-2						12	10.90
22-3						24	10.90

Relays and Timers



Model 15

AC NULL SENSING RELAYS—Servo/Differential Controls

Models 14 & 15: Useful in ac bridge networks and with LVDT's to sense and monitor unbalanced conditions. AC primary power supply and ac signal system must be same source since phase relation between primary voltage and signal voltage determines level and direction of unbalance.

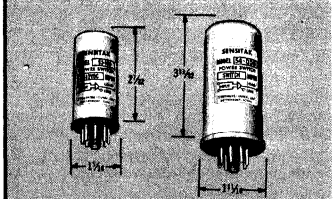
Models 14 and 15 differ only in input impedances and signal levels. Primary power is 120 Vac, 50 to 400 Hz. Pull-in vs. dropout differential of signal voltage is approximately 10%.

Load contacts for each direction of unbalance are single pole, Form A dry reed switches rated 10 watts maximum at 250 volts maximum or 500 mA maximum.

Further Data: 1973 Relay Catalog

Model	Input Impedance (Ohms)	Min. Signal RMS Millivolts	Max. Signal RMS Volts	Price
14	200K	500	25*	$24.00
15	20K	5	10	35.00

*Maximum signal level may be increased to 150 volts by external current limiting resistance in series with terminal #7 at values of 100 ohms per volt.



Model 53 Model 54

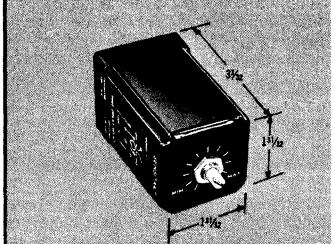
AC POWER SWITCHES

Models 53 & 54 use triacs with high inrush capabilities to control ac loads, 18 to 240 Vac. Triacs may be fired by external contact closure or dc signals as indicated below. All models are enclosed in metal enclosures and mounted on octal plugs.

Further Data: 1973 Relay Catalog

Model	Control Signal		Current Ratings Amps			Price
	Type	Voltage	*Continuous	50% Duty	10 mS Peak	
53-000	Contact	—	3	5	20	$ 9.90
53-101	DC	10-28	3	5	20	11.00
54-000	Contact	—	10	15	60	15.40
54-101	DC	10-28	10	15	60	16.50

*Load energized for 10 minutes or more.



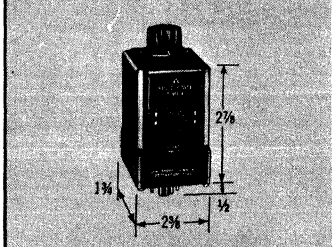
Model 41

ADJUSTABLE TIME DELAY RELAYS

Models 41-45 have adjustable solid state delays designed specifically for industrial service to withstand 8 mS transients of twice rated voltage. Built-in DPDT relay load contacts are rated 10 amps, 1/6 hp at 120 Vac; 5 amps, 1/3 hp at 240 Vac. Timing remains stable over a ±10% nominal voltage change.

Operating Characteristics	Model 41	Models 42-45
Repeat accuracy at 25°C and constant voltage*	±5%	±2%
Operating ambient temperature	0 to +50°C	−10 to +55°C
Time between fully timed cycles to assure repeat accuracy	100 mS	100 mS
Time after interrupted cycle to assure repeat accuracy	200 mS	100 mS

*NOTE: Load contacts may transfer momentarily if power supply is interrupted during timing period.



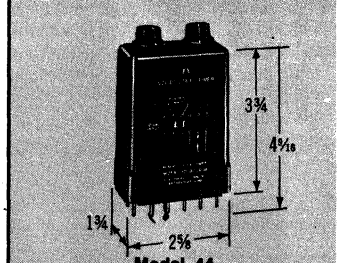
Model 42

DELAY ON "OPERATE"
Control voltage energizes output relay after preset delay. Octal plug.

DELAY ON "RELEASE"
Closing pilot switch energizes output relay. Next switch opening starts timing; relay de-energizes upon timeout. Requires continuous primary voltage. 11-pin tube base plug.

MONITOR TIMER
Momentary operation of pilot switch energizes output relay. Switch must cycle open and closed at least once during preset timing period or relay de-energizes. Requires continuous primary voltage. 11-pin tube base plug.

REPEAT CYCLE TIMER
After pilot switch closes, output relay cycles according to separate preset ON and OFF delays. When switch opens, cycle stops after OFF delay. Requires continuous primary voltage. 12-pin plug fits S-D type 27390 socket (**Socket Price** $2.50).



Model 44

Model	Delay Seconds	Supply Voltage		Price	
		50/60 Hz ac	dc	ac	dc
DELAY ON OPERATE					
41-002	0.2-2	24,120	24,48	$19.80	$19.80
41-020	2.0-20	24,120	24,48	19.80	19.80
41-200	20.0-200	24,120	24,48	22.00	22.00
45-010	0.1-10	24,120		19.50	
45-060	0.6-60	24,120		19.50	
45-180	1.8-180	24,120		19.50	
DELAY ON RELEASE					
42-010	0.1-10	24,120	24,48	23.50	21.50
42-060	0.6-60	24,120	24,48	23.50	21.50
42-180	1.8-180	24,120	24,48	23.50	21.50
MONITOR TIMERS					
43-010	0.1-10	24,120	24,48	29.50	28.50
43-060	0.6-60	24,120	24,48	29.50	28.50
43-180	1.8-180	24,120	24,48	29.50	28.50
REPEAT CYCLE TIMERS					
44-010	0.1-10	120		59.50	
44-060	0.6-60	120		59.50	
44-180	1.8-180	120		59.50	

Always specify supply voltage and frequency

STRUTHERS-DUNN, INC., Pitman, N.J. 08071 • (609) 589-7500

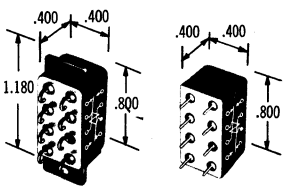
Hermetically Sealed

Specifically designed to withstand the adverse operating environments of aircraft, missile, undersea, and ground-support equipment, the broad S-D military line paces the state of the art in reliability of miniature relays. They are produced in spotlessly clean "white rooms" under rigidly controlled conditions. Flexible, bifurcated contacts are used in most types to assure dependable operation under high shock and vibration. A qualified in-plant testing laboratory, approved by NASA, the Air Force, Army and Navy, assures compliance with applicable MIL specifications.

Typical Specifications

Shock: 25 to 50G for 9 to 11 msec. **Vibration:** 10 to 20G, 1500 to 2000 cps. **Operate Time:** 10 to 20 msec. max. **Release Time:** dc types 5 to 20 msec. max.; ac types 50 msec. max.

HALF-SIZE CRYSTAL CAN RELAYS



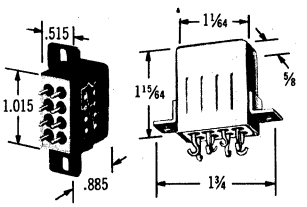
FC-1 FC-1P

FC-1 Series features all-welded internal construction and gold plated DPDT contacts rated low level to 2 amps. "MV" models are individually miss-tested for 5,000 operations to insure reliable low level switching.

FCL-1 Series are energy-saving magnetic latching relays that provide bi-stable operation for logic functions. Physically identical to FC-1 relays, they operate on a pulse of 2 milliwatt-seconds.

Sockets for plug-in types are commercially available.

TWO POLE POWER RELAYS



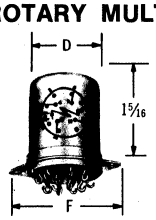
FC-210 & 210P FC-215 & 215P

FC-210 Series are ruggedly constructed power relays with DPDT contacts conservatively rated for resistive loads to 10 amps. All welded internal construction and balanced rotary armatures give high resistance to shock and vibration. Choice of solder or plug-in terminals.

FC-215 Series are similar to FC-210 in rating, but more powerful and in a slightly larger can. Solder hook or plug-in terminals.

Sockets for plug-in types are commercially available.

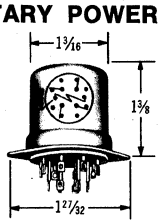
ROTARY MULTIPOLE RELAYS—to MIL-R-5757



FC-4-250 four pole, and FC-6-250 six pole, are cylindrical control relays with 2-amp double-throw contacts. Balanced rotary armatures; solder hook and plug-in terminals.

FC-4-250 D-1 3/4, F-1 21/32
FC-6-250 D-1 3/16, F-1 7/8

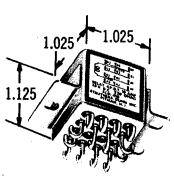
ROTARY POWER RELAY



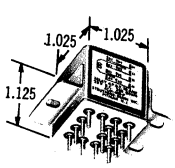
FC-410 packs 10-amp 4PDT contacts in a can only slightly larger than 2-amp cylindrical types. Spaded and pierced tab terminals can be soldered directly or used for plug-in applications with sockets available from various manufacturers.

COMPACT 4-POLE AIR FRAME RELAYS—to MIL-R-6106

Series FCM-410 is one of the smallest relays with 10-amp, 4PDT contacts. An efficient double-coil magnet assembly combines low operating power with high resistance to shock and vibration. Available with solder hook or plug-in terminals.

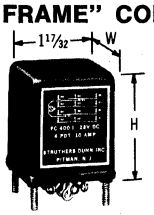


FCM-410

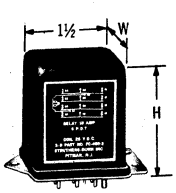


FCM-410P

"AIR FRAME" CONTROL & POWER RELAYS—to MIL-R-5757 and 6106



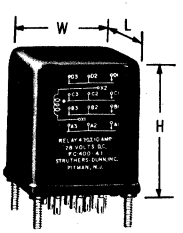
	W	H
FC-400-1 & 2 FC-400-60, 61, 62 FC-406-1 & 2 FC-406-60, 61, 62	1 17/32	1 13/16
FC-402-1 & 2 FC-404-1 & 2 FC-404-60, 61, 62	1 7/64 1 1/8 1 1/8	1 25/32 1 3/4 1 3/4

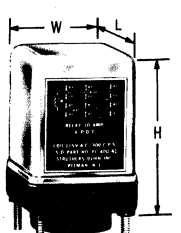


	W	H
FC-400-3 & 4 FC-406-3 & 4	1 17/32	1 13/16
FC-404-3 & 4	1 1/32	1 13/16

Series FC-400, FC-402, FC-404, and FC-406 form a complete line of two, four and six-pole relays for 28 Vdc or 115 V, 400 Hz operation. Contact ratings range from 3 to 10 amps. Three basic sizes accommodate a variety of terminal and mounting options.

Series FCL-400 are energy-saving magnetic latching versions of the FC-400 that trip on a pulse of less than 35 milliwatt seconds at the guaranteed operating level of 18 Vdc.





	W	L	H
FC-400-41	1 17/32	1 17/32	2 1/4
FC-404-41	1 1/8	1 1/2	1 3/4

	W	L	H
FC-400-42	1 17/32	1 17/32	2 21/32
FC-400-48 & 49	1 17/32	1 17/32	2 5/16
FC-404-42	1 1/8	1 1/2	2 3/16
FC-404-48 & 49	1 1/8	1 17/32	2 3/16
FC-406-42	1 1/2	1 1/2	2 1/8
FC-406-48 & 49	1 17/32	1 17/32	2 3/16

Aerospace & Military Relays

RELAYS LISTED BY GOVERNMENT PART NUMBERS

GOVERNMENT PART NUMBER	S-D TYPE	CONTACTS # DT POLES	CONTACTS AMP RATING	COIL VOLTAGE	TERMINAL TYPE‡	WEIGHT (oz.)	PRICE
Relays Designed to MSFC-339							
S2GP-7.25-71	**FC-1-182W**	2	2	26.5 DC	H	0.35	**$23.00**
S2GP-7.25-73	**FC-1-181W**	2	2	26.5 DC	P	0.35	**23.00**
S2GP-7.25-74	**FC-1-303W**	2	2	26.5 DC	P	0.35	**23.00**
Relays Designed to MIL-R-5757							
M5757/1-013	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**$25.00**
M5757/1-014	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**25.00**
M5757/1-015	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**25.00**
M5757/1-019	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**25.00**
M5757/1-020	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**25.00**
M5757/1-021	**FC-6-495**	6	0.100	26.5 DC	H	3.5	**25.00**
M5757/1-103	**FC-6-250**	6	2	26.5 DC	H	3.5	**25.00**
M5757/9-002	**FC-1-350**	2	†	26.5 DC	H	0.35	**21.50**
M5757/9-004	**FC-1-550**	2	†	26.5 DC	P	0.35	**21.50**
M5757/15-001	**FC-404-60**	4	5*	28 DC	H	4.8	**22.50**
M5757/15-003	**FC-404-61**	4	5*	115/400 Hz	H	5.1	**29.50**
M5757/15-005	**FC-404-62**	4	5	115/60 Hz	H	5.1	**29.50**
M5757/16-001	**FC-406-60**	6	5*	28 DC	H	5.6	**26.50**
M5757/16-003	**FC-406-61**	6	5*	115/400 Hz	H	5.9	**36.00**
M5757/16-005	**FC-406-62**	6	5*	115/60 Hz	H	5.9	**36.00**
M5757/18-001	**FC-400-60**	4	10*	28 DC	H	7.2	**23.50**
M5757/18-003	**FC-400-61**	4	10*	115/400 Hz	H	7.2	**31.00**
M5757/18-005	**FC-400-62**	4	10*	115/60 Hz	H	7.2	**31.00**
M5757/23-001	**FC-215-350**	2	10	26.5 DC	H	2.0	**19.50**
M5757/23-002	**FC-215-550**	2	10	28 DC	H	2.0	**19.50**
M5757/23-003	**FC-215-650**	2	10	28 DC	P	2.0	**19.50**
M5757/23-004	**FC-215-750**	2	10	28 DC	P	2.0	**19.50**
M5757/23-005	**FC-215-850**	2	10	28 DC	P	2.0	**19.50**
M5757/28-001	**FC-215-450**	2	10	26.5 DC	H	2.0	**20.50**
RY4LB3B3L01	**FC-4-250**	4	2	26.5 DC	H	3.0	**23.50**
Relays Designed to MIL-R-6106							
MS25627-D1	**FC-404-1**	4	5	28 DC	H	5.1	**$23.50**
MS25267-A1	**FC-404-2**	4	5	115/400 Hz	H	5.1	**29.50**
MS25268-D1	**FC-404-48**	4	5*	28 DC	W	9.1	**31.00**
MS25268-A1	**FC-404-49**	4	5	115/400 Hz	W	9.1	**38.00**
MS25269-D1	**FC-406-1**	6	5	28 DC	H	6.0	**26.50**
MS25269-A1	**FC-406-2**	6	5	115/400 Hz	H	6.0	**36.00**
MS25270-D1	**FC-406-48**	6	3	28 DC	W	10.7	**37.00**
MS25270-A1	**FC-406-49**	6	3	115/400 Hz	W	10.7	**47.00**
MS25271-D1	**FC-400-1**	4	10	28 DC	H	6.0	**23.50**
MS25271-A1	**FC-400-2**	4	10	115/400 Hz	H	6.0	**31.00**
MS25272-D1	**FC-400-48**	4	10	28 DC	W	12.3	**32.00**
MS25272-A1	**FC-400-49**	4	10	115/400 Hz	W	12.3	**39.50**
MS25273-D1	**FC-402-1**	2	10	28 DC	H	4.8	**20.00**
MS25273-A1	**FC-402-2**	2	10	115/400 Hz	H	5.1	**27.00**
MS25323-D2	**FC-402-3**	2	10	28 DC	P	4.5	**21.00**
MS25323-A2	**FC-402-4**	2	10	115/400 Hz	P	4.8	**28.50**
MS25325-D1	**FC-404-3**	4	5	28 DC	P	4.5	**23.50**
MS25325-A1	**FC-404-4**	4	5	115/400 Hz	P	4.8	**31.00**
MS25327-D1	**FC-400-3**	4	10	28 DC	P	6.0	**26.50**
MS25327-A1	**FC-400-4**	4	10	115/400 Hz	P	6.0	**33.00**
MS25329-D1	**FC-406-3**	6	5	28 DC	P	6.0	**28.00**
MS25329-A1	**FC-406-4**	6	5	115/400 Hz	P	6.0	**34.50**
MS25917-1	**FC-404-41**	4	3	28 DC	S	4.0	**25.50**
MS25917-2	**FC-404-42**	4	3	28 DC	W	8.0	**31.00**
MS25918-2	**FC-406-42**	6	3	28 DC	W	9.6	**37.00**
MS25919-1	**FC-400-41**	4	10	28 DC	S	8.0	**28.00**
MS25919-2	**FC-400-42**	4	10	28 DC	W	12.8	**32.00**
MS27245-1	**FC-210-12**	2	10	28 DC	H	1.3	**19.50**
MS27245-2	**FC-210-16**	2	10	28 DC	W	3.7	**23.00**
MS27247	**FC-210-13**	2	10	28 DC	P	1.3	**19.50**
MS27709-1	**FCM-410-1**	4	10	28 DC	H	3.2	**34.00**
MS27709-2	**FCM-410-3**	4	10	28 DC	P	3.2	**34.00**

STANDARD STRUTHERS-DUNN TYPES NOT LISTED BY GOVERNMENT PART NUMBERS

RELAY TYPE	DESIGNED TO GOV'T. SPEC.	CONTACTS # DT POLES	CONTACTS AMP RATING	COIL VOLTAGE	TERMINAL‡ TYPE	WT. (oz.)	PRICE
FC-1	MIL-R-5757	2	2	26.5 DC	H	0.3	**$20.50**
FC-1-P	MIL-R-5757	2	2	26.5 DC	P	0.3	**20.50**
FC-1-MV	MIL-R-5757	2	2	26.5 DC	H	0.3	**20.50**
FC-1-PMV	MIL-R-5757	2	2	26.5 DC	P	0.3	**20.50**
FCL-1	MIL-R-5757	2	2	28 DC	H	0.35	**26.00**
FCL-1-P	MIL-R-5757	2	2	28 DC	P	0.35	**26.00**
FC-210	MIL-R-5757	2	10	26.5 DC	H	1.8	**18.00**
FC-210-P	MIL-R-5757	2	10	26.5 DC	P	1.8	**18.00**
FC-215	MIL-R-5757	2	10	26.5 DC	H	2.0	**18.00**
FC-215-P	MIL-R-5757	2	10	26.5 DC	P	2.0	**18.00**
FCL-400-1	MIL-R-6106	4	10	28 DC	H	7.0	**29.00**
FCL-400-2	MIL-R-6106	4	10	115/400 Hz	H	7.0	**36.50**
FCL-400-3	MIL-R-6106	4	10	**	H	7.0	**36.50**
FC-410	MIL-R-5757	4	10	26.5 DC	L	3.5	**27.50**
FCM-410	MIL-R-6106	4	10	28 DC	H	3.2	**31.00**
FCM-410-P	MIL-R-6106	4	10	28 DC	P	3.2	**31.00**

Contacts: All contacts are double-throw. Most ratings are in maximum amps for non-inductive loads at 28 VDC or 115 VAC, 400 Hz except:
† 0.1 amp, 50 mv DC
* Inductive and resistive ratings

Ambient Temperature Ranges
MIL-R-5757 Types: –65° to 125° C
MIL-R-6106 Types: –70° to 120° C

** **Two-Coil Magnetic Latching Type:** Contacts transfer on alternate pulses to 28 VDC or 115 VAC, 400 Hz coils.

AC Coils: All relays for 115 VAC, 400 Hz operation include self-contained rectifier.

‡**Terminal Designations:**
H = hook type for soldering
L = pierced lugs for soldering
P = pins for plug-in mounting
S = solder pot terminals
W = stranded wire leads in potted header

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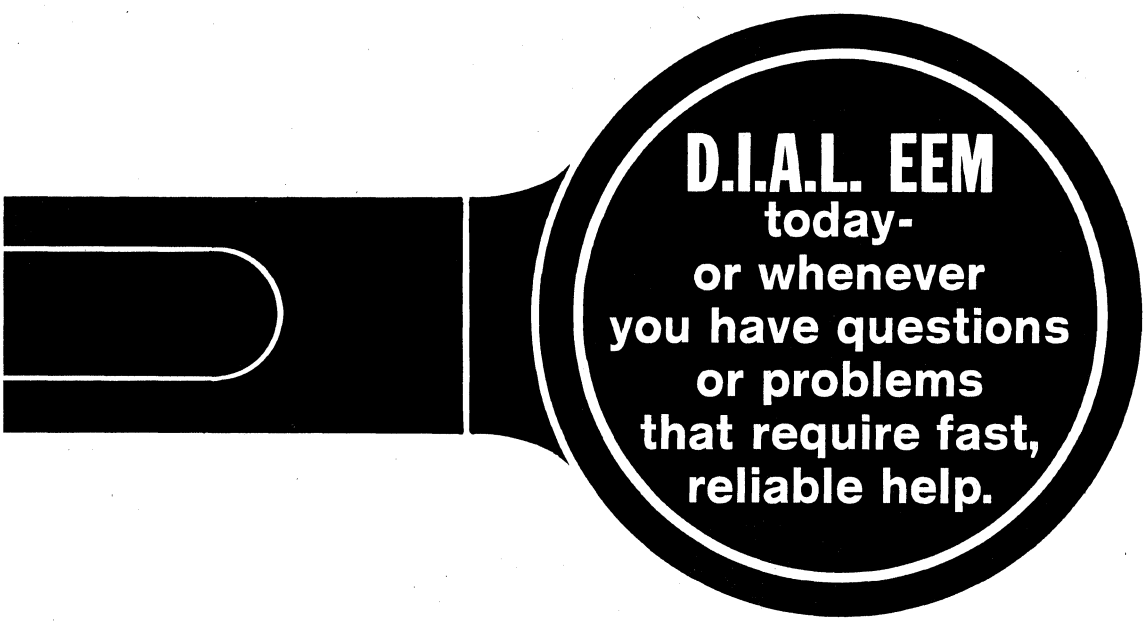

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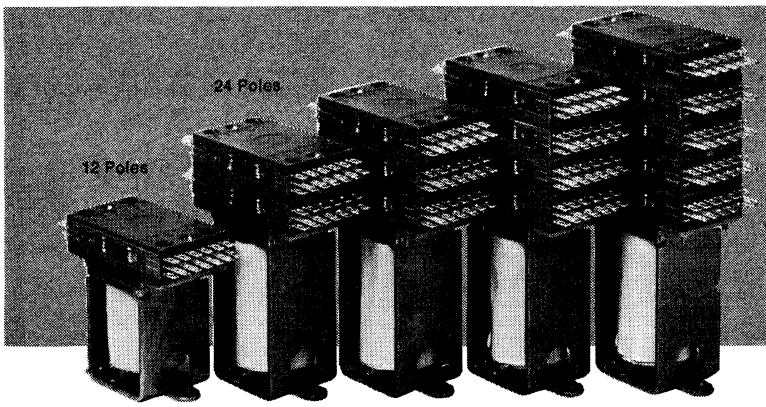
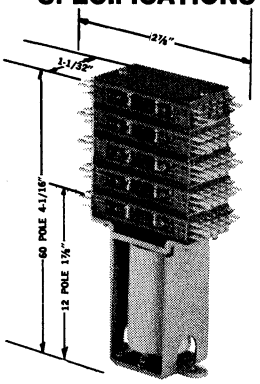


T•bar® RELAYS for Multipole High Density Switching

Switch from 4 to 60 circuits with only one T-Bar Relay. Available in configurations of 4, 8, 12, 24, 36, 48 and 52 poles with "A" or "C" contacts and 60 poles with "A" form contacts. For low level applications specify the 901 Series. For general purpose applications specify the 801 Series.

SPECIFICATIONS

36 Poles | 48 Poles | 52 Poles or 60 Poles Single Throw



Contacts: Series 800—general purpose gold plated
Series 900—low-level bifurcated gold plated

Contact Rating: Series 800—5 amps max. resistive to 150 watts
Series 900—1 amp max. resistive to 50 watts

Life Expectancy: at 20 CPM Series 800—30,000,000 mechanical (latching limited to 1,000,000) 20,000,000 @ 100 mw 100,000 @ 5 amps 28 VDC
Series 900—30,000,000 mechanical 20,000,000 @ 100 mw 100,000 @ 1 amp at 28 VDC

Contact Resistance: 20 milliohms typical

Ambient Temperatures: —55° to plus 85°C

Terminals: Mate with T-Bar Connectors

Dielectric Strength: 1000 VRMS @ 60 cycles/sec. (higher available)

Insulation Resistance: 5000 megohms min. (higher available)

Power @ 25°C:

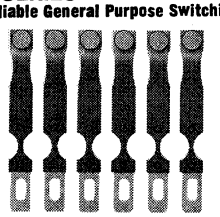
Poles	Form	Watts
4, 8 or 12	A, B or C	3
24	A, B or C	3.4
36	A, B or C	5.2
48	A	5.2
48	B or C	6.5
52	A, B or C	6.5
60	A	6.5
4, 8 or 12	D	3.4
24	D	5.2
36	D	6.5

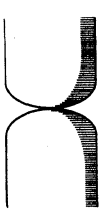
NOTE: On all latching standard pulse coil power is 6 watts, except on bifilar coils, which is 10 watts.

Operate and Release Time Typical (at nominal voltage 25°C):
Operate (Refer to factory for faster operation):
4, 8 or 12 poles: 15 MS max.
24 poles: 25 MS max.
36 poles: 30 MX max.
48 poles: 35 MX max.
52 or 60 poles: 45 MS max.
For latching types: latch and unlatch times are 15 MS typical, all sizes.
Release: 5 MS typical
Contact Bounce:
2 MS typical N.O. contacts
6 MS typical N.C. contacts
4 MS typical for latching units (both ways)

Take your choice of 2 contacts!

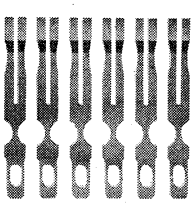
800 SERIES
for reliable General Purpose Switching

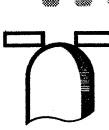




The 800 Series contact is a highly reliable gold-plated button contact. With its high contact pressure and positive wiping action, it is used in control type applications and in general purpose switching, such as relays, valves, lamps, etc. Contact Rating: up to 5 AMPS max.

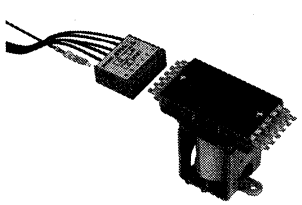
900 SERIES
for reliable Low Level Switching



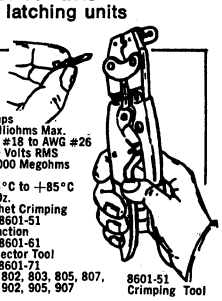


The 900 Series DATA-RITE™ contact has the reliability of a bifurcated contact with the added feature of two degrees of wiping action. The unique EDGE-TO-DOME contact guarantees a clean surface, which is critical for low level signals. The 900 Series is typically used in computer I/O signals; voice and data-grade communications; thermocouple and strain gauge outputs; all low level switching, whenever reliability is a premium, or whenever slight variations in contact resistance cannot be tolerated. Contact Rating: Microvolts up to 1 AMP max.

T-BAR CONNECTORS



The T-Bar Series 88601 Connector has been specifically designed for use with T-Bar switches and relays. The connector contacts are crimp type which are snapped into a plastic insulator block. After installation, connectors are held in place against shock and vibration by use of a retaining clip.



Current Carrying Capacity	5 Amps
Contact Resistance	5 Milliohms Max.
Wire Accommodated	AWG #18 to AWG #26
Dielectric Strength	1000 Volts RMS
Insulation Resistance	100,000 Megohms Min.
Ambient Temperature	—55°C to +85°C
Weight	0.3 Oz.
Recommended Tools	Ratchet Crimping P/N 8601-51 Extraction P/N 8601-61 Connector Tool P/N 8601-71
Use 88601 With	801, 802, 803, 805, 807, 901, 902, 905, 907

8601-51 Crimping Tool

HOW TO ORDER

1. Specify Series **2.** Specify Number of Poles and Contact Form **3.** If A Relay, Specify Coil Voltage

Don't forget to order the mating T-Bar Series 88601 Connector! One for each 6 poles.

901 — 12 C — 24

SERIES	Application	No. of Poles	Contact Forms*	Latching or Non-Latching	Coil Voltage
801	Gen. Purpose	4 to 52 60 Pole Unit "A" Form Only	"A" or "C"	Non-Latching	6, 12, 24, 28, 48, 110 VDC 115 VAC
901	Low Level				
805	Gen. Purpose	4 to 24	"C"	Latching	6, 12, 24, 28, 48, 110 VDC
905	Low Level				
807	Gen. Purpose	36 to 52			
907	Low Level				

*Form "A"—normally open contacts. Form "B"—normally closed contacts. Form "C"—double throw, break-before-make.

T-Bar INCORPORATED SWITCHING TECHNOLOGY

Manufactured under 1 or more of the following patents: 3206990, 3226508, 3689856.
®"T-Bar"—Reg. T.M.

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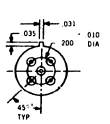
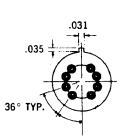
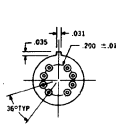
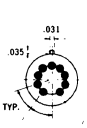
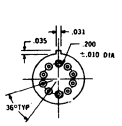
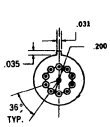
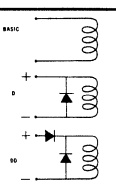
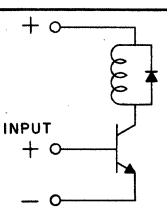
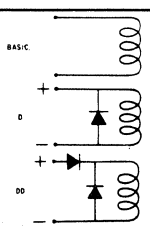
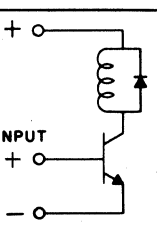
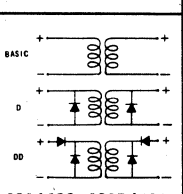
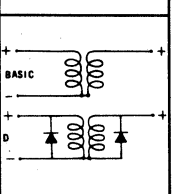
TELEDYNE TRANSISTOR CASE RELAYS

- ALL WELDED CONSTRUCTION
- TO-5 TRANSISTOR TYPE ENCLOSURE
- CONTACTS — GOLD PLATED FOR DRY CIRCUIT REQUIREMENTS
- HERMETICALLY SEALED
- EXCELLENT FOR HIGH ISOLATION AND RF SWITCHING
- CAPABLE OF WITHSTANDING HIGH SHOCK AND VIBRATION

- INSULATION RESISTANCE: 10,000 megohms min. between mutually insulated terminals
- TERMINAL STRENGTH: Each terminal will withstand a 1 lb. pull in any direction
- TEMPERATURE RANGE: −65°C to +125°C (200°C units available)
- ENCLOSURE: All welded - Hermetically sealed
- APPLICABLE SPECIFICATION: Meets or exceeds MIL-R-5757 & MIL-R-39016
- RATED DUTY: Continuous
- CONTACT RESISTANCE: 0.1 ohm max before life 0.2 ohm max after life at max rated current

	411 411D 411DD SPDT	411T SPDT	412 412D 412DD DPDT	412T DPDT	MAG-LATCH 420/422, 420D/422D, 4200DD/422DD	MAG-LATCH 421/421D / 424A 421DD / 424AD SPDT / 4PST
CONTACT RATING (OPERATIONS)	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^5 at 0.5 amp
CONTACT BOUNCE	1.5 MS Max.	1.5 MS Max.	1.5 MS Max.	1.5 MS Max.	2.0 MS Max.	0.5 MS Max.
OPERATE POWER (TURN ON) @ 25°C	100 MW	130 MW	130 MW	130 MW	100 MW	100 MW
OPERATE TIME	2.0 MS Max.	2 MS Max.	2.0 MS Max.	2.0 MS Max.	1.5 MS Max.	1.5 MS Max.
RELEASE TIME @ 25°C	411 - 1.5 MS Max. 411D - 4.0 MS Max. 411DD - 4.0 MS Max.	4.0 MS Max.	412 - 1.5 MS Max. 412D - 4 MS 412DD - 4 MS	7.5 MS Max.	—	—
OVERLOAD	2 Amp at 28 V DC	2 Amp at 28 V DC	2 Amp at 28 V DC	2 Amp at 28 V DC	2 Amp at 28 V DC	1 Amp at 28 V DC
VIBRATION	30 G's to 3,000 cps.	30 G's to 3,000 cps.	30 G's to 3,000 cps.	30 G's to 3,000 cps.	30 G's to 3,000 cps.	50 G's to 3,000 cps.
SHOCK	80 G's - 11 MS	80 G's - 11 MS	80 G's - 11 MS	80 G's - 11 MS	100 G's - 11 MS	150 G's - 11 MS
DIELECTRIC STRENGTH	500 V RMS 300 V RMS at 1.3" Hg	500 V RMS 125 V RMS at 1.3" Hg	500 V RMS 125 V RMS at 1.3" Hg	500 V RMS 125 V RMS at 1.3" Hg	500 V RMS 125 V RMS at 1.3" Hg	500 V RMS 125 V RMS at 1.3" Hg
NOM. COIL DATA (VDC)	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5
COIL RESISTANCE OHMS ±10% @ 25°C	411 & 411D - 63, 125, 280, 500 1130, 2000 411DD - 50, 98, 280, 500, 1130, 2000	63, 125, 280, 500, 1130, 2000	412 & 412D - 50, 98, 220, 390, 880, 1560 412DD - 39, 78, 220, 390, 880, 1560	50, 98, 220, 390, 880, 1560	420/422 & 420D/ 422D - 61, 120, 280, 500, 1130, 2000 420DD/422DD - 48, 97, 280, 500, 1130, 2000	61, 120, 280, 500, 1130, 2000
H (HEIGHT OF CAN)	.265 Max.	.265 Max.	.265 Max.	.265 Max.	.275 Max.	.275 max. / .325 Max.
NUMBER OF LEADS (.017 dia.)	5 Leads	8 Leads	8 Leads	9 Leads	420 - 9 Leads 422 - 10 Leads	421 - 7 Leads 424A - 11 Leads
LEAD LOCATION (VIEWED FROM TERMINAL SIDE)						
COIL SCHEMATIC	 **411, 411D 411DD SPDT**	 **411T SPDT**	 **412, 412D 412DD, DPDT**	 **412T, DPDT**	 **420/422, 420D/422D 420DD/422DD MAG-LATCH DPDT 422 SHOWN**	 **424A 424AD MAG-LATCH 4PST**

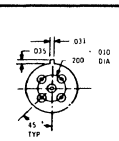
TELEDYNE RELAYS
3155 WEST EL SEGUNDO BLVD.
HAWTHORNE, CALIF. 90250
TELEPHONE (213) 679-2205
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

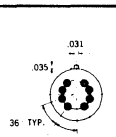
Teledyne is currently providing for space flight applications Screened Relays which meet or exceed the following NASA Screening Specifications:

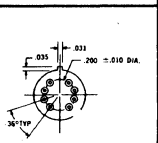
- Marshall Space Flight Center
  MSFC — 339A / MSFC — 40M37496
- Goddard Space Flight Center
  GSFC — S311-P-2(06)
- Jet Propulsion Laboratory
  JPL — ZZP — 2073

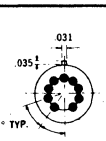
TELEDYNE TRANSISTOR CASE RELAYS

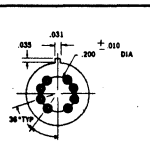
431 431D 431DD SENSITIVE SPDT	431T SENSITIVE SPDT	432 432D 432DD SENSITIVE DPDT	432T SENSITIVE DPDT	712 712D INDUSTRIAL DPDT	712TN INDUSTRIAL DPDT / 732TN SENSITIVE INDUSTRIAL DPDT	732 732D SENSITIVE INDUSTRIAL/ DPDT
10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp	10^7 at low level 10^6 at 0.5 amp 10^5 at 1.0 amp
1.5 MS Max.	1.5 MS Max.	1.5 MS Max.	1.5 MS Max.	—	—	—
40 MW	40 MW	60 MW	60 MW	185 MW	.2 to 1.0 MW / .1 to 0.5 MW	90 MW
431 - 3.5 MS Max. 431D/431DD 4.0 MS Max.	4 MS Max.	4.0 MS Max.	4.0 MS Max.	4.0 MS Max.	4.0 MS Max. / 6.0 MS Max.	6.0 MS Max.
431 - 2.0 MS Max. 431D/431DD - 7.5 MS Max.	7.5 MS Max.	432 - 2 MS Max. 432D/432DD 7.5 MS Max.	7.5 MS Max.	712 - 3 MS Max. 712D - 6 MS Max.	6.0 MS Max. / 7.5 MS Max.	732- 3 MS Max. 732D - 7.5 MS Max.
2 amp at 28 V DC	2 amp at 28 V DC	2 amp at 28 V DC	2 amp at 28 V DC	2 amp at 28 V DC	2 amp at 28 V DC	2 amp at 28 V DC
30 G's to 3000 cps.	30 G's to 3000 cps.	30 G's to 3000 cps.	30 G's to 3000 cps.	10 G's to 500 cps.	10 G's to 500 cps.	10 G's to 500 cps.
80 G's to 11 MS	80 G's to 11 MS	80 G's to 11 MS	80 G's to 11 MS	30 G's to 11 MS	30 G's	30 G's
500 V RMS 350 V RMS 300 V RMS at 1.3" Hg	500 V RMS 350 V RMS 125 V RMS at 1.3" Hg	500 V RMS 350 V RMS NC - NO 125 V RMS at 1.3" Hg	500 V RMS 350 V RMS NC - NO 125 V RMS at 1.3" Hg	350 V RMS	350 V RMS / 250 V RMS	250 V RMS
5, 6, 9, 12, 18, 26.5, 32, 40	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5, 36, 48	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5	5, 6, 9, 12, 18, 26.5
431/431D — 125, 255, **630,** 1025, 2300, 4000 6500, 11000 431DD — 100, 200, **630,** 1025, 2300, 4000, 6500, 11000	125, 255, 630, 1025, 2300, 4000	432/432D - 100, 200, 400, 850, **1600, 3300,** 6500, 11000 432DD - 64, 125, 400, 850, 1600, 3300, 6500, 11000	100, 200, 400 850, 1600, 3300	50, 100, 220, 390, 880, 1560	50, 100, 220 390, 880, 1560 / 100 200, 400, 850, 1600, 3300	100, 200, 400 850, 1600, 3300
.375 Max.	.375 Max.	.375 Max.	.375 Max.	.275 Max.	.275 Max./ .385 Max.	.385 Max.
5 Leads	8 Leads	8 Leads	9 Leads	8 Leads	9 Leads	8 Leads

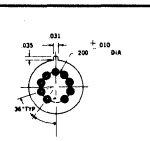


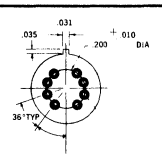


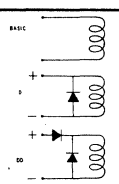




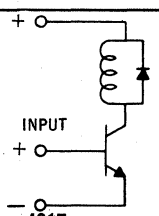




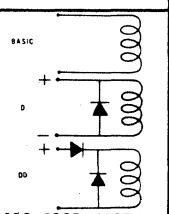




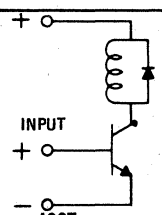
431, 431D, 431DD SENSITIVE SPDT



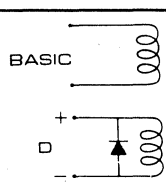
431T SENSITIVE SPDT



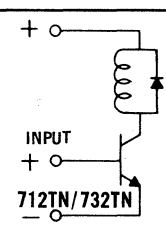
432, 432D, 432DD SENSITIVE DPDT



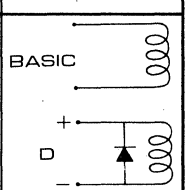
432T SENSITIVE DPDT



712, 712D INDUSTRIAL DPDT



712TN/732TN INDUSTRIAL DPDT



732, 732D SENSITIVE INDUSTRIAL DPDT

TELEDYNE RELAYS
3155 WEST EL SEGUNDO BLVD.
HAWTHORNE, CALIF. 90250
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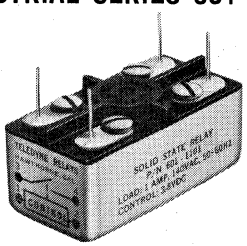
TELEDYNE SOLID STATE A.C. RELAYS

INDUSTRIAL SERIES 601



MECHANICAL SPECIFICATIONS

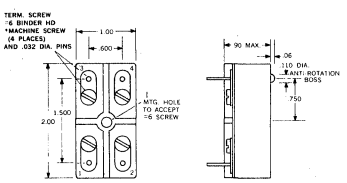
Ambient Temperature Range:
—25°C to 110°C (operating and storage)

Size: 1″ x 2″ x .9″

Weight: 3 oz. max.

Case Material: Aluminum

Header Material: Phenolic



INDUSTRIAL SERIES 601

SOLID STATE SPST (N.O.) 60 Hz A.C. RELAY 1, 3, 5, 7 & 10 AMP.

FEATURES

— Completely solid state.
— Total isolation between control and load.
— Low cost - small size.
— No external heat sink required on units thru 5 AMPS.
— Zero Voltage turn-on option to minimize RFI.

Output (Load) Specifications	Economy		Zero Voltage Turn-On		Units
	Min.	Max.	Min.	Max.	
Output Current Rating (see part numbering)	.03 .100	1, 3, 5, 7, 10	.05	5, 10	Amps (rms)
Load Voltage Rating (see part numbering)	6	140, or 250	12	140, or 250	VAC (rms)
Freqency Range	10	70	50	70	Hz
Surge Current Rating		1000		1000	% of rating
Contact Voltage Drop at Rated Current		1.5	.8(typ)	1.2	VAC
Turn-On Time (60 Hz)		25	3.0(typ)	16	MS
Turn-Off Time (60 Hz)		35	5.0(typ)	16	MS
Isolation (contacts to coil, contacts to case)	10^9		10^9		Ohms
Dielectric Strength (contacts to coil, to case)	1000		1500		VAC 60 Hz
Off-State Leakage ($0°C \geq T_A \geq 110°$)		8		10	MA RMS
Voltage Across Load at Turn-On	Not applicable		±6(typ)		V (peak)

ECONOMY MODEL PART NUMBERING

Input (Control) Voltage Range	Output Voltage Rating	Output (Load) Current Rating & Part Numbers				
		1 Amp	3 Amp	5 Amp	7 Amp	10 Amp
3-10 VDC	140 VAC	601-1001	601-1002	601-1003	601-1004	601-1005
	250 VAC	601-1006	601-1007	601-1008	601-1009	601-1010
6-32 VDC	140 VAC	601-1011	601-1012	601-1013	601-1014	601-1015
15-45 VAC	250 VAC	601-1016	601-1017	601-1018	601-1019	601-1020
20-75 VDC	140 VAC	601-1021	601-1022	601-1023	601-1024	601-1025
60-140 VAC	250 VAC	601-1026	601-1027	601-1028	601-1029	601-1030

ZERO VOLTAGE TURN-ON PART NUMBERING (OPTICALLY ISOLATED)

Input (Control) Voltage Range	Output Voltage Rating	Output (Load) Current Rating & Part Numbers	
		5 Amp	10 Amp
3-32 VDC	140 VAC	601-1401	601-1402
	250 VAC	601-1403	601-1404

NOTES: Add "P" to P/N for pin terminals only. (Example: 601-1001P)
Add "Q" to P/N for quick disconnect terminals only. (Example: 601-1001Q)

INDUSTRIAL SERIES 6

MECHANICAL SPECIFICATIONS

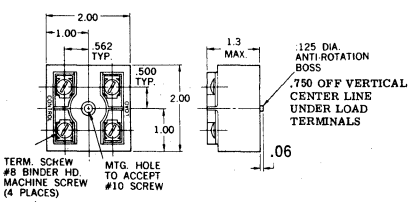
Ambient Temperature Range:
—55°C to 110°C (operating)
—55°C to 125°C (storage)

Size: 2″ x 2″ x 1.3″ max.

Weight: 6.0 oz. max.

Terminal: #8 Binder Head Screw

Mounting: For maximum load current rating, mount unit on a 6″ x 6″ x .125″ Aluminum panel, or equivalent.



INDUSTRIAL SERIES 6

SOLID STATE SPST (N.O.) 60 Hz A.C. RELAY 14 & 21 AMP.

FEATURES

— Completely solid state
— Total isolation between control and load circuits.
— Transient protection on input and output.
— Ultra-sensitive control input — compatible with TTL logic
— Zero-voltage turn-on option to minimize RFI.
— 400 Hz military version available

SPECIFICATIONS:

INPUT (CONTROL):
Voltage Ranges: See table
Pull-in Power: 1.5 mw. typ.
Isolation: 10^{11} ohms, coil to contacts, and coil to mounting plate (minimum).
Dielectric Strength: 1800 VAC (rms), coil to contacts, and coil to mounting plate.

OUTPUTS (LOAD):
Voltage Ratings: See table
Current Ratings: See table
Minimum Current: 100 MA.
Surge Current Rating: 1000% of rating for one AC cycle.
"Contact" Resistance: Typically 1 volt drop.
Response Time: Pull-in within 1.5 AC cycles. Drop-out within 1.5 AC cycles max. Drop-out occurs at the zero current crossing point of the AC line.
Isolation: 10^{11} ohms, contacts to coil, contacts to mounting plate (minimum).
Dielectric Strength: 1800 VAC (rms), contacts to coil, contacts to mounting plate.
Shock/Vibration: Meets requirements of Mil-Std-202.

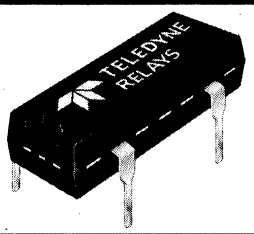
Part No.	Control Voltage	Load	Part No.	Control Voltage	Load
61A-14A1-9(Z)	3-8 VDC	14A, 140 V RMS	61A-21A1-9(Z)	3-8 VDC	21A, 140 V RMS
61A-14A1-10(Z)	7-85 VDC	14A, 140 V RMS	61A-21A1-10(Z)	7-85 VDC	21A, 140 V RMS
61A-14A1-11(Z)	90-280 V RMS	14A, 140 V RMS	61A-21A1-11(Z)	90-280 V RMS	21A, 140 V RMS
61A-14A2-9(Z)	3-8 VDC	14A, 280 V RMS	61A-21A2-9(Z)	3-8 VDC	21A, 280 V RMS
61A-14A2-10(Z)	7-85 VDC	14A, 280 V RMS	61A-21A2-10(Z)	7-85 VDC	21A, 280 V RMS
61A-14A2-11(Z)	90-280 V RMS	14A, 280 V RMS	61A-21A2-11(Z)	90-280 V RMS	21A, 280 V RMS

NOTE: Z added to P/N indicates zero voltage turn on.

TELEDYNE RELAYS
3155 WEST EL SEGUNDO BLVD.
HAWTHORNE, CALIF. 90250
TELEPHONE (213) 679-2205
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

- COMPLETELY SOLID STATE — NO MOVING PARTS
- INPUT DRIVE DIRECTLY COMPATIBLE WITH 5V DIGITAL LOGIC
- TOTAL ISOLATION BETWEEN CONTROL AND LOAD CIRCUIT
- MINIATURE LOW PROFILE CASES (STANDARD TO-116 DUAL IN-LINE, AND STANDARD TO-5 TRANSISTOR CAN CASES)
- ONLY FOUR TERMINALS (TWO INPUT AND TWO OUTPUT)

TELEDYNE MINIATURE SPST SOLID STATE RELAYS



SerenDIP®
COMMERCIAL/INDUSTRIAL DIP SOLID STATE RELAYS

MILITARY TYPE*

TO-5 SOLID STATE RELAY

LOAD VOLTAGE	±50 V MAX. PEAK	140 VAC RMS	280 VAC RMS	60 VDC	250 VDC	±50 V MAX. PEAK
MODEL NO.	**640-1**	**641-1**	**641-2**	**643-1**	**643-2**	**M640-1**
INPUT (CONTROL) SPECIFICATIONS						
CONTROL VOLTAGE	3 - 10 VDC	3 - 10 VDC	3 - 10 VDC	3 - 10 VDC	3 - 10 VDC	3-7 VDC
MAX. INPUT CURRENT @ 5 V	22 MA DC	15 MA DC	15 MA DC	15 MA DC	15 MA DC	13 MA DC
TURN OFF VOLTAGE	0.4 VDC	0.8 VDC	0.8 VDC	0.4 VDC	0.4 VDC	1.0 VDC MAX.
DIELECTRIC STRENGTH	1000 VAC (PP)	1500 VAC (RMS)	1500 VAC (RMS)	1000 VAC (PP)	1000 VAC (PP)	1000 VAC (PP)
ISOLATION	$10^{11}\ \Omega$	$10^{11}\ \Omega$	$10^{11}\ \Omega$	$10^{11}\ \Omega$	$10^{11}\ \Omega$	$10^{11}\ \Omega$
OUTPUT (LOAD) SPECIFICATIONS						
OUTPUT CURRENT RATING	±100 MA PEAK AT 10 VDC INPUT	1.0 AMP	1.0 AMP	400 MA AT 10 VDC INPUT	100 MA AT 10 VDC INPUT	±100 MA PEAK AT 7 VDC INPUT
OUTPUT VOLTAGE	±50 V MAX. PEAK	140 VAC RMS	280 VAC RMS	60 VDC	250 VDC	±50 V MAX. PEAK
OFFSET VOLTAGE	±5.0 MV MAX.	—	—	—	—	±5.0 MV MAX.
CONTACT "ON" RESISTANCE (OHMS)	5.0 MAX.	—	—	5.0 MAX.	5.0 MAX.	5.0 MAX.
CONTACT "OFF" RESISTANCE (OHMS)	10^9 MIN.	2×10^5 MIN.	2×10^5 MIN.	10^8 MIN.	10^8 MIN.	10^7 MIN.
MAX. DRIVE FREQUENCY (Hz)	100 K	500	500	30 K	30 K	100 K
MAX. SURGE RATING	0.1 JOULE	10 AMP	10 AMP	0.1 JOULE	0.1 JOULE	0.1 JOULE
CONTACT VOLTAGE DROP AT RATED CURRENT	250 MV	1.5 V	1.5 V	0.5 V	0.5 V	250 MV

*DESIGNED TO MEET MIL-R-28750 & MIL-STD-883. MIL VERSIONS OF OTHER SEREN DIP® MODELS ALSO AVAILABLE.

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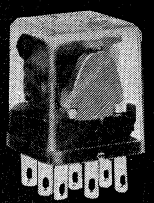
TELEDYNE RELAYS

NEW PRODUCTS

TELEDYNE Mini T*



ACTUAL SIZE

SUBMINIATURE HEAVY-DUTY INDUSTRIAL RELAYS

FEATURES

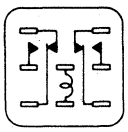
- Low price
- Subminiature size
- Rugged construction
- Socket or PC board mounting
- 1500 volts AC dielectric strength
- Low power consumption
- Fast operate and release times
- AC or DC coils

ELECTRICAL SPECIFICATIONS

DC COIL		
Volts	Resistance (Ohms)	Nominal Current (Milliamperes)
6	25	240
12	100	120
24	400	60
48	1600	30
110	8500	13

AC (50/60Hz) COIL		
Volts	Resistance (Ohms)	Nominal Current (Milliamperes)
6	10	420
12	40	210
24	160	105
48	635	52
120	4,300	19.5

5 AMP DPDT

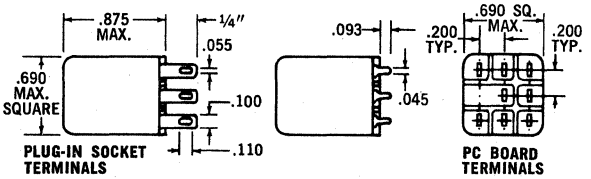


SCHEMATIC
(Viewed from Bottom)

SPECIFICATIONS

CONTACTS: Arrangement DPDT
LIFE EXPECTANCY: 10,000,000 operations (min.) mechanical
100,000 operations (min.) at rated contact load
CONTACT RATING: Low level to 2.0 amps, resistive, at 28VDC or 120V RMS, 60 Hz (Type Y, fine silver contact material)
1.0 amps to 5.0 amps, resistive, at 28VDC or 120V RMS, 60 Hz (Type G, silver alloy contact material)
COIL SENSITIVITY DC COIL: 750 milliwatts to operate 1.5 watt at nominal coil voltage
AC COIL: 1.6VA to operate at 70% power factor
2.5VA at nominal coil voltage
OPERATE TIME: 10 milliseconds, maximum
RELEASE TIME: 8 milliseconds, maximum
INITIAL BREAKDOWN VOLTAGE: 1500 VRMS, 60 Hz between all elements
500 VRMS, 60 Hz between open contacts

INSULATION RESISTANCE: 10,000 megohms minimum
TEMPERATURE RANGE: −45°C to +70°C (−50°F to 160°F)
ENCLOSURE: Plastic dust cover
WEIGHT: 0.5 ounce maximum
MADE IN U.S.A.



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P/N TS
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MINI T* SERIES MOUNTING HARDWARE

RETAINER P/N TR

CLAMP P/N TC

*PATENT PENDING

HOW TO ORDER

T — AY — 120P

- P = Plug-in Socket Terminals; C-PC Board Terminals
- Nominal Coil Voltage: 6, 12, 24, or 110 for DC Coils; 6, 12, 24, or 120 for AC Coils
- Y = Fine Silver Contact material; G = Silver Alloy
- A = AC Coil; D = DC Coil

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PRIME' SEMICONDUCTOR DEVICES

Microglass Regulators and Rectifiers, Temperature Compensated Reference Diodes and Regulator, Rectifier and Temperature Compensated Diode Chips.

PRIME' MICROGLASS REGULATORS

Nominal Zener Voltage	400 mW (1) DO-35 Case	1 Watt (1) Type 6 Case	1 Watt (2) Type 6 Case	1 Watt (1) Type 6 Case	1½ Watt (3) (4) Type 6 Case	3 Watt (3) Type 30 Case	5 Watt (3) (4) Type 20 Case
6.2	—	—	—	—	1N4460	—	—
6.8	HM 6.8	HW 6.8	1N4736	1N5559	1N4461	1N5063	1N4954
7.5	HM 7.5	HW 7.5	1N4737	1N5560	1N4462	1N5064	1N4955
8.2	HM 8.2	HW 8.2	1N4738	1N5561	1N4463	1N5065	1N4956
9.1	HM 9.1	HW 9.1	1N4739	1N5562	1N4464	1N5066	1N4957
10	HM 10	HW 10	1N4740	1N5563	1N4465	1N5067	1N4958
11	HM 11	HW 11	1N4741	1N5564	1N4466	1N5068	1N4959
12	HM 12	HW 12	1N4742	1N5565	1N4467	1N4883	1N4960
13	HM 13	HW 13	1N4743	1N5566	1N4468	1N5069	1N4961
14	—	—	—	—	—	1N5070	1N5118
15	HM 15	HW 15	1N4744	1N5567	1N4469	1N5071	1N4962
16	HM 16	HW 16	1N4745	1N5568	1N4470	1N5072	1N4963
18	HM 18	HW 18	1N4746	1N5569	1N4471	1N5073	1N4964
20	HM 20	HW 20	1N4747	1N5570	1N4472	1N4881	1N4965
22	HM 22	HW 22	1N4748	1N5571	1N4473	1N5074	1N4966
24	HM 24	HW 24	1N4749	1N5572	1N4474	1N5075	1N4967
27	HM 27	HW 27	1N4750	1N5573	1N4475	1N5076	1N4968
30	HM 30	HW 30	1N4751	1N5574	1N4476	1N5077	1N4969
33	HM 33	HW 33	1N4752	1N5575	1N4477	1N5078	1N4970
36	HM 36	HW 36	1N4753	1N5576	1N4478	1N5079	1N4971
39	HM 39	HW 39	1N4754	1N5577	1N4479	1N5080	1N4972
40	—	—	—	—	—	1N5081	1N5119
43	HM 43	HW 43	1N4755	1N5578	1N4480	1N5082	1N4973
45	—	—	—	—	—	1N5083	1N5120
47	HM 47	HW 47	1N4756	1N5579	1N4481	1N5084	1N4974

Nominal Zener Voltage	400 mW (1) DO-35 Case	1 Watt (1) Type 6 Case	1 Watt (2) Type 6 Case	1 Watt (1) Type 6 Case	1½ Watt (3) (4) Type 6 Case	3 Watt (3) Type 30 Case	5 Watt (3) (4) Type 20 Case
50	—	—	—	—	—	1N5085	1N5121
51	HM 51	HW 51	1N4757	1N5580	1N4482	1N5086	1N4975
56	HM 56	HW 56	1N4758	1N5581	1N4483	1N5087	1N4976
60	—	—	—	—	—	1N5088	1N5122
62	HM 62	HW 62	1N4759	1N5582	1N4484	1N5089	1N4977
68	HM 68	HW 68	1N4760	1N5583	1N4485	1N5090	1N4978
70	—	—	—	—	—	1N5091	1N5123
75	HM 75	HW 75	1N4761	1N5584	1N4486	1N5092	1N4979
80	—	—	—	—	—	1N5093	1N5124
82	HM 82	HW 82	1N4762	1N5585	1N4487	1N5094	1N4980
90	—	—	—	—	—	—	1N5125
91	HM 91	HW 91	1N4763	1N5586	1N4488	1N5095	1N4981
100	HM100	HW100	1N4764	1N5587	1N4489	1N4097	1N4982
110	HM110	HW110	—	1N5588	1N4490	1N5096	1N4983
120	HM120	HW120	—	1N5589	1N4491	1N5097	1N4984
130	HM130	HW130	—	1N5590	1N4492	1N5098	1N4985
140	—	—	—	—	—	1N5099	1N5126
150	HM150	HW150	—	1N5591	1N4493	1N4098	1N4986
160	HM160	HW160	—	1N5592	1N4494	1N5100	1N4987
170	—	—	—	—	—	1N5101	1N5127
180	HM180	HW180	—	1N5593	1N4495	1N5102	1N4988
190	—	—	—	—	—	1N5103	1N5128
200	HM200	HW200	—	1N5594	1N4496	1N5104	1N4989

NOTES: Types available in ±20%, ±10% or ±5% voltage tolerances.
(1) Basic Type ±20% A suffix ±10%, B suffix 5%
(2) Basic type ±10% A suffix ±5%
(3) Basic type ±5%

(4) JAN AND JAN-TX QUALIFIED.

PRIME' MICROGLASS RECTIFIERS (1) Type 30 Case (2) Type 20 Case

Type Number	Maximum Ratings: Working Peak Reverse Voltage $V_{RM(wkg)}$	Maximum Ratings: Average Rectified Forward Current I_O	Maximum Ratings: Peak Surge Current I_{FM}	Electrical Characteristics: Forward Voltage Drop V_F @ 1 Amp	Electrical Characteristics: Maximum Reverse Current I_R @ V_{RM}
	Volts	Amps	Amps	Volts	μA
(1)					
HGR-5	50	1.0 @ T_A = 75°C	30 (1 Cycle) 10 (Repetitive)	1.1 Max. @ T_A = 25°C	10 @ T_A = 25°C 50 @ T_A = 100°C
HGR-10	100				
HGR-20	200				
HGR-30	300				
HGR-40	400				
HGR-60	600				
1N3611 (4)	200	1.0 @ T_A = 100°C 0.3 @ T_A = 150°C	10 (1 Cycle)	.6 to 1.2 @ T_A = 100°C	5 @ T_A = 25°C 300 @ T_A = 100°C
1N3612 (4)	400				
1N3613 (4)	600				
1N4001	50	1.0 @ T_A = 75°C	30 (1 Cycle)	1.1 Max. @ T_J = 25°C	10 @ T_J = 25°C 50 @ T_J = 100°C
1N4002	100				
1N4003	200				
1N4004	400				
1N4005	600				
1N4245 (4)	200	1.0 @ T_A = 55°C 0.1 @ T_A = 160°C	25 (1 Cycle) 10 (Repetitive)	1.2 Max. @ T_A = 55°C	1.0 @ T_A = 25°C 25 @ T_A = 125°C
1N4246 (4)	400				
1N4247 (4)	600				

(4) JAN AND JAN-TX QUALIFIED.

Type Number	Maximum Ratings: Working Peak Reverse Voltage $V_{RM(wkg)}$	Maximum Ratings: Average Rectified Forward Current I_O	Maximum Ratings: Peak Surge Current I_{FM}	Maximum Ratings: Maximum Forward Voltage Drop $I_F = I_O$ V_F	Electrical Specifications: Maximum Reverse Current I_R @ V_{RM} 25°C	Electrical Specifications: Maximum Reverse Current I_R @ V_{RM} 100°C	Electrical Specifications: Maximum Reverse Recovery Time t_{rr}	Electrical Specifications: Maximum Junction Capacity C_J @ V_R	
	Volts	Amps	Amps	Volts	μA	μA	n sec	pf	Volts
(1)									
HFR-5	50	1 @ 75°C	25 (1 Cycle)	1.2	1.3	200	80	100	−1
HFR-10	100							75	
HFR-15	150							60	
HFR-20	200							60	
(2)									
1N5185	50	3 @ 25°C	80 (1 Cycle)	1.1	5	100	250	600	0
1N5186	100						250	400	
1N5187	200						250	320	
1N5188	400						300	240	
1N5189	500						350	200	
1N5190	600						400	160	
1N5185A	50	4 @ 25°C	80 (1 Cycle)	1.1	2	80	250	400	0
1N5186A	100						250	300	
1N5187A	200						250	250	
1N5188A	400						250	200	
1N5189A	500						250	160	
1N5190A	600						300	120	

VOLTAGE REFERENCE AMPLIFIER TO-12 Case

Parameters	Reference Voltage (1)	Transconductance (1)	Temperature Coefficient of Reference Voltage 0°C to +75°C (%/°C)					DC Current Gain I_C = 100μA, V_{CE} = 5V	Collector Leakage Current (V_{CB} = 25V, I_E = 0)
			CH 2001	CH 2002	CH 2003	CH 2004			
Limits	6.8 V ± 5%	2500 μ mho min.	±.001	±.0025	±.005	±.010	%/°C	150 min.	10 n A max.

(1) V_{CA} = 14V, I_C = 100μA, I_Z = 3.1mA

CENTRALAB SEMICONDUCTOR
GLOBE-UNION INC. 4501 NORTH ARDEN DRIVE • EL MONTE, CALIFORNIA 91734 • TELEPHONE (213) 579-0700 • TWX (910) 587-3429

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CENTRALAB SEMICONDUCTOR

PRIME' TEMPERATURE COMPENSATED REFERENCE DIODES DO-7 Case

Nominal Zener Voltage @ I_{ZT} $V_Z \pm 5\%$	Test Current I_{ZT}	Maximum Dynamic Resistance @ I_{ZT} Z_{ZT}	Average Temperature Coefficient (%/°C) .01	.005	.002	.001	.0005	Test Temperatures °C
6.2	7.5	15	1N821 1N822 (1)	1N823 1N824 (1)	1N825	1N827	1N829	−55, +25, +100
		10	1N821A	1N823A	1N825A	1N827A	1N829A	
6.4	0.5	200	1N4565	1N4566	1N4567	1N4568	1N4969	0, +75
			1N4565A	1N4566A	1N4567A	1N4568A	1N4569A	−55, +100
	1.0	100	1N4570	1N4571	1N4572	1N4573	1N4574	0, +75
			1N4570A	1N4571A	1N4572A	1N4573A	1N4574A	−55, +100
	2.0	50	1N4575	1N4576	1N4577	1N4578	1N4579	0, +75
			1N4575A	1N4576A	1N4577A	1N4578A	1N4579A	−55, +100
	4.0	25	1N4580	1N4581	1N4582	1N4583	1N4584	0, +75
			1N4580A	1N4581A	1N4582A	1N4583A	1N4584A	−55, +100
8.4	10.0	15	1N3154	1N3155	1N3156	1N3157		−55, +100
			1N3154A	1N3155A	1N3156A	1N3157A		−55, +150
8.5	0.5	200	1N4775	1N4776	1N4777	1N4778	1N4779	0, +25, +75
			1N4775A	1N4776A	1N4777A	1N4778A	1N4779A	−55, 0, +25, +75, +100
	1.0	100	1N4780	1N4781	1N4782	1N4783	1N4784A	0, +25, +75
			1N4780A	1N4781A	1N4782A	1N4783A	1N4784	−55, 0, +25, +75, +100
9.0	7.5	20	1N935	1N936	1N937	1N938	1N939	0, +75
			1N935A	1N936A	1N937A	1N938A	1N939A	−55, +100
			1N935B	1N936B	1N937B	1N938B	1N939B	−55, +150
9.1	0.5	350	1N4765	1N4766	1N4767	1N4768	1N4769	0, +25, +75
			1N4765A	1N4766A	1N4767A	1N4768A	1N4769A	−55, 0, +25, +75, +100
	1.0	200	1N4770	1N4771	1N4772	1N4773	1N4774	0, +25, +75
			1N4770A	1N4771A	1N4772A	1N4773A	1N4774A	−55, 0, +25, +75, +100
11.7	7.5	30	1N941	1N942	1N943	1N944	1N945	0, +75
			1N941A	1N942A	1N943A	1N944A	1N945A	−55, +100
			1N941B	1N942B	1N943B	1N944B	1N945B	−55, +150

JAN AND JAN-TX QUALIFIED. 1N821-1N829, 1N935B-1N939B, 1N941B-1N944B, 1N3154-1N3157, 1N4565A-1N4574A

NOTE: (1) Symmetrical Types.

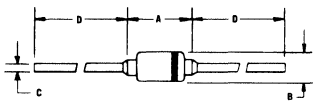
SILICON TUNNEL DIODES (1) TO-18 Case (2) DO-17 Case

Type Number	Static Characteristics: Peak Point Current I_P mA Min.	mA Max.	Maximum Valley Point Current I_V mA	Maximum Peak Point Voltage V_P mV	Maximum Valley Point Voltage V_V mV	Forward Voltage @ Applied Current V_F @ I_F mV Min.	mV Max.	mA	Dynamic Characteristics: Total Series Resistance R_S Ohms	Valley Point Terminal Capacitance Freq. = 5 MHz C pF Typical
(1)										
1N2927	.09	.11	.035	75	475	600	1000	.11	10.0	40
1N2928	.42	.52	.170	80	490	670	1000	.52	3.0	50
1N2929	.90	1.10	.350	80	500	700	1000	1.10	2.0	75
1N2929A	.98	1.02	.300	75	500	730	1000	1.02	2.0	75
1N2930	4.23	5.17	1.70	85	520	740	1000	5.17	1	125
1N2930A	4.61	4.79	1.45	79	520	750	1000	4.79	1	125
1N2931	9.0	11.0	3.50	85	530	740	1000	11.0	1	200
1N2931A	9.8	10.2	3.0	80	530	750	1000	10.2	1	200
1N2932	19.8	24.2	8.0	90	530	740	1000	24.2	.8	600
1N2932A	21.56	22.44	6.5	82	530	750	1000	22.44	.8	600
1N2933	42.3	51.7	17.0	90	530	740	1000	51.7	.6	900
1N2933A	46.06	47.94	14.5	83	530	750	1000	47.94	.6	900
1N2934	90.0	110.0	35.0	90	530	720	1000	110.0	.5	1200
1N2934A	98.0	102.0	30.0	85	530	730	1000	102.0	.5	1200
(2)										
1N4393	.09	.11	.035	75	475	650	1000	.11	10	40
1N4393A	.095	.105	.030	70	475	670	1000	.105	10	40
1N4394	.20	.24	.080	80	480	660	1000	.24	7	45
1N4394A	.209	.231	.065	72	480	680	1000	.231	7	45
1N4395	.42	.52	.170	80	490	670	1000	.52	3	50
1N4395A	.45	.49	.145	74	490	690	1000	.49	3	50
1N4396	.90	1.10	.350	80	500	680	1000	1.10	2	75
1N4396A	.95	1.05	.300	75	500	700	1000	1.05	2	75
1N4396B	.98	1.02	.280	70	500	730	1000	1.02	2	75
1N4397	1.98	2.42	.800	80	510	690	1000	2.42	2	100
1N4397A	2.09	2.31	.650	77	510	710	1000	2.31	2	100
1N4397B	2.16	2.24	.600	73	510	740	1000	2.24	2	100
1N4398	4.23	5.17	1.70	85	520	700	1000	5.17	1	125
1N4398A	4.46	4.94	1.45	79	520	720	1000	4.95	1	125
1N4398B	4.61	4.79	1.30	74	520	750	1000	4.73	1	125
1N4399	9.0	11.0	3.50	85	530	700	1000	11.0	1	200
1N4399A	9.5	10.5	3.00	80	530	720	1000	10.5	1	200
1N4399B	9.8	10.2	2.80	75	530	750	1000	10.2	1	200

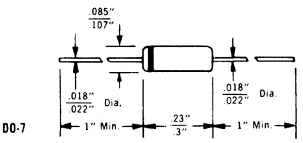
SILICON UNI-TUNNEL DIODES

Type Number TO-18 Case	Type Number DO-17 Case	Static Characteristics: Reverse Operating Voltage V_r @ I_r mV Min.	mV Max.	mA	Maximum Reverse Voltage V_r max. @ I_r max. mV	mA	Minimum Forward Voltage V_f @ I_f mV	mA	Minimum Forward Peak Point Voltage V_{fp} @ I_{fp} max. mV	mA	Dynamic Characteristics: Maximum Terminal Capacitance C pF
1N3539	U1001	150	250	.47	350	1.25	600	.047	475	.0047	—
1N3539A	U1002	150	250	.47	350	1.25	700	.047	500	.0047	10
1N3540	U1003	150	250	1.0	350	2.50	600	.10	475	.010	—
1N3540A	U1004	150	250	1.0	350	2.50	700	.10	500	.010	20
1N3541	U1005	150	250	2.2	400	6.25	600	.22	475	.022	—
1N3541A	U1006	150	250	2.2	400	6.25	700	.22	500	.022	50
1N3542	U1007	150	250	4.7	400	12.5	600	.47	475	.047	—
1N3542A	U1008	150	250	4.7	400	12.5	700	.47	500	.047	70
1N3543	U1009	150	250	10.0	400	25.0	600	1.0	475	.100	—
1N3543A	U1010	150	250	10.0	400	25.0	700	1.0	500	.100	100

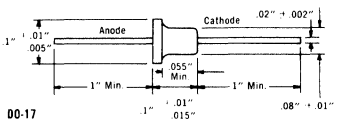
MICROGLASS DEVICES



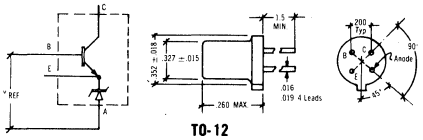
DIMENSIONS (INCHES) CASE TYPE	WATTAGE	A (MAX)	B (MAX)	C (± .002)	D (MIN)
D035	4	.16	.085	.02	1
6	1	.16	.085	.03	1
30	3	.16	.100	.03	1
20	5	.16	.140	.04	1



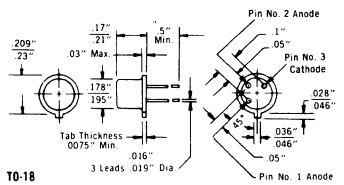
DO-7



DO-17



TO-12



TO-18

PRIME' Centralab semiconductor products are available at four levels of reliability—at realistic prices to meet individual requirements.

PRIME' 1 For critical applications requiring maximum reliability. 100% conditioning, testing and data profiling - in excess of JAN-TX requirements.

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CENTRALAB SEMICONDUCTOR

REGULATOR CHIPS

Nominal Zener Voltage @ I_{ZT} V_Z (Volts)	Test Current	Dynamic Resistance @ I_{ZT} Z_{ZT}	Reverse Leakage Current I_R @ V_R		Chip Number Style A
	mA	Ohms	I_R	V_R	
2.7	5	85 Typ	75 Typ	1	C6100
3.0		70	50		C6101
3.3		60	10		C6102
3.6		50	10		C6103
3.9		45	10		C6104
4.3		40	2		C6105
4.7		30	2		C6106
5.1		15	1		C6107
5.6		5	1		C6108
6.2		10	.1		C6109
6.8	1	20 Typ	5 Typ	4.9	C6112
7.5		20	5	5.4	C6113
8.2		20	5	5.9	C6114
9.1		25	3	6.6	C6115
10		25	1.5	7.2	C6116
11		30	.5	8.0	C6117
12		30	.5	8.6	C6118
13		35	.5	9.4	C6119
15		40	.1	10.8	C6120
16		40	.1	11.5	C6121
18		45	.1	13.0	C6122
20		50	.1	14.4	C6123
22		60	.1	15.8	C6124
24		70	.1	17.3	C6125
27		80	.1	19.4	C6126
30		90	.1	21.6	C6127
33		100	.1	23.8	C6128
36		110	.1	25.9	C6129
39		120	.1	28.1	C6130
43		130	.1	31.0	C6131
47		150	.1	33.8	C6132
3.3	20	28 Max	10 Max	1	(1) CZ746
3.6		24	10		CZ747
3.9		23	10		CZ748
4.3		22	2		CZ749
4.7		19	2		CZ750
5.1		17	1		CZ751
5.6		11	1		CZ752
6.2		7	.1		CZ753
6.8		5	.1		CZ754
7.5		6	.1		CZ755
8.2		8	.1		CZ756
9.1		10	.1		CZ757
10		17	.1		CZ758
12		30	.1		CZ759

Available in LID configuration.

NOTES: (1) Electrically equivalent to 1N746 - 1N759

Basic type number ±10% tolerance. ±5% tolerance available and designated with "A" suffix.
All chips passivated P/N with top contact aluminum, back surface gold.
N P types available from 6.8 through 47 volts.

Chips equivalent to 1N957 - 1N977 also available as CZ957 - CZ977

TEMPERATURE COMPENSATED CHIPS ON CHANNELS

Nominal Zener Voltage @ I_{ZT} V_Z ±5%	Test Current I_{ZT}	Maximum Dynamic Resistance @ I_{ZT} Z_{ZT}	Average Temperature Coefficient (%/°C)					Test Temperatures °C
			.01	.005	.002	.001	.0005	
6.2	7.5	15	CZ821	CZ823	CZ825	CZ827	CZ829	−55, +25, +100
			CZ822 (1)	CZ824 (1)				
		10	CZ821A	CZ823A	CZ825A	CZ827A	CZ829A	
6.4	0.5	200	CZ4565	CZ4566	CZ4567	CZ4568	CZ4569	0, +75
			CZ4565A	CZ4566A	CZ4567A	CZ4568A	CZ4569A	−55, +100
	1.0	100	CZ4570	CZ4571	CZ4572	CZ4573	CZ4574	0, +75
			CZ4570A	CZ4571A	CZ4572A	CZ4573A	CZ4574A	−55, +100
9.0	7.5	20	CZ935	CZ936	CZ937	CZ938	CZ939	0, +75
			CZ935A	CZ936A	CZ937A	CZ938A	CZ939A	−55, +100
			CZ935B	CZ936B	CZ938B	CZ938B	CZ939B	−55, +150

NOTE: (1) Symmetrical Types. **CZ941-CZ944B and CZ3154-CZ3157A also available**

PLANAR TEMPERATURE COMPENSATED REFERENCE DIODE CHIPS

Chip Number Style B	Electrical Equivalent JEDEC Type	Nominal Zener Voltage @ I_{ZT} V_Z ±5%	Test Current I_{ZT}	Maximum Dynamic Resistance Z_{ZT}	Maximum Voltage Change ΔV_Z	Maximum Temperature Coefficient	Test Temperature
		Volts	mA	Ohms	mV	%/°C	°C
C6330	1N4570	6.4	1.0	100	640	.01	0, +75
C6330A	1N4570A				640	.01	−55, +100
C6331	1N4571				320	.005	0, +75
C6331A	1N4571A				320	.005	−55, +100

ULTRA-FAST PLANAR DIODE CHIPS

Chip Number Style A	Electrical Equivalent JEDEC Type	Maximum Forward Voltage V_F @ 20mA	Maximum Reverse Current I_R @ 75V	Maximum Reverse Current I_R @ 20V	Maximum Capacitance $V_R = 0$ $f = 1.0MHz$	Minimum Breakdown Voltage BV @ 100μA	Maximum Reverse Recovery Time, trr $I_F = 10mA$, $V_R = 6V$
		Volts	μA	nA	pf	Volts	ns
C6311	1N914 1N916	1.0	5	25	4	100	4

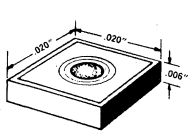
RECTIFIER CHIPS

Chip Number Style C	Electrical Equivalent JEDEC Type	Minimum Breakdown Voltage B_{VR} @ 100 μA	Maximum Reverse Current			Maximum Forward Voltage Drop V_F @ 400mA	Maximum Reverse Recovery Time t rr
			I_R @ 25°C	I_R @ 100°C	V_R		
		Volts	μA	μA	Volts	Volts	n sec
C6391	1N482	50	.20	20	50	1.0	——
C6392	1N483	100					
C6393	1N484	150					
C6394	1N485	200					
C6395	1N645	250					
C6396	1N646	300					
C6397	1N647	400					
C6398	1N648	500					
C6399	1N649	600					
C6391A	1N482A	50	.025	10	50	1.0	——
C6392A	1N483A	100					
C6393A	1N484A	150					
C6394A	1N485A	200					
C6395A	1N486A	250					
C6396A	1N487A	300					
C6397A	1N488A	400					
C6251	——	60	1.0	100	50	1.0	250
C6252		120			100		
C6253		180			150		
C6254		240			200		

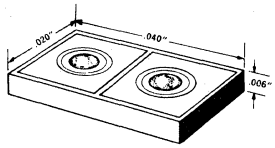
NOTES: (1) All chips passivated N P with top contact aluminum, back surface gold. (3) .037" x .037" chip size also available.
(2) Bare silicon or gold over nickel back available at additional cost.

A comprehensive condensed catalog of all Centralab PRIME semiconductor products is available upon request.

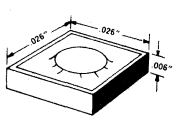
Contact us for complete data on these devices or for assistance from our applications group.



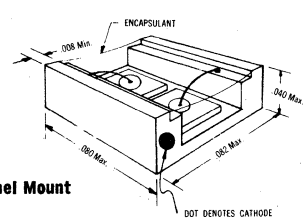
Chip Style A



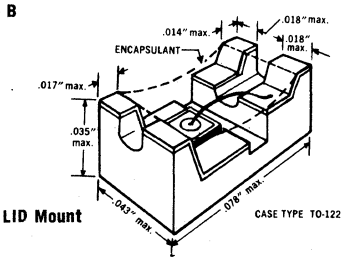
Chip Style B



Chip Style C



Channel Mount



LID Mount

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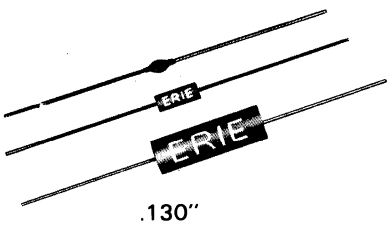
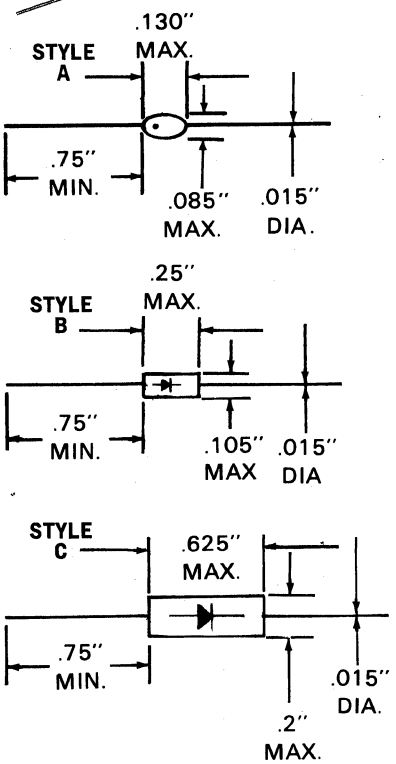


HIGH VOLTAGE SILICON RECTIFIERS

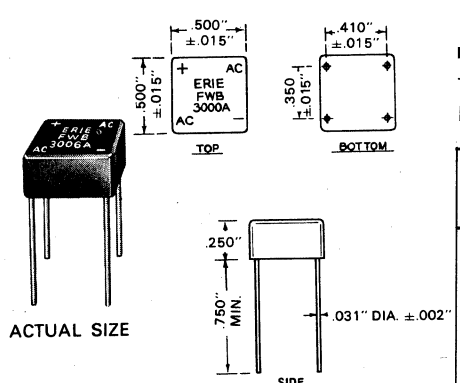


These High Voltage Silicon Rectifiers incorporate the latest technologies in diffusion and fabrication. Erie's proprietary surface passivation ensures low leakage currents with long term stability and reliability.

STANDARD RECOVERY					FAST RECOVERY				
Series	P.R.V.	Average Forward Current	Max. Reverse Current @ 25°C	Style	Series	P.R.V.	Average Forward Current	Max. Reverse Current @ 25°C	Style
HV50P	1KV Thru 5KV	50mA	.01μA	A	HX50P	1KV Thru 5KV	40mA	.1μA	A
HV50M	1KV Thru 5KV	50mA	.01μA	B	HX50M	1KV Thru 5KV	40mA	.1μA	B
HV50E	1KV Thru 5KV	50mA	.02μA	C	HX50E	1KV Thru 5KV	40mA	.1μA	C
HV80ML	5KV Thru 8KV	20mA	.05μA	B	HX80ML	5KV Thru 8KV	15mA	.1μA	B
HV80EL	6KV Thru 8KV	25mA	.05μA	C	HX80EL	6KV Thru 8KV	20mA	.1μA	C
HV140EO	10KV Thru 14KV	8mA	.05μA	C	HX140EO	10KV Thru 14KV	6mA	.1μA	C
HV200EP	16KV Thru 20KV	5mA	.05μA	C	HX200EP	16KV Thru 20KV	4mA	.1μA	C
HTV150S *	12.5KV & 15KV	5mA	.1μA	C					

* SPECIFICALLY DESIGNED FOR USE IN TV VOLTAGE MULTIPLIERS

FULL WAVE BRIDGE RECTIFIERS



Erie Full Wave Bridge Rectifiers are a series of miniature bridges — double-sealed modules designed for printed circuit applications. Available with working voltage from 100 to 1000 volts per leg. Operating temperature range from −55°C to +100°C. Double seal ensures moisture resistance to MIL-STD-750A, Method 1021.1.

ERIE Part Number	Minimum Peak Repetitive Reverse Voltage Per Arm (P.R.V.)	Maximum Applied R.M.S. Voltage
FWB3001A	100 V	70 V
FWB3002A	200 V	140 V
FWB3004A	400 V	280 V
FWB3006A	600 V	420 V
FWB3008A	800 V	560 V
FWB3010A	1000 V	700 V

ELECTRICAL SPECIFICATIONS

Average rectified forward current.... 1.5A
Single cycle 60Hz surge cur... 25A (min.)
V_f per leg @ 25°C..... 1.1Vdc
I_r per leg @ P.R.V. & 25°C..... 5μA
Operating temp..... −55°C to +100°C

DELCO POWER SEMICONDUCTORS

Transistors

Type	Ic Amps	VCBO Volts	VCEO Volts	hFE @ Ic Amps		VCE (sat) @ Ic Volts @ Amps	
NPN SILICON TO-3 (TO-204MA) HIGH VOLTAGE							
DTS-401	2.0	400	400	20/100	0.5	0.8	1.0
DTS-402	3.5	400	400			0.8	1.0
DTS-403	3.5	400	400	—	—	2.0	3.5
DTS-409	3.5	400	400	15/	1.0	1.2	1.0
DTS-410	3.5	200	200	30/90	1.0	0.8	1.0
DTS-411	3.5	300	300	30/90	1.0	0.8	1.0
DTS-413	2.0	400	400	20/80	0.5	0.8	0.5
DTS-423	3.5	400	400	30/90	1.0	0.8	1.0
DTS-424	3.5	700⑥	500	30/90	1.0	0.8	1.0
DTS-425	3.5	700⑥	500	30/90	1.0	0.8	1.0
DTS-430	5.0	400	400	15/45	2.5	0.9	2.5
DTS-431	5.0	400	400	15/35	2.5	0.7	2.5
DTS-431M†	5.0	400	400	15/35	2.5	0.7	2.5
DTS-701	1.0	—	800	20/	0.15	—	—
DTS-702	3.0	1200⑥	1000	2.5/	2.0	—	—
DTS-704	3.0	1400⑤	1000	2.5/	2.0	—	—
DTS-708	3.0	900	900	—	—	2.0	1.0
DTS-709	3.0	900	900	—	—	1.0	2.0
DTS-710	3.0	900	900	7	1.0	—	—
DTS-711	3.0	1000	800	2.5/	2.0	—	—
DTS-712	3.0	1200⑥	900	2.5/	2.0	—	—
DTS-714	3.0	1400⑥	900	2.5/	2.0	—	—
DTS-721	3.0	1000⑥	1000	20/60	0.15	—	—
DTS-723	3.0	1200⑥	1000	10/	0.5	0.8	1.0
DTS-801	2.0	1000	800	20/	0.2	—	—
DTS-802	5.0	1200⑤	1000	2.2/	3.5	—	—
DTS-804	5.0	1400⑥	1000	2.2/	3.5	—	—
DTS-812	5.0	1200⑥	900	2.2/	3.5	—	—
DTS-814	5.0	1400⑥	900	2.2/	3.5	—	—
DTS-1006	10.0	—	60	500/	3.0	1.8	5.0
DTS-1008	10.0	—	80	500/	3.0	1.8	5.0
DTS-1010	10.0	120	120	500/	3.0	1.8	5.0
DTS-1020	10.0	120	120	1000/	3.0	1.5	5.0
DTS-4040	15.0	400	400	250/	3.0	1.8	15.0
DTS-4045	15.0	400	400	500/	3.0	1.65	15.0
DTS-4060	15.0	600	600	250/	3.0	1.8	15.0
DTS-4065	15.0	600	600	500/	3.0	1.65	15.0
2N3902	3.5	400	400	30/90	1.0	0.8	1.0
JAN2N3902Δ	3.5	700⑥	400	30/90	1.0	0.8	1.0
2N5157	3.5	700⑥	500	30/90	1.0	0.8	1.0
JAN2N5157Δ	3.5	700⑥	500	30/90	1.0	0.8	1.0
2N5241	5.0	400	400	15/35	2.5	0.7	2.5
JAN2N5241Δ	5.0	400	400	15/35	2.5	0.7	2.5
NPN SILICON TO-36 (TO-207MA) HIGH VOLTAGE							
2N2580	10.0	400	400	10/40 4 min	5.0 10.0	0.7	5.0
2N2581	10.0	400	400	25/65 10 min	5.0 10.0	1.0	10.0
2N2582	10.0	500	500	10/40 4 min	5.0 10.0	0.7	5.0
2N2583	10.0	500	500	25/65 10 min	5.0 10.0	1.0	1.0
2N3079	5.0	200	200	10/50	5.0	0.7	5.0
2N3080	5.0	300	300	10/50	5.0	0.7	5.0

Type	Ic Amps	VCBO Volts	VCEO Volts	hFE @ Ic Amps		VCE (sat) @ Ic Volts @ Amps	
NPN SILICON TO-66 (TO-213MA) HIGH VOLTAGE							
DTS-660	3.5	200	200	30/90	1.0	0.8	1.0
DTS-663	3.5	400	400	30/90	1.0	0.8	1.0
DTS-665	3.5	700	500	30/90	1.0	0.8	1.0
PNP GERMANIUM TO-3 (TO-204MA) NU-BASE							
2N5155	25.0	140⑥	120⑦	25/100	8.0	0.9	25.0
DTG-110A	25.0	110⑥	70	50/300	1.0	0.5	5.0
DTG-110B	25.0	90⑥	40⑦	65/300	1.0	0.5	5.0
DTG-600	25.0	90⑥	50⑦	50/115⑤	5.0	0.75	25.0
DTG-601	25.0	90⑥	60⑦	50/115⑤	5.0	0.75	25.0
DTG-602	25.0	100⑥	70⑦	50/115⑤	5.0	0.75	25.0
DTG-603	25.0	90⑥	80⑦	50/	5.0	0.75	25.0
DTG-603M†	25.0	90⑥	80⑦	50/	5.0	0.75	25.0
DTG-1010	15.0	325⑥	110⑦	100⑤	8.0	0.5	12.0
DTG-1110	15.0	200⑥	80⑦			0.5	10.0
DTG-1200	15.0		120⑦	27.5	8.0	0.5	12.0
DTG-2000	25.0	60⑥	30⑦	25/	8.0	0.9	25.0
DTG-2100	25.0	80⑥	60⑦	25/	8.0	0.9	25.0
DTG-2200	25.0	100⑥	80⑦	25/	8.0	0.9	25.0
DTG-2300	25.0	120⑥	100⑦	25/	8.0	0.9	25.0
DTG-2400	25.0	140⑥	120⑦	25/	8.0	0.9	25.0
DTG-2400M†	25.0	140⑥	120	25/125	10.0	0.9	25.0
DTG-5000	50.0	100⑥	80	60/180	10.0	1.0	50.0
DTG-5100	50.0	120⑥	100	60/180	10.0	1.0	50.0
DTG-5200	50.0	80⑥	60	80/240	10.0	1.0	50.0
DTG-5300	50.0	80⑥	50	40/120	10.0	2.0	50.0
PNP GERMANIUM TO-41 (TO-204MB) NU-BASE							
2N1073	10.0	40②	40③	20/60	5.0	0.6	5.0
2N1073A	10.0	80②	80③	20/60	5.0	0.6	5.0
2N1073B	10.0	120②	120②	20/60	5.0	0.6	5.0
PNP GERMANIUM TO-3 (TO-204MA) ALLOY BASE							
2N301	3.0	40	32	62.5	0.7		
2N301A	3.0	60	32	62.5	0.7		
2N379	7.0	80⑨	40	20/90	2.0	1.0	2.0
2N380	7.0	60⑨	30	20/90	2.0	1.0	2.0
2N392	5.0	60	45	60/150	3.0	0.5	3.0
2N456A	7.0	40	20	30/90	5.0	0.5	5.0
2N456B	7.0	40	30	30/90	5.0	0.5	5.0
2N457A	7.0	60	30	30/90	5.0	0.5	5.0
2N457B	7.0	60	40	30/90	5.0	0.5	5.0
2N458A	7.0	80	40	30/90	5.0	0.5	5.0
2N458B	7.0	80	45	30/90	5.0	0.5	5.0
2N554	5.0	15	30	30	1.0		
2N669	3.0	30⑧	30①	250④	0.5	0.4⑤	3.0
2N1159	5.0	80	60	30/75	3.0	1.0	3.0
2N1160	7.0	80	60	20/50	5.0	1.0	5.0
2N1168	5.0	50	30	60⑤	3.0	0.25⑤	3.0
2N1534	5.0	40	20	35/70	3.0	1.2	3.0
2N1535	5.0	60	30	35/70	3.0	1.2	3.0
2N1536	5.0	80	40	35/75	3.0	1.2	3.0
2N1539	5.0	25	20	50/100	3.0	0.3	3.0
2N1540	5.0	40	30	50/100	3.0	0.3	3.0
2N1542	5.0	65	50	50/100	3.0	0.3	3.0
2N1544	5.0	25	20	75/150	3.0	0.2	3.0
2N1546	5.0	55	40	75/150	3.0	0.2	3.0

① VCES ② VCER ③ Power gain db ④ Max. ⑤ Typical ⑥ VCEX ⑦ VCE Sus ⑧ @ 90° C-REB = 100 ohm ⑨ VCBX †Military Type Spec. Δ JANTX Type Available

Delco Electronics

GENERAL MOTORS CORPORATION, KOKOMO, INDIANA

DELCO POWER SEMICONDUCTORS

Type	Ic Amps	VCBO Volts	VCEO Volts	hFE @ Ic Amps		VCE (sat) @ Ic Volts @ Amps	
PNP GERMANIUM TO-3 (TO-204MA) ALLOY BASE con't							
2N5156	10.0	100	60⑦	25/60	5.0	1.0	10.0
DTG-110	7.0	40	40②	74/250	1.0	5.0	2.0
PNP GERMANIUM TO-36 (TO-207MA) ALLOY BASE							
2N173	15.0	60	45	35/70	5.0	1.0	12.0
2N174	15.0	80	55	25/50	5.0	0.9	12.0
JAN2N174A	15.0	80	40	40/80	1.2	0.7	12.0
2N277	15.0	40	25	35/70	5.0	0.3②	12.0
2N278	15.0	50	30	35/70	5.0	1.0	12.0
2N441	15.0	40	25	20/40	5.0	0.3②	12.0
2N442	15.0	50	30	20/40	5.0	0.3②	12.0
2N443	15.0	60	45	20/40	5.0	1.0	12.0
2N1099	15.0	80	55	35/70	5.0	0.7	12.0
2N1100	15.0	100	65	25/50	5.0	0.7	12.0
2N1358	15.0	80	40	40/80	1.2	0.7	12.0
2N1358A	15.0	100	60	25/50	5.0	0.7	12.0
JAN2N1358	15.0	80	40	25/50	5.0	0.7	12.0
2N1412	15.0	100	65	25/50	5.0	0.7	12.0
JAN2N1412A	15.0	100	70	25/50	5.0	0.6	12.0
2N1518	25.0	50	40	15/60	15.0	0.7	25.0
2N1519	25.0	80	60	15/60	15.0	0.7	25.0
2N1520	35.0	50	40	17/68	15.0	0.6	35.0
2N1521	35.0	80	60	17/68	15.0	0.6	35.0
2N1522	50.0	50	40	25/100	15.0	0.5	50.0
2N1523	50.0	80	60	25/100	15.0	0.5	50.0
2N1970	15.0	100	50	17/40	5.0	1.0	12.0
2N2075	15.0	80	65	20/40	5.0	0.7	12.0
2N2076	15.0	70	55	20/40	5.0	0.7	12.0
2N2077	15.0	50	45	20/40	5.0	0.9	12.0
2N2078	15.0	40	25	20/40	5.0	0.9	12.0
2N2079	15.0	80	65	35/70	5.0	0.7	12.0
2N2080	15.0	70	55	35/70	5.0	0.7	12.0
2N2081	15.0	50	45	35/70	5.0	0.9	12.0
2N2082	15.0	40	25	35/70	5.0	0.9	12.0
2N2490	15.0	70	50	20/40	5.0	0.7	12.0
2N2491	15.0	60	40	35/70	5.0	0.7	12.0
2N2492	15.0	80	65	25/50	5.0	0.5	12.0
2N2493	15.0	100	75	25/50	5.0	0.5	12.0

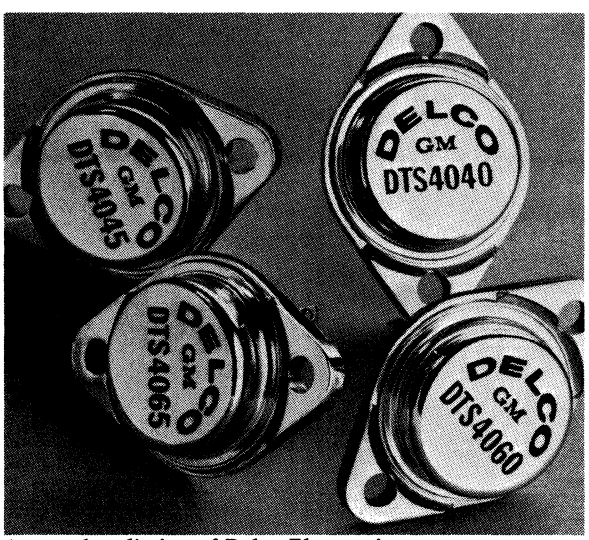
Silicon Rectifiers

TYPE	MAXIMUM FORWARD CURRENT	REVERSE WORKING VOLTAGE	PEAK TRANSIENT REVERSE VOLTAGE	REVERSE CURRENT	FORWARD VOLTAGE DROP	REPETITIVE PEAK FORWARD CURRENT
25 AMPERE PRESS FIT						
DRS1851	25A	100V	—	10 mA	1.15V	110A
DRS1852	25A	200V	—	10 mA	1.15V	110A
DRS1853	25A	300V	—	10 mA	1.15V	110A
DRS1854	25A	400V	—	10 mA	1.15V	110A
DRS1855	25A	500V	—	10 mA	1.15V	110A

TYPE	MAXIMUM FORWARD CURRENT	PEAK REVERSE VOLTAGE	PEAK TRANSIENT REVERSE VOLTAGE	REVERSE CURRENT	FORWARD VOLTAGE DROP	REPETITIVE PEAK FORWARD CURRENT
250 AMPERE STUD BASE㉑						
DRS250	250A	800V	1050V	10 mA	1.55V	4500A⑳
DRS251	250A	1000V	1300V	10 mA	1.55V	4500A⑳
DRS252	250A	1200V	1600V	10 mA	1.55V	4500A⑳
DRS253	250A	1400V	2000V	10 mA	1.55V	4500A⑳
DRS254	250A	1600V	2400V	10 mA	1.55V	4500A⑳

Zener Diodes

TYPE	MIN. ZENER VOLTAGE Vz @ 0.25 Adc	MAX. ZENER VOLTAGE PULSE WIDTH = 1ms	MAXIMUM CLAMPING FACTOR	MAXIMUM REVERSE CURRENT I_R(mA)
30 KW POWER ZENERS DO-9 CASE				
DPZ30-30R	30	43 Vdc @ 700 A	1.4	5.0
DPZ30-33R	33	47 Vdc @ 604 A	1.4	5.0
DPZ30-36R	36	52 Vdc @ 580 A	1.4	5.0
DPZ30-39R	39	56 Vdc @ 535 A	1.4	5.0
DPZ30-43R	43	62 Vdc @ 485 A	1.4	5.0
DPZ30-45R	45	65 Vdc @ 460 A	1.4	5.0
DPZ30-47R	47	68 Vdc @ 440 A	1.4	5.0
DPZ30-50R	50	72 Vdc @ 420 A	1.4	5.0



A complete listing of Delco Electronics Semiconductor Distributors can be found in the Manufacturers & Sales Office Directory.

㉑ Add R to part number for reverse polarity ⑳ ½ Cycle non-repetitive

Sales Offices

Union, New Jersey 07083,
Box 1018, Chestnut Station,
(201) 687-3770.

El Segundo, Calif. 90245,
354 Coral Circle,
(213) 640-0443.

Kokomo, Ind. 46901, 700 E.
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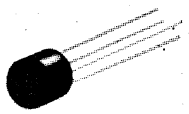
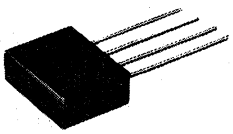
GENERAL INSTRUMENT CORPORATION

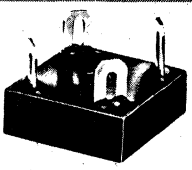
BRIDGE RECTIFIERS



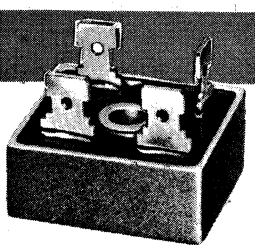
"W" ROUND CASE
PRV 50 to 600 Volts
1.5 A @ 25°C Amb Temp



KBP FLAT CASE
PRV 50 to 600 Volts
1.5 A @ 50°C Amb Temp

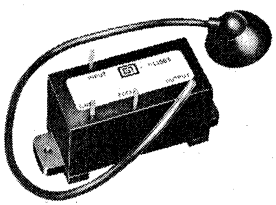


KBPC
PRV 50 to 600 Volts
3 A at 50°C Case Temp

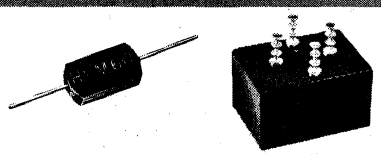


TYPE KBH & KBH25
PRV 50 to 600 Volts
At 50°C Case Temperature
10 and 25 Amperes

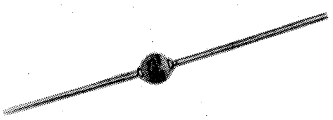
VOLTAGE MULTIPLIERS • HIGH VOLTAGE ASSEMBLIES



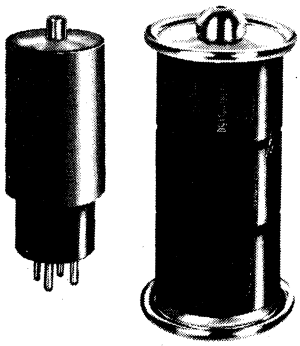
PRV Input	8.3 kV
Output V at 2.5 mA DC	25.0 kV
Focusing Voltage at 0.5 mA	8.3 kV
Overvoltage Capability	4.5 kV



GLASS MULTI-JUNCTION



HIGH VOLTAGE DIODES



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1 AMP (DO-29) G 100

I_o – 1 AMP
V_R – 1 KV

IN 4383	IN 4385
IN 4585	IN 4586
G 100A	G 100M

G 40 SILICON (DO-7) **500 MA**

IN 483	IN 486
IN 483A	IN 486A
IN 483B	IN 486B
IN 645	IN 649

I_o – 500 MA
V_R – 800 V

GLASS-AMP II®

1 & 2 AMP GPR

I_o – 1 & 2 AMP
V_R – 1 KV

IN 3611	IN 3614
IN 3866	IN 3868
IN 4245	IN 4249
IN 5059	IN 5062
G1A	G1M
G2A	G2M

3 AMP GPR

IN 3981	IN 3983
IN 5624	IN 5627
G3A	G3M

I_o – 3 AMP
V_R – 1 KV

GPR FAST RECOVERY 1 AMP

IN 4933	IN 4937
IN 4942	IN 4948
IN 5055	IN 5058
RG1A	RG1M

I_o – 1 AMP
V_R – 1 KV

GPR CLAMPER/DAMPER

CG1 — DG1 Series

I_o – 1 AMP V_R – 1.5 kV

GPR FAST RECOVERY 3 AMP

IN 5185	IN 5190
RG3A	RG3M

I_o – 3 AMP V_R – 1 kV

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MEM511	3N145
MEM511C	3N146
MEM517	3N155
MEM517A	3N155A
MEM517B	3N156
MEM517C	3N156A
MEM520	3N157
MEM520C	3N157A
MEM556	3N158
MEM556C	3N158A
MEM560	3N160
MEM560C	3N161
MEM561	3N162
MEM561C	3N163
	3N164
MEM575	3N167
MEM803	3N168
MEM804	3N172
MEM806	3N173
MEM806A	3N174
MEM807	3N178
MEM807A	3N179
MEM809	3N180
MEM814	3N181
	3N182
2N3608	3N183
2N4065	3N184
2N4120	3N185
2N4352	3N186
2N4353	

DUAL MOSFETS

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MEM550C*	MEM955B
	2N3609
MEM551	2N4066
MEM551C	2N4067
	3N147
MEM954	3N148
MEM954A	3N151
MEM954B	3N165
MEM955	3N166

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MEM557	3N141
MEM557C	3N142
MEM564C	3N143
MEM571C	3N152
MEM614	3N153
MEM615A	3N154
MEM616	3N159
MEM617	3N187
MEM618	3N192
MEM655	3N193
MEM656A	3N200
MEM660	3N201
	3N202
3N128	3N203
3N138	

N-CHANNEL ENHANCEMENT MODE MOSFETS

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MEM562C	3N170
MEM563	3N171
MEM563C	3N175
2N4038	3N176
2N4351	3N177

MULTIFET SWITCHES

MEM 780 P, D, F††
MEM 851 P, D, F
MEM 853 P, D, F
MEM 855 P, D, F
MEM 856 P, D, F
MEM 857 P, D, F

†† When ordering specify P for Plastic, D for Ceramic DIP, F for Flat/Pack to designate package desired.

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IN 4816 — IN 4822
IN 5301 — IN 5397
P 100A — P 100K

I_0 – 1 AMP V_R – 800 V

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GENERAL INSTRUMENT

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M 100A — M 100M

I_0 – 1 AMP V_R – 1 kV

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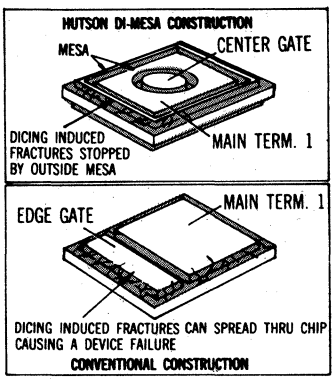
TRIAC's & SCR's

HUTSON INDUSTRIES



DI-MESA* CONSTRUCTION

This unique construction technique, patented by Hutson, provides the proven advantages of inorganic (glass) passivation while eliminating field breakdown of the passivated device.

A problem encountered in any glass passivation is that of minute edge fractures, representing incipient failures, which frequently occur in the glass as a result of laser, saw, scribe or other dicing methods. These fractures usually escape detection during ordinary testing; however, during repeated operational cycling, these fractures spread to the device junction and result in a device failure.

This failure mode is eliminated by Hutson's Di-Mesa construction, which provides a physical barrier to the spread of any fracture which may occur.

The Di-Mesa construction technique also allows, for the first time, unpackaged thyristor chips to be easily and safely handled by chip users for mounting on their substrates.

An applications bulletin on the handling and mounting techniques of thyristors in chip form and the materials required is available on request from Hutson Industries.

Hutson Industries, with in-depth experience in thyristor applications, provides its customers with technical applications assistance. Hutson engineers are always available to assist in the proper selection and application of semiconductor switching devices for specific needs.

TRIAC's

$I_{T(RMS)}$ (AMP)	T_C (°C)	HUTSON[1] NO.	PKG[2]	V_{DROM} T_J = 100°C (VOLT)	I_{TSM} (ONE-CYCLE) (AMP)	I_{GT} (MAX) T_C = 25°C (mA) QUADS I & III	QUADS II & IV
3[3]	75	HIX3SS	TO-5	50-600	30	3[4]	3[4]
		HIX3SC	TO-5	50-600	30	4	4
		HIX3SD	TO-5	50-600	30	5	5
		HIX3SG	TO-5	50-600	30	10	10
		HIX3SH	TO-5	50-600	30	25	25
6	75	HTX6	TO-5	50-600	100	50	80
		HBX6	2 LEAD TO-5	200 & 400	100	50	—
		ITX6	ISOTAB*	50-600	100	50	80
		PTX6	½" PRESS	50-600	100	50	80
		SPTX6	½" STUD	50-600	100	50	80
		6TX6	TO-66	50-600	100	50	80
8	75	ITX8	ISOTAB*	50-600	100	50	80
		PTX8	½" PRESS	50-600	100	50	80
		SPTX8	½" STUD	50-600	100	50	80
		SIPTX8	½" STUD ELEC. ISO.	50-600	100	50	80
		CTX8	CERMA-CELL	50-400	80	50	80
		6TX8	TO-66	50-600	100	50	80
10	75	ITX10	ISOTAB*	50-600	100	50	80
	70	PTX10	½" PRESS	50-600	100	50	80
		SPTX10	½" STUD	50-600	100	50	80
		SIPTX10	½" STUD ELEC. ISO.	50-600	100	50	80
15	75	ITX15	ISOTAB*	50-600	150	50	80
	70	PTX15	½" PRESS	50-600	150	50	80
		SPTX15	½" STUD	50-600	150	50	80
		SIPTX15	½" STUD ELEC. ISO.	50-600	150	50	80
25	70	PTX25	½" PRESS	50-600	250	100	150
		SPTX25	½" STUD	50-600	250	100	150
		SIPTX25	½" STUD ELEC. ISO.	50-600	250	100	150
30	70	PTX30	½" PRESS	50-600	300	100	150
		SPTX30	½" STUD	50-600	300	100	150
		SIPTX30	½" STUD ELEC. ISO.	50-600	300	100	150
		IPTX30	¾" PRESS ELEC. ISO.	50-600	300	100	150
		ISPTX30	¾" STUD ELEC. ISO.	50-600	300	100	150
		I3PTX30	TO-3 ELEC. ISO.	50-600	300	100	150
40	70	PTX40	½" PRESS	50-600	400	100	150
		SPTX40	½" STUD	50-600	400	100	150
		SIPTX40	½" STUD ELEC. ISO.	50-600	400	100	150
		IPTX40	¾" PRESS ELEC. ISO.	50-600	400	100	150
		ISPTX40	¾" STUD ELEC. ISO.	50-600	400	100	150
		I3PTX40	TO-3 ELEC. ISO.	50-600	400	100	150
40	70	2N5441	PRESS	200	300	125**	240**
		2N5442	PRESS	400	300	125**	240**
		2N5443	PRESS	600	300	125**	240**
	65	2N5444	STUD	200	300	125**	240**
		2N5445	STUD	400	300	125**	240**
		2N5446	STUD	600	300	125**	240**
60	75	PTXX60[5]	¾" PRESS	200-1000	600	100	150
		SPTXX60[5]	¾" STUD	200-1000	600	100	150

OPERATING TEMP: HUTSON NO's. = −40°C to +100°C, (T_C) (5. OPER. TEMP. = −40°C to +125°C)
"2N" SERIES = −65°C to +110°C, (T_C) V_{DROM} @ T_J = 110°C

*TRADEMARKS OF HUTSON INDUSTRIES, INC.

HUTSON INDUSTRIES
BOX 34235 • 2019 W. VALLEY VIEW LANE
DALLAS, TEXAS 75234 (214) 241-3511
TWX 910-860-5537

VICE-PRESIDENT, EUROPEAN OPERATIONS:
30 Rue Pierre Semard, Yerres, 91, France
Tel: 925-8258 • Telex: 21311

■ SHORTED-EMITTER, CENTER-GATE DESIGN ■ IMPROVED dv/dt RATINGS & di/dt CAPABILITIES ■ LOW SWITCHING LOSSES ■ VOID-FREE GLASS-PASSIVATED CHIPS ■ PATENTED DI-MESA CHIP CONSTRUCTION

SCR's

$I_{T(RMS)}$ (AMP)	T_C (°C)	HUTSON[1] NO.	PKG[1]	V_{DROM} and V_{RROM} @ T_C=100°C (VOLT)	I_{TSM} (ONE-CYCLE) (AMP)	I_{GT} T_C=25°C (MAX)
4[3]	75	HSX4S	TO-5	50-600	40	200μA
4	75	HSX4	TO-5	50-600	40	1mA
7	75	HSX7	TO-5	50-600	100	25mA
8	75	ISX8	ISOTAB*	50-600	100	25mA
		PSX8	½" PRESS	50-600	100	25mA
		SPSX8	½" STUD	50-600	100	25mA
		SIPSX8	½" STUD ELEC. ISO.	50-600	100	25mA
		CSX8	CERMA-CELL	50-400	80	25mA
		6SX8	TO-66	50-600	100	25mA
20	75	ISX20	ISOTAB	50-600	150	25mA
		PSX20	½" PRESS	50-600	150	25mA
		SPSX20	½" STUD	50-600	150	25mA
		SIPSX20	½" STUD ELEC. ISO.	50-600	150	25mA
35	75	PSX35	½" PRESS	50-600	300	25mA
		SPSX35	½" STUD	50-600	300	25mA
		SIPSX35	½" STUD ELEC. ISO.	50-600	300	25mA

OPERATING TEMP=−40°C to +100°C, (T_C)

NOTES:

1. HUTSON DEVICE NUMBERS:
   TO SPECIFY THE REQUIRED **REPETITIVE PEAK OFF-STATE VOLTAGE (V_{DROM}) RATING,** SUBSTITUTE ONE OF THE FOLLOWING NUMBERS FOR THE "X" SHOWN IN THE HUTSON NUMBER:
   0 for 50V (V_{DROM}) — 5 for 500V (V_{DROM})
   1 for 100V (V_{DROM}) — 6 for 600V (V_{DROM})
   2 for 200V (V_{DROM}) — 8 for 800V (V_{DROM})
   3 for 300V (V_{DROM}) — 10 for 1000V (V_{DROM})
   4 for 400V (V_{DROM})
2. HUTSON THYRISTORS AVAILABLE IN CHIP FORM. 50V TO 400V (V_{DROM})
3. SENSITIVE GATE THYRISTORS. SENSITIVE GATE SCR's ARE RATED AT V_{DRXM} and V_{RROM}.
4. 3mA (I_{GT}) SENSITIVE GATE TRIAC's ARE with V_{DROM} at T_J= 90°C.

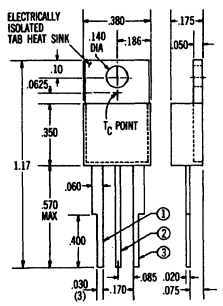
**"2N" SERIES (I_{GT}) RATINGS ARE JEDEC REGISTERED INFORMATION.

HUTSON STUD PACKAGE TRIAC's AND SCR AVAILABLE AT JEDEC OUTLINE TO-48

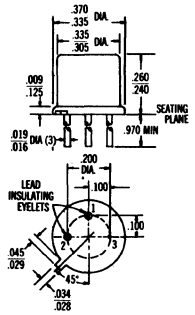
HUTSON DIACS ARE COMPATIBLE WITH HUTSON TRIAC's & SCR's.

PACKAGE:	DO-7
BREAKOVER VOLTAGE	32V ± 4V
BREAKOVER SYMMETRY	± 3V

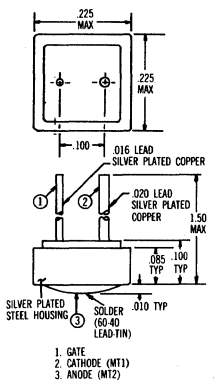
HUTSON TRIAC AND SCR OUTLINE DRAWINGS



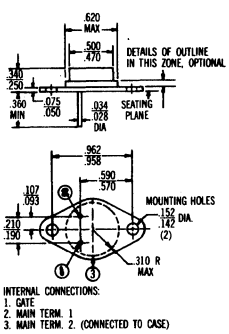
ELECTRICALLY ISOLATED ISOTAB



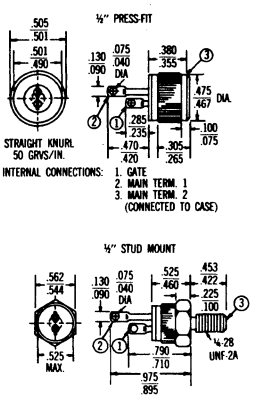
MODIFIED TO-5



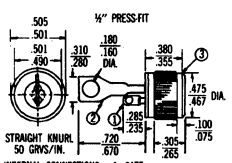
CERMA-CELL

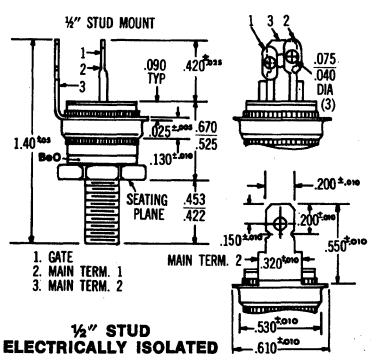


TO-66

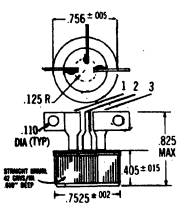


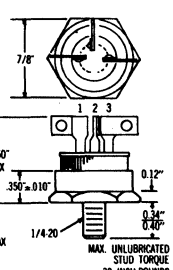
½" PRESS-SERIES

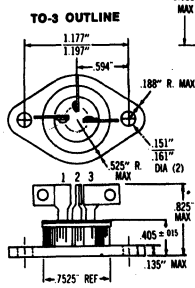




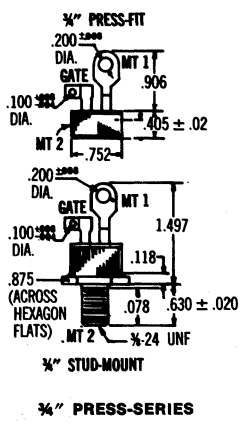
½" STUD ELECTRICALLY ISOLATED



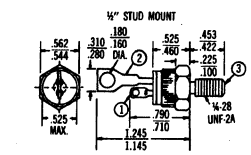




ELECTRICALLY ISOLATED ¾" PRESS-SERIES



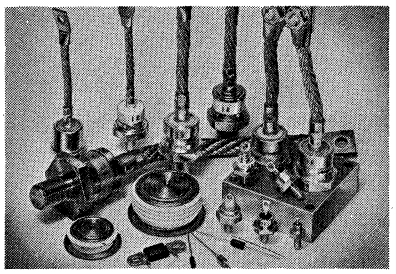
¾" PRESS-SERIES



½" PRESS-SERIES (FLAG; MT-1)

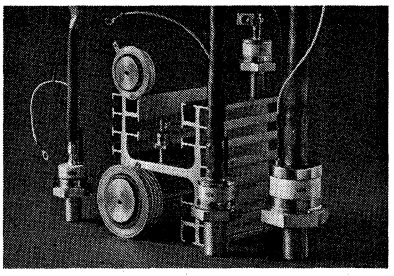
HUTSON INDUSTRIES
2019 W. VALLEY VIEW LANE
DALLAS, TEXAS 75234 (214) 241-3511
TWX 910-860-5537

What we know about solid-state conversion/control power products would fill nine books. They're yours for the asking.



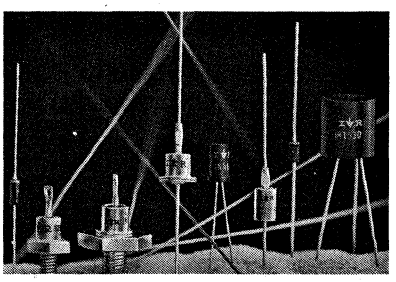
Silicon Rectifiers. IR, as the major producer in the field since its inception, provides the widest array of types including Fast Recovery units. IF range is 400 mA-800Amp(AV). PRV: 50-3000V. Our new 50A at 20V Schottky device promises to revolutionize low voltage/high current applications such as IC power supplies — particularly in the 3V-to-5V region.

Request IR Product Locator PL 2.



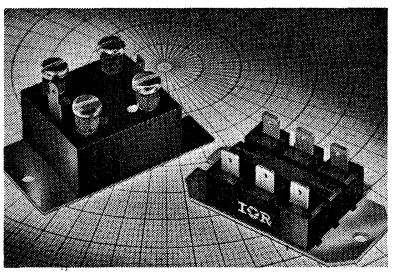
Silicon Controlled Rectifiers/Power Logic Triacs. IR's broad SCR line ranges from 1.6 Amp (RMS) units, in TO-5 cases, up to 850 Amp (RMS) "HOCKEY PUKS". Plastic devices for economy applications. Voltages: 25-1700 PRV. Also special inverter types. POWER LOGIC TRIACS — 60 to 200A; 400 to 1000V.

Request IR Product Locator PL 3.



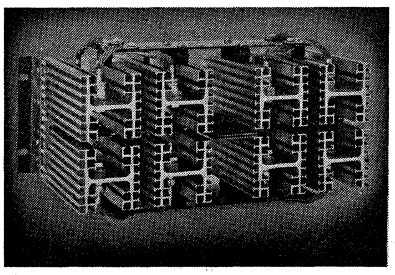
Zener Voltage Regulators/T.C. Voltage References. Long a recognized leader in zener technology, IR makes a complete line of standard, selected and special types. Regulators range from 150mW to 50W dissipation and 2 to 200Vz ratings, in tolerances from 20% down to 1%. T.C. devices — 5.9 to 49.6V in tolerances from 0.015 to 0.0005%/°C.

Request IR Product Locator PL 1.



PACE/pak™ Passivated Assembled Circuit Elements. Originated by IR, solid-state PACE/paks offer many advantages over conventionally fabricated power assemblies such as: lower costs, electrical isolation, greater dissipation efficiency, higher reliability and smaller package size. Applications are power supplies, control circuits, battery chargers and choppers. Presently, standard types come in 25A and 42.5A; 120V and 230V.

Request IR Product Locator PL 4.

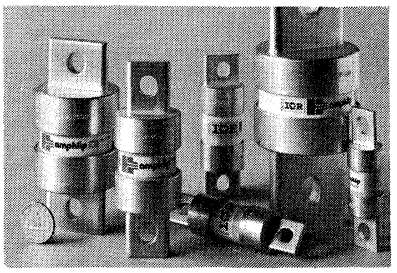


Power Assemblies/Heat Exchangers. From tube replacements to single and 3-phase power stacks/AC contactors into the megawatt range, IR supplies complete packages including heat-sinks and control circuitry.

Request IR Product Locator PL 4.

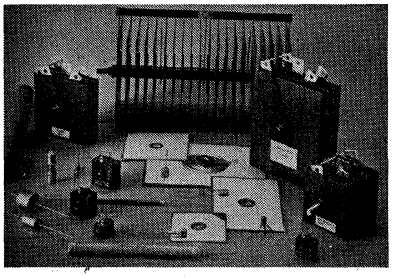
Designed by power semiconductor specialists, IR heat exchangers are specially fabricated to optimize thermal dissipation and reduce mounting costs.

Request Heat Exchanger bulletin 7.001.



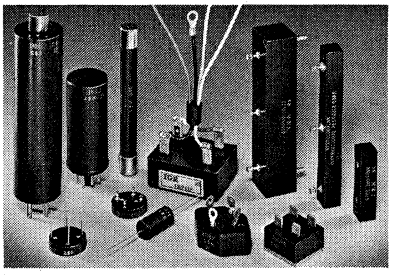
Semiconductor Protective Fuses. IR's fast-acting AMPKLIP fuses are rated for "worst case" conditions by power semiconductor specialists to eliminate trial and error testing. All-welded ceramic body assures reliability under high temperatures. Can't char or burn. Superior I^2t allows close match between the fuse and power semiconductor circuits. Wide range of ratings: 130—700V; 10—800A, RMS.

Write on letterhead for free copy of "Semiconductor Fuse Application Handbook"



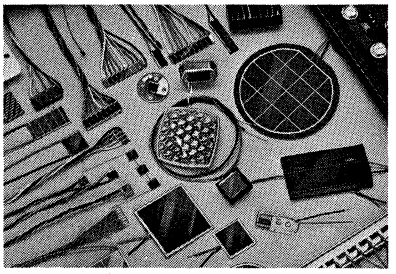
Selenium Rectifiers/Suppressors/Contact Protectors. IR offers an extensive assortment of standard and custom configurations including: power stacks, cartridges, miniature stacks, single diodes, universal "quick charger" stacks, loose-cell "kits", TV replacement cartridges, voltage suppressors ("Klip-Sels") and contact protectors.

Request IR Product Locator PL 5.



Molded Circuit Assemblies. IR's range of compact molded assemblies include half-wave, doubler and bridge rectifier circuits, as well as high-power cartridge rectifiers from 1.5 to 50KV. They include a variety of package and lead configurations — fuse-clip mounting; direct heat-sink mounting; square; rectangular; tubular; single-ended or axial-lead types. Some types feature RC compensation for added system reliability.

Request IR Product Locator PL 4.



Opto-Electronic Devices. A pioneer in the photo-voltaic sensing field, IR offers a variety of silicon and selenium devices and arrays for applications such as: card/tape readers; analog-to-digital encoding; shaft positioning; photo-electric activation; solar energy converters; etc. They are available for both standard and custom requirements.

Request IR Product Locator PL 6.

from IR... the innovative power people

INTERNATIONAL RECTIFIER IOR

SEMICONDUCTOR DIVISION, 233 KANSAS STREET, EL SEGUNDO, CALIFORNIA 90245, (213)678-6281

LOOKING FOR THOSE HARD-TO-GET SPECIAL AND DISCONTINUED TRANSISTORS... INCLUDING PHILCO AND SPRAGUE TYPES?

TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE
2N128	2N535B	2N795	2N965	2N1200	2N1655	2N1986	2N2221	2N2539	2N2967
2N207	2N536	2N796	2N966	2N1201	2N1656	2N1987	2N2221A	2N2540	2N3011
2N207A	2N588	2N785	2N967	2N1204	2N1663	2N1988	2N2222	2N2651	2N3015
2N207B	2N589	2N828	2N976	2N1204A	2N1676	2N1989	2N2222A	2N2699	2N3133
2N223	2N597	2N834	2N977	2N1219	2N1677	2N1990	2N2274	2N2710	2N3134
2N224	2N598	2N835	2N979	2N1220	2N1683	2N2048	2N2275	2N2795	2N3135
2N225	2N599	2N846	2N980	2N1221	2N1711	2N2086	2N2276	2N2796	2N3136
2N226	2N600	2N846A	2N982	2N1222	2N1726	2N2087	2N2277	2N2904	2N3317
2N227	2N601	2N846B	2N983	2N1223	2N1727	2N2088	2N2278	2N2904A	2N3318
2N231	2N670	2N858	2N984	2N1267	2N1728	2N2147	2N2279	2N2905	2N3319
2N232	2N671	2N859	2N1024	2N1268	2N1742	2N2148	2N2280	2N2905A	2N3320
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2N344	2N674	2N862	2N1027	2N1271	2N1745	2N2164	2N2360	2N2907	2N3342
2N345	2N675	2N863	2N1028	2N1272	2N1746	2N2165	2N2361	2N2907A	2N3343
2N346	2N696	2N864	2N1034	2N1300	2N1747	2N2166	2N2362	2N2954	2N3344
2N352	2N697	2N865	2N1035	2N1301	2N1748	2N2167	2N2368	2N2966	2N3345
2N353	2N698	2N924	2N1036	2N1411	2N1748A	2N2168	2N2369		2N3346
2N355	2N699	2N926	2N1037	2N1416	2N1749	2N2169	2N2369A		
2N386	2N699A	2N927	2N1118	2N1427	2N1750	2N2170	2N2374		
2N387	2N706	2N928	2N1118A	2N1428	2N1752	2N2175	2N2375		
2N393	2N706A	2N929	2N1119	2N1429	2N1753	2N2176	2N2376		
2N395	2N706B	2N930	2N1122	2N1436	2N1754	2N2177	2N2377		
2N396	2N708	2N935	2N1122A	2N1467	2N1785	2N2178	2N2378		
2N396A	2N709	2N936	2N1123	2N1472	2N1786	2N2180	2N2380		
2N408	2N768	2N937	2N1124	2N1478	2N1787	2N2181	2N2380A		
2N428	2N769	2N938	2N1125	2N1494	2N1788	2N2182	2N2398		
2N495	2N770	2N939	2N1128	2N1494A	2N1789	2N2183	2N2399		
2N496	2N771	2N940	2N1129	2N1495	2N1790	2N2184	2N2400		
2N499	2N772	2N941	2N1130	2N1496	2N1864	2N2185	2N2401		
2N499A	2N773	2N942	2N1131	2N1499	2N1865	2N2186	2N2402		
2N501	2N774	2N943	2N1132	2N1499A	2N1866	2N2187	2N2410		
2N501A	2N775	2N944	2N1135	2N1499B	2N1867	2N2199	2N2451		
2N502	2N776	2N945	2N1135A	2N1500	2N1868	2N2200	2N2478		
2N502A	2N777	2N946	2N1158	2N1606	2N1893	2N2217	2N2479		
2N502B	2N778	2N947	2N1158A	2N1607	2N1905	2N2218	2N2487		
2N503	2N779	2N960	2N1177	2N1608	2N1917	2N2218A	2N2488		
2N504	2N779A	2N961	2N1178	2N1613	2N1918	2N2219	2N2489		
2N534	2N779B	2N962	2N1179	2N1623	2N1983	2N2219A	2N2537		
2N535	2N784A	2N963	2N1199	2N1643	2N1984	2N2220	2N2538		
2N535A	2N794	2N964	2N1199A	2N1654	2N1985				

SPECIALS

T1750	T2039
T1872	T2040
T1905	T2042
T1943	T2044
T2028	T2092
T2029	T2113
T2030	T2122
T2038	T2340

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LTE 709C	LTE 711C

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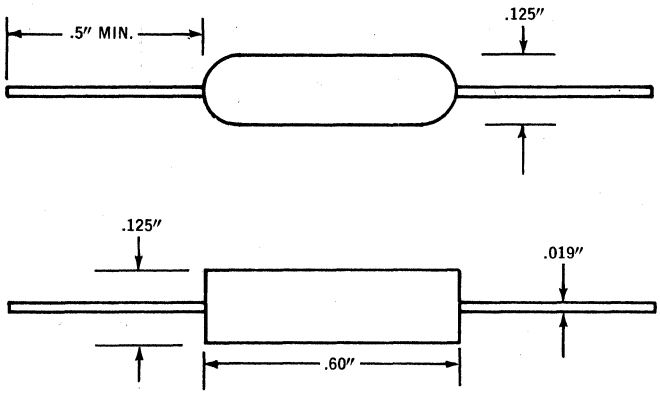
MINIATURE SILICON RECTIFIER STACKS

MH SERIES

AVALANCHE 5,000 TO 13,000 20 MA CURRENT STANDARD & FAST RECOVERY

AVALANCHE MINIATURE HIGH VOLTAGE



SILICON RECTIFIER STACKS
STANDARD & FAST RECOVERY

REVERSE VOLTAGE TRANSIENT PROTECTION

All rectifier types have built-in reverse avalanche voltage characteristics at a minimum of 20% above the rated PIV. Avalanche voltage is measured at 100 μa DC in the avalanche region.

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Average Forward Current @ 100°C (MA)	Max. Forward Voltage @ 20 MA
MH5	5,000	20	10	15
MH6	6,000	20	10	15
MH7	7,000	20	10	15
MH8	8,000	20	10	15
MH10	10,000	20	10	15
MH12	12,000	20	10	15
MH13	13,000	20	10	15

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 25°C	0.1μa
Max. Reverse Current @ PIV @ 100°C	10.0 μa
Max. 8 MS Surge	3 AMP
Storage Temperature: −55°C to +150°C	

FAST RECOVERY

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Average Forward Current @ 100°C (MA)	Max. Forward Voltage @ 20 MA
MH5F	5,000	20	70	18
MH6F	6,000	20	70	18
MH7F	7,000	20	70	18
MH8F	8,000	20	70	18
MH10F	10,000	20	70	18
MH12F	15,000	20	70	18

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 25°C	2 μa
Max. Reverse Current @ PIV @ 90°C	10 μa
Max. 8 MS Surge	3 AMP
Reverse Recovery Time, T_{rr} @ I_F=2 MA to I_R=4 MA	250NS TYP
Storage Temperature: −55°C to +150°C	

M & H ELECTRONICS

500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES

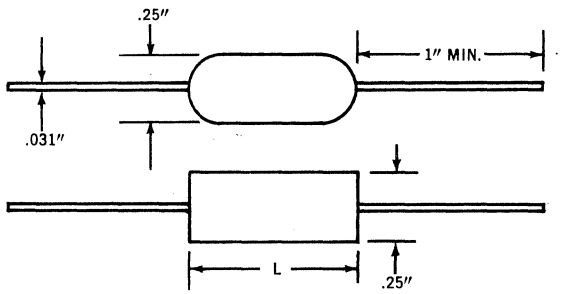
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

HIGH VOLTAGE SILICON RECTIFIER STACKS 20 MA CONTINUOUS CURRENT

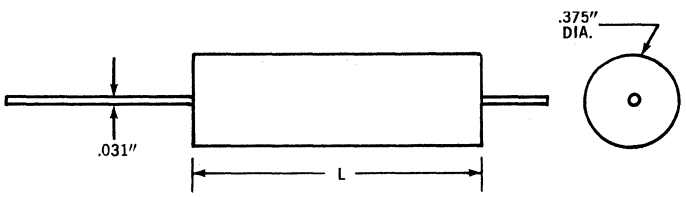
BULLETIN S11
HIGH VOLTAGE
20 MA SERIES

8,000-45,000 VOLTS
20 MA CURRENT
STANDARD &
FAST RECOVERY

AVALANCHE HIGH VOLTAGE RECTIFIERS



CASE STYLE A — L = .75″
CASE STYLE B — L = 1.5″
CASE STYLE D — L = 2.5″



CASE STYLE E — L = 2.0″
CASE STYLE F — L = 2.5″
CASE STYLE G — L = 3.5″

20 MA CONTINUOUS CURRENT
STANDARD & FAST RECOVERY

REVERSE VOLTAGE TRANSIENT PROTECTION

All rectifier types have built-in reverse avalanche voltage characteristic at a minimum of 20% above the rated PIV. Avalanche voltage is measured at 100 microamps DC in the avalanche region.

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 20 MA	Case Style
20MH8	8,000	20	15	A
20MH10	10,000	20	15	A
20MH15	15,000	20	30	B
20MH20	20,000	20	30	B
20MH25	25,000	20	30	E
20MH30	30,000	20	45	D & F
20MH45	45,000	20	60	G

ELECTRICAL CHARACTERISTICS

Max Reverse Current @ 25°C	0.2 Micro A
Max. Reverse Current @ 100°C	10 Micro A
Avg. Forward Current @ 100°C	10 MA
Max. 8 MS Surge	3 AMP
Storage Temperature	−55°C to 150°C

FAST RECOVERY

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 20 MA	Case Style
20MH8F	8,000	20	18	A
20MH10F	10,000	20	18	A
20MH15F	15,000	20	36	B
20MH20F	20,000	20	36	B
20MH25F	25,000	20	36	E
20MH30F	30,000	20	54	D & F
20MH45F	45,000	20	72	G

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ 25°C	1 Micro A
Max. Reverse Current @ 90°C	10 Micro A
Avg. Forward Current @ 90°C	10 MA
Max. 8 MS Surge	3 AMP
Storage Temperature	−55°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=2 MA to I_R=4 MA	250 NS TYP

M & H ELECTRONICS
500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

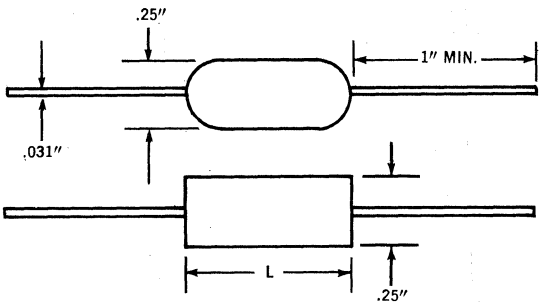
THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

HIGH VOLTAGE SILICON RECTIFIER STACKS 100 MA CONTINUOUS CURRENT

BULLETIN S12
HIGH VOLTAGE
100 MA SERIES

8,000-45,000 VOLTS
100 MA CURRENT
STANDARD &
FAST RECOVERY

AVALANCHE HIGH VOLTAGE RECTIFIERS



CASE STYLE A — L = .75″
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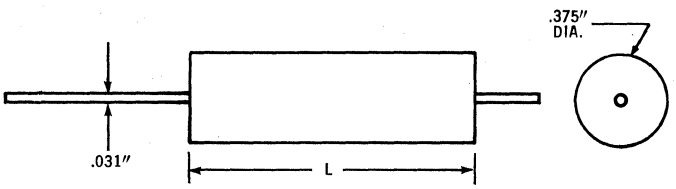

CASE STYLE E — L = 2.0″
CASE STYLE F — L = 2.5″
CASE STYLE G — L = 3.5″

100 MA CONTINUOUS CURRENT
STANDARD & FAST RECOVERY

REVERSE VOLTAGE TRANSIENT PROTECTION

All rectifier types have built-in reverse avalanche voltage characteristic at a minimum of 20% above the rated PIV. Avalanche voltage is measured at 200 microamps DC in the avalanche region.

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 100 MA	Case Style
100MH8	8,000	100	15	A
100MH10	10,000	100	15	A
100MH15	15,000	100	30	B
100MH20	20,000	100	30	B
100MH25	25,000	100	30	E
100MH30	30,000	100	45	D & F
100MH45	45,000	100	60	G

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ 25°C	0.5 Micro A
Max. Reverse Current @ 100°C	20 Micro A
Avg. Forward Current @ 100°C	50 MA
Max. 8 MS Surge	10 AMP
Storage Temperature	−65°C to 150°C

FAST RECOVERY

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 100 MA	Case Style
100MH8F	8,000	100	18	A
100MH10F	10,000	100	18	A
100MH15F	15,000	100	36	B
100MH20F	20,000	100	36	B
100MH25F	25,000	100	36	E
100MH30F	30,000	100	54	D & F
100MH45F	45,000	100	72	G

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ 25°C	1 Micro A
Max. Reverse Current @ 90°C	20 Micro A
Avg. Forward Current @ 90°C	50 MA
Max. 8 MS Surge	10 AMP
Storage Temperature	−65°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=2 MA to I_R=4 MA	250 NS TYP

M & H ELECTRONICS
500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES

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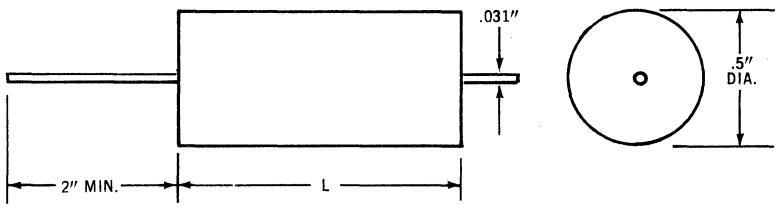
HIGH VOLTAGE SILICON RECTIFIER STACKS 350 MA CONTINUOUS CURRENT

BULLETIN S13
HIGH VOLTAGE
350 MA SERIES

3,000-30,000 VOLTS
350 MA CURRENT
STANDARD &
FAST RECOVERY

AVALANCHE HIGH VOLTAGE RECTIFIERS



350 MA CONTINUOUS CURRENT
STANDARD & FAST RECOVERY

REVERSE VOLTAGE TRANSIENT PROTECTION

All rectifier types have built-in reverse avalanche voltage characteristic at a minimum of 20% above the rated PIV. Avalanche voltage is measured at 250 microamps DC in the avalanche region.

STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 350 MA	Case Length (L) (In.)
350MH3	3,000	350	3	0.5
350MH5	5,000	350	6	1.0
350MH8	8,000	350	9	1.5
350MH10	10,000	350	12	1.5
350MH15	15,000	350	15	2.0
350MH20	20,000	350	18	2.5
350MH25	25,000	350	24	3.0
350MH30	30,000	350	30	3.0

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 25°C	1 Micro A
Max. Reverse Current @ PIV @ 100°C	10 Micro A
Avg. Forward Current @ 100°C	175 MA
Max. 8 MS Surge	15 AMP
Storage Temperature	−55°C to 150°C

FAST RECOVERY

M & H Part No.	PIV (Volts)	Average Forward Current @ 25°C (MA)	Max. Forward Voltage @ 350 MA	Case Length (L) (In.)
350MH3F	3,000	350	4	0.5
350MH5F	5,000	350	8	1.0
350MH8F	8,000	350	12	1.5
350MH10F	10,000	350	16	1.5
350MH15F	15,000	350	20	2.0
350MH20F	20,000	350	24	2.5
350MH25F	25,000	350	32	3.0
350MH30F	30,000	350	40	3.0

ELECTRICAL CHARACTERISTICS

Max. Reverse Current @ PIV @ 25°C	2 Micro A
Max. Reverse Current @ PIV @ 90°C	20 Micro A
Avg. Forward Current @ 90°C	175 MA
Max. 8 MS Surge	12 AMP
Reverse Recovery Time, T_{rr} @ I_F=2 MA to I_R=4 MA	300 NS TYP
Storage Temperature	−55°C to 150°C

M & H ELECTRONICS
500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

FULL WAVE BRIDGES 1 AMPERE

BULLETIN B11
FULL WAVE BRIDGE

BRIDGE RECTIFIERS
50 TO 1000 VOLTS
1 AMPERE
STANDARD &
FAST RECOVERY

1.0 AMP AVERAGE OUTPUT CURRENT

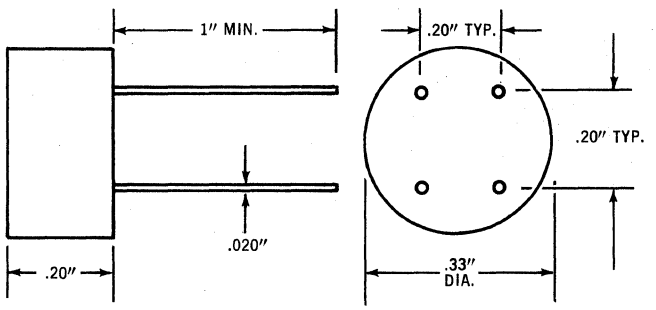
50 TO 1000 VOLTS

25 AMPERES CURRENT SURGE

CONTROLLED AVALANCHE TYPES

STANDARD & FAST RECOVERY

2000 V MIN CASE INSULATION



STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
1BR05	50	1	0.5	25
1BR10	100	1	0.5	25
1BR20	200	1	0.5	25
1BR40	400	1	0.5	25
1BR60	600	1	0.5	25
1BR80	800	1	0.5	25
1BR100	1000	1	0.5	25

FAST RECOVERY

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
1BR05F	50	1	0.5	20
1BR10F	100	1	0.5	20
1BR20F	200	1	0.5	20
1BR40F	400	1	0.5	20
1BR60F	600	1	0.5	20
1BR80F	800	1	0.5	20
1BR100F	1000	1	0.5	20

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
1CBR20	250	700	1	0.5	25
1CBR40	450	900	1	0.5	25
1CBR60	650	1100	1	0.5	25
1CBR80	850	1300	1	0.5	25
1CBR100	1050	1400	1	0.5	25

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 1 Amp (per Diode)	1.2 V
Max. Reverse Current @ PIV @ 50°C	10 Micro A
Storage Temperature	−50°C to 150°C

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
1CBR20F	250	700	1	0.5	20
1CBR40F	450	900	1	0.5	20
1CBR60F	650	1100	1	0.5	20
1CBR80F	850	1300	1	0.5	20
1CBR100F	1050	1400	1	0.5	20

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 1 Amp (per Diode)	1.5 V
Max. Reverse Current @ PIV @ 50°C	20 Micro A
Storage Temperature	−50°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=1 A to I_R=2 A	300 NS

M & H ELECTRONICS

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THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES

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FULL WAVE BRIDGES 2 AMPERES

BULLETIN B12
FULL WAVE BRIDGE

BRIDGE RECTIFIERS
50 TO 1000 VOLTS
2 AMPERES
STANDARD &
FAST RECOVERY

2.0 AMPS AVERAGE OUTPUT CURRENT

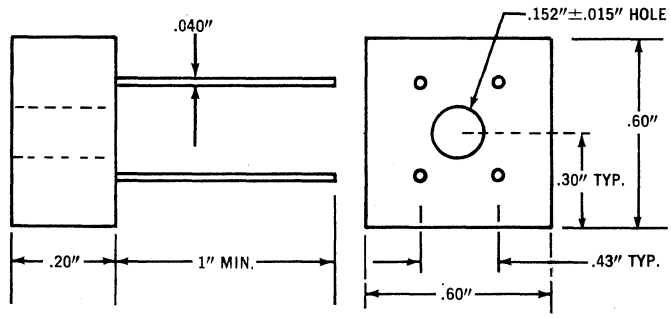
50 TO 1000 VOLTS

50 AMPERES CURRENT SURGE

CONTROLLED AVALANCHE TYPES

STANDARD & FAST RECOVERY

2000 V MIN CASE INSULATION



STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
2BR05	50	2	1	50
2BR10	100	2	1	50
2BR20	200	2	1	50
2BR40	400	2	1	50
2BR60	600	2	1	50
2BR80	800	2	1	50
2BR100	1000	2	1	50

FAST RECOVERY

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
2BR05F	50	2	1	35
2BR10F	100	2	1	35
2BR20F	200	2	1	35
2BR40F	400	2	1	35
2BR60F	600	2	1	35
2BR80F	800	2	1	35
2BR100F	1000	2	1	35

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
2CBR20	250	700	2	1	50
2CBR40	450	900	2	1	50
2CBR60	650	1100	2	1	50
2CBR80	850	1300	2	1	50
2CBR100	1050	1400	2	1	50

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 2 Amp (per Diode)	1.2 V
Max. Reverse Current @ PIV @ 50°C	10 Micro A
Storage Temperature	−50°C to 150°C

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
2CBR20F	250	700	2	1	35
2CBR40F	450	900	2	1	35
2CBR60F	650	1100	2	1	35
2CBR80F	850	1300	2	1	35
2CBR100F	1050	1400	2	1	35

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 2 Amp (per Diode)	1.5 V
Max. Reverse Current @ PIV @ 50°C	20 Micro A
Storage Temperature	−50°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=1 A to I_R=2 A	300 NS

M & H ELECTRONICS
500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

THE NEW SYMBOL IN HIGH RELIABILITY IN SEMICONDUCTOR DEVICES
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

FULL WAVE BRIDGES 6 AMPERES

BULLETIN B13
FULL WAVE BRIDGE

BRIDGE RECTIFIERS
50 TO 1000 VOLTS
6 AMPERES
STANDARD &
FAST RECOVERY

6.0 AMPS AVERAGE OUTPUT CURRENT

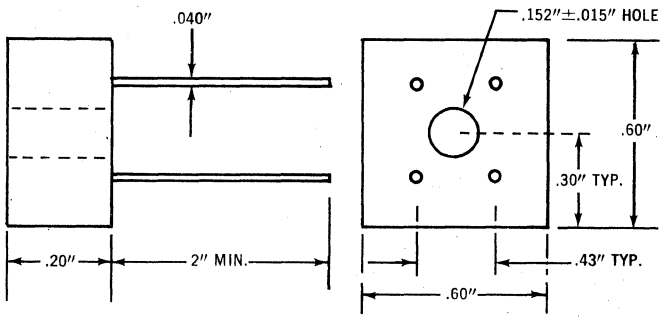
50 TO 1000 VOLTS

100 AMPERES CURRENT SURGE

CONTROLLED AVALANCHE TYPES

STANDARD & FAST RECOVERY

2000 V MIN CASE INSULATION



STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
6BR05	50	6	3	100
6BR10	100	6	3	100
6BR20	200	6	3	100
6BR40	400	6	3	100
6BR60	600	6	3	100
6BR80	800	6	3	100
6BR100	1000	6	3	100

FAST RECOVERY

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
6BR05F	50	6	3	75
6BR10F	100	6	3	75
6BR20F	200	6	3	75
6BR40F	400	6	3	75
6BR60F	600	6	3	75
6BR80F	800	6	3	75
6BR100F	1000	6	3	75

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
6CBR20	250	700	6	3	100
6CBR40	450	900	6	3	100
6CBR60	650	1100	6	3	100
6CBR80	850	1300	6	3	100
6CBR100	1050	1400	6	3	100

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 6 Amp (per Diode)	1.2 V
Max. Reverse Current @ PIV @ 50°C	10 Micro A
Storage Temperature	−50°C to 150°C

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
6CBR20F	250	700	6	3	75
6CBR40F	450	900	6	3	75
6CBR60F	650	1100	6	3	75
6CBR80F	850	1300	6	3	75
6CBR100F	1050	1400	6	3	75

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 6 Amp (per Diode)	1.5 V
Max. Reverse Current @ PIV @ 50°C	20 Micro A
Storage Temperature	−50°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=1 A to I_R=2 A	300 NS

M & H ELECTRONICS
500 LONG BRANCH AVENUE, LONG BRANCH NEW JERSEY 07740 PHONE (201) 229-0500

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50 TO 800 VOLTS
10 AMPERES
STANDARD &
FAST RECOVERY

10.0 AMPS AVERAGE OUTPUT CURRENT

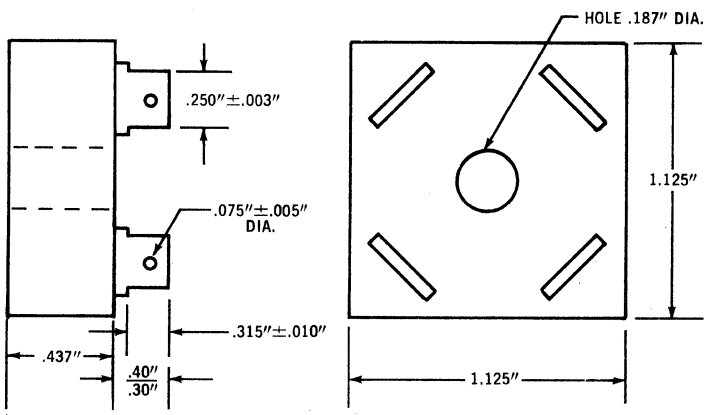
50 TO 800 VOLTS

200 AMPERES CURRENT SURGE

CONTROLLED AVALANCHE TYPES

STANDARD & FAST RECOVERY

2000 V MIN CASE INSULATION



STANDARD 60 HZ

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
10BR05	50	10	5	200
10BR10	100	10	5	200
10BR20	200	10	5	200
10BR40	400	10	5	200
10BR60	600	10	5	200
10BR80	800	10	5	200

FAST RECOVERY

M & H Part No.	PIV (Volts)	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
10BR05F	50	10	5	175
10BR10F	100	10	5	175
10BR20F	200	10	5	175
10BR40F	400	10	5	175
10BR60F	600	10	5	175
10BR80F	800	10	5	175

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 100°C	Peak 8 MS Surge Current (Amps)
10CBR20	250	700	10	5	200
10CBR40	450	900	10	5	200
10CBR60	650	1100	10	5	200
10CBR80	850	1300	10	5	200

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 10 Amp (per Diode)	1.2 V
Max. Reverse Current @ PIV @ 50°C	10 Micro A
Storage Temperature	−50°C to 150°C

CONTROLLED AVALANCHE TYPES

M & H Part No.	Avalanche Voltage Min.	Avalanche Voltage Max.	Avg. DC Forward Current (Amps) @ 50°C	Avg. DC Forward Current (Amps) @ 85°C	Peak 8 MS Surge Current (Amps)
10CBR20F	250	700	10	5	175
10CBR40F	450	900	10	5	175
10CBR60F	650	1100	10	5	175
10CBR80F	850	1300	10	5	175

ELECTRICAL CHARACTERISTICS

Max. Inst. Forward Voltage @ 10 Amp (per Diode)	1.5 V
Max. Reverse Current @ PIV @ 50°C	20 Micro A
Storage Temperature	−50°C to 150°C
Reverse Recovery Time, T_{rr} @ I_F=1 A to I_R=2 A	300 NS

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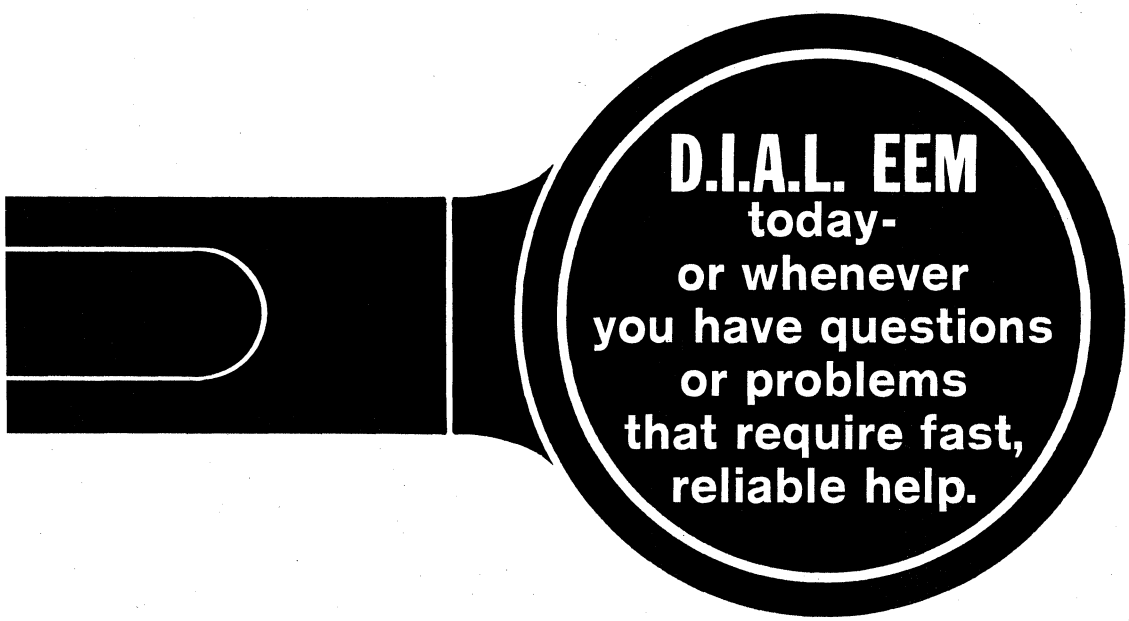

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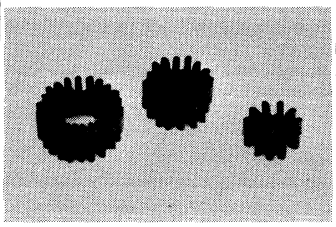
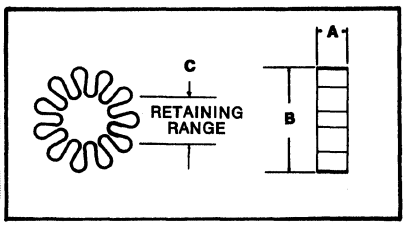
TR SERIES TRANSISTOR HEAT RADIATORS





TYPE	DIMENSIONS A	B	C
TR 101	.250	.600 / .650	.290 / .400
TR 120	.185	.600 / .650	.290 / .400
TR 108	.250	.650 / .825	.360 / .525
TR 118	.150	.450 / .500	.150 / .200

- Protect TO-packaged transistors from destructive heat rise
- Provide up to 4 sq. in. radiating surface in close thermal contact with package
- Self-adjusting. Sizes for TO packages listed with tolerances as specified by JEDEC.
- May be PC-board mounted
- Beryllium copper #25 with black ebanol finish

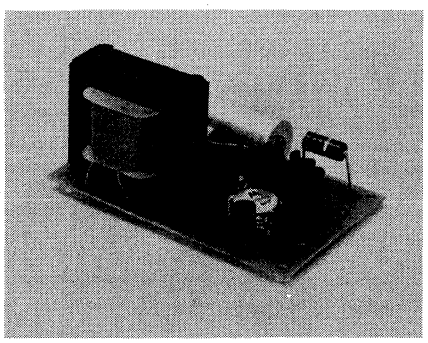
Self-adjusting to the follcwing outlines:

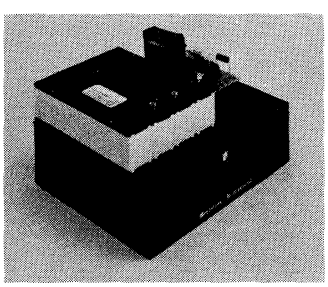
TR 118.....TO-18
TR 108.....TO-8
TR 101.....TO-5, TO-9, TO-11, TO-12, TO-16, TO-29, TO-33, TO-39, TO-42, TO-43

TO ORDER: SPECIFY TYPE NUMBER.

CURRENT-REGULATED BATTERY CHARGERS

- Complete line, 20 mA to 50A output current
- Chargers available for all output voltage ranges
- Multiple-cell series-charging capability
- PC card, rack, or wall mounting
- Input frequencies available from 40 to 400 Hz.
- Current regulation ±2% (1%, 3%, or 5% available)
- Options include meters, timers, dual charge rates (full and trickle) and multiple current ranges (laboratory-type chargers).





POWER-PAKS

- Nickel-cadmium batteries integrally packaged with Mauratron's transistorized, current-regulated chargers
- "Dierdre" Power Paks: Pressed pocket-type plates for average discharge rates, long cycle life
- "Sean" Power Paks: Sintered plate type for high discharge current loads, extremely long cycle life
- 115 VAC, 60 Hz inputs (25 Hz to 400 Hz available)
- Ideal for standby power for controls, uninterruptible power systems, etc.

GELLED-ELECTROLYTE BATTERY CHARGERS

Complete line of chargers for gelled-electrolyte batteries.

500 Series provides full recharge in 16 to 20 hours.

800 Series for "standby" or "float" service automatically provides current required to maintain full charge.

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GOULD, INC.: NICKEL-CADMIUM RECHARGEABLE BATTERIES Complete line includes individual cells or packaged configurations (battery packs) in button, cylindrical and rectangular cell types.

GLOBE-UNION, INC. BATTERY DIVISION: GEL/CELL® GELLED-ELECTROLYTE BATTERIES

SCHAUER MFG. CORP.: 1 W ZENER DIODES, 2.0 to 18.V ■ SILICON VARISTORS, 25 A peak ½ cycle, ¾ W. Types SV1, SV1-LR, and V64 ■ STABISTOR FORWARD REFERENCE DIODES, one- and two-junction types, 20 A peak ½ cycle, ¾ W.

WOOD ELECTRIC: THERMAL & MAGNETIC CIRCUIT BREAKERS.

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DIRECTRON INDUSTRIAL SELENIUM RECTIFIERS,

ELEVATOR CONTROL RECTIFIERS

Part No.	AC Input Volts Up To	Phase	Amps	Units Required	List Price Unit	List Price Set
CD260	260	1φ	1.5	2	$10.00	$20.00
		3φ	2.2	3	10.00	30.00
DD260	260	1φ	2.2	2	12.00	24.00
		3φ	3.3	3	12.00	36.00
ED260	260	1φ	3.4	2	15.00	30.00
		3φ	5.1	3	15.00	45.00
FD260	260	1φ	6.6	2	19.00	38.00
		3φ	10.	3	19.00	57.00
COMPACT UNIT (Double Decker)						
3D260	260	3φ	3.	1	36.00	

24 Hour Service on Custom Built Rectifiers — Send us your samples.

FULL WAVE BRIDGE RECTIFIERS, SINGLE PHASE, RESISTIVE-INDUCTIVE LOADS

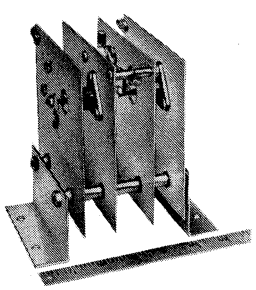
Max. Amps	18V In— 14V Out No.	Price	36V In— 28V Out No.	Price	54V In— 42V Out No.	Price	130V In— 100V Out No.	Price	160V In— 130V Out No.	Price	260V In— 200V Out No.	Price
½	A18	$1.30	A36	$2.00	A54	$3.00	A130	$6.75	A160	$10.00	A260	$11.00
1	B18	1.50	B36	2.75	B54	4.00	B130	11.00	B160	16.50	B260	17.75
2	C18	2.75	C36	4.00	C54	5.50	C130	13.25	C160	20.00	C260	22.00
3	D18	3.50	D36	5.50	D54	7.75	D130	17.75	D160	26.50	D260	31.00
4	E18	4.50	E36	9.00	E54	12.00	E130	27.50	E160	41.50	E260	53.00
6	F18	6.50	F36	12.00	F54	15.50	F130	37.50	F160	56.00	F260	59.50
10	G18	9.00	G36	16.50	G54	22.00	G130	44.00	G160	66.00	G260	75.00
12	H18	11.00	H36	20.00	H54	26.50	H130	51.00	H160	*	H260	86.00
15	J18	13.50	J36	25.00	J54	32.00	J130	61.00	J160	*	J260	108.00
20	K18	16.50	K36	34.00	K54	44.00	K130	88.00	K160	*	K260	158.00
24	L18	18.50	L36	38.00	L54	51.00	L130	94.00	L160	*	L260	170.00
30	M18	23.00	M36	46.00	M54	66.00	M130	*	M160	*	M260	*
36	P18	29.00	P36	57.00	P54	*	P130	*	P160	*	P260	*
50	R18	36.00	R36	71.00	R54	*	R130	*	R160	*	R260	*

220V Single Phase available . . . up to 1000 amps.
HALF-WAVE, CENTER-TAP, DOUBLER, TRIPLER or 3-PHASE — Quotations on request.
Minimum Order — $15.00 *Prices on Request — Quantity Discount — Prices Subject to Change

HY-A-SIL HIGH-AMPERE SILICON RECTIFIERS

FEATURES

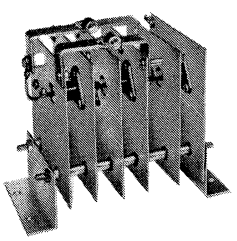
- High Operating Temperature, 190°C (Up to 120°C ambient)
- High Operating Voltage (Up to 600 p.i.v.)
- High Efficiency (99% compared to about 75% for selenium)
- Excellent Regulation (4% compared to about 15% for selenium)



SL–BR–F

CENTER-TAP

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SI-CT-A	18-0-18	16	40	80	B	$17.00
SI-CT-B	36-0-36	32	40	80	B	22.00
SL-CT-A	18-0-18	16	50	100	B	20.00
SL-CT-B	36-0-36	32	50	100	B	25.00
SL-CT-D	72-0-72	64	50	100	B	40.00
SL-CT-F	140-0-140	125	50	100	B	49.00
SK-CT-A	18-0-18	16	100	200	C	33.00
SK-CT-B	36-0-36	32	100	200	C	38.00
SK-CT-D	72-0-72	64	100	200	C	41.00
SK-CT-F	140-0-140	125	100	200	C	53.00
SM-CT-A	18-0-18	16	200	400	D	50.00
SM-CT-B	36-0-36	32	200	400	D	66.00
SM-CT-D	72-0-72	64	200	400	D	69.00
SM-CT-F	140-0-140	125	200	400	D	84.00
SO-CT-B	36-0-36	32	400	800	E	110.00



SL–PH–F

DIMENSIONS WITH BRACKETS

Size	Length	Height	Width	Weight
B	3″	6″	5″	12 oz.
C	3″	6″	6″	1 lb.
D	4″	8″	7″	2 lbs.
E	4″	9″	8″	6 lbs.
F	6″	5″	5″	1¼ lbs.
G	6″	6″	5″	1½ lbs.
H	6″	6″	6″	2 lbs.
J	6″	6″	5″	1½ lbs.
K	7″	8″	7″	4 lbs.
L	8″	9″	8″	6 lbs.
M	8″	11″	10″	6 lbs.
N	8″	6″	5″	4 lbs.

*Not suitable for fan-cooling.

1φ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SA-BR-D	140	125	1	*	—	$10.00
SA-BR-F	280	250	1	*	—	12.00
SC-BR-D	140	125	2	*	—	12.00
SC-BR-F	280	250	2	*	—	14.00
SD-BR-A	36	32	6	12	F	20.00
SD-BR-D	140	125	6	12	F	33.00
SD-BR-F	280	250	6	12	F	43.00
SE-BR-A	36	32	10	20	G	24.00
SE-BR-D	140	125	10	20	G	40.00
SE-BR-F	280	250	10	20	G	49.00
SF-BR-A	36	32	20	40	H	27.00
SF-BR-D	140	125	20	40	H	44.00
SF-BR-F	280	250	20	40	H	53.00
SI-BR-A	36	32	40	80	J	33.00
SI-BR-B	72	64	40	80	J	40.00
SI-BR-C	105	90	40	80	J	66.00
SI-BR-D	140	125	40	80	J	70.00
SI-BR-F	280	250	40	80	J	105.00
SL-BR-A	36	32	50	100	J	37.00
SL-BR-B	72	64	50	100	J	43.00
SL-BR-D	140	125	50	100	J	77.00
SL-BR-F	280	250	50	100	J	121.00
SG-BR-A	36	32	70	140	J	44.00
SG-BR-B	72	64	70	140	J	55.00
SG-BR-D	140	125	70	140	J	88.00
SG-BR-F	280	250	70	140	J	143.00
SK-BR-A	36	32	100	200	K	66.00
SK-BR-B	72	64	100	200	K	75.00
SK-BR-D	140	125	100	200	K	100.00
SK-BR-F	280	250	100	200	K	165.00
SM-BR-A	36	32	200	400	L	110.00
SM-BR-B	72	64	200	400	L	132.00
SM-BR-D	140	125	200	400	L	200.00
SM-BR-F	280	250	200	400	L	285.00
SO-BR-B	72	64	400	800	M	300.00
SO-BR-F	280	250	400	800	M	525.00

3φ BRIDGE

Stock No.	AC Input Volts Up To	DC Output Volts Up To	Max. Amps Self Cooled	Max. Amps Fan Cooled	Size & Weight	User Net Price
SL-PH-A	36	48	75	150	N	$66.00
SL-PH-B	72	96	75	150	N	94.00
SL-PH-C	105	144	75	150	N	132.00
SL-PH-D	140	188	75	150	N	200.00
SL-PH-E	220	290	75	150	M	240.00
SK-PH-E	220	290	100	200	M	270.00
SM-PH-E	220	290	200	400	M	330.00
SO-PH-E	220	290	400	800	M	410.00

All above ratings based on 30°C ambient. Fan-cooled ratings based on air velocity of 1000 linear ft/minute. For resistive or inductive loads, as rated. For capacitive or battery loads, derate amperage 20%. Doublers, triplers, 3 phase half wave and 3 phase center-tap also available. Custom-built stacks, 24 hour service.

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SILICON PHOTOTRANSISTORS

.4 - 1.1 Micrometer Response
OP600 Series — Case Type 1

Parameter	Light Current			Dark Current	Collector Breakdown	Emitter Breakdown	Light Current Rise Time	Saturation Voltage	Angular Response
Test Condition	V_{CE} = 5V H As Shown			V_{ce} = 10V H = 0	I_C = 100 μA	I_C = 100 μA	R_L = 1K, V_{CE} = 5V, I_L = 0.8 mA	I_C = 0.4 mA	Peak to Half Power Points
Symbol	I_L			I_D	BV_{CEO}	BV_{ECO}	t_r	$V_{CE(SAT)}$	θ
Unit	mA			nA	Volts	Volts	Microseconds	Volts	Degrees
	Min.	Max.	H	Max.	Min.	Min.	Typical	Typical	Typical
OP600	0.8	—	20	25	50	7	2.5	0.4	24
OP601	0.5	3.0	20	25	50	7	2.0	0.4	24
OP602	2.0	5.0	20	25	50	7	2.0	0.4	24
OP603	4.0	8.0	20	25	50	7	2.5	0.4	24
OP604	7.0	22.0	20	25	50	7	2.5	0.4	24
OP605	15.0	—	20	25	50	7	3.0	0.4	24
OP640	0.8	—	20	100	25	5	2.5	0.4	24
OP641	0.5	3.0	20	100	25	5	2.0	0.4	24
OP642	2.0	5.0	20	100	25	5	2.0	0.4	24
OP643	4.0	8.0	20	100	25	5	2.5	0.4	24
OP644	7.0	22.0	20	100	25	5	2.5	0.4	24
OP645	15.0	—	20	100	25	5	3.0	0.4	24
OP666	Calibrated		20	25	50	7	2.5	0.4	24

OP800 Series — Case Type 2

OP800	0.8	—	5	100	30	7	3.0	0.4	10
OP801	0.5	3.0	5	100	30	7	3.0	0.4	10
OP802	2.0	5.0	5	100	30	7	3.0	0.4	10
OP803	4.0	8.0	5	100	30	7	3.0	0.4	10
OP804	7.0	22.0	5	100	30	7	3.0	0.4	10
OP805	15.0	—	5	100	30	7	3.0	0.4	10

OP700 Series — Case Type 3

OP700	0.15	—	20	100	25	5	2.5	0.4	
OP701	0.15	0.6	20	100	25	5	2.0	0.4	
OP702	0.4	1.6	20	100	25	5	2.0	0.4	
OP703	1.0	4.0	20	100	25	5	2.5	0.4	
OP704	3.0	12.0	20	100	25	5	2.5	0.4	
OP705	8.0	—	20	100	25	5	3.0	0.4	

OP400 Series — Case Type 4

OP400	1.0		9.0 CS7-69 filter	25 @ 30V	50	7	2.5	0.4	
OP440	1.0		9.0 CS7-69 filter	100	25	5	2.5	0.4	

PHOTODIODES

Parameter	Light Current		Dark Current	Forward Drop	Reverse Breakdown	Case Type
Test Condition	V_{CE} = 10V, H As Shown		V_{CE} = 10V, H = 0	@ 1 mA	10 μA	
Symbol	I_L		I_D	V_F	BV_R	
Unit	μA		nA	Volts	Volts	
	Min.	H	Max.	Max.	Min.	
OP900	8	20	10	1.0V	100V	1
OP790	13	20	10	1.0V	100V	3

SILICON PHOTO DARLINGTON TRANSISTORS

OP300 Series — Case Type 1 — Note: Also available in TO-18 package similar to Case Type 2

Parameter	Light Current			Dark Current	Collector Breakdown	Emitter Breakdown	Light Current Rise Time	Saturation Voltage	Angular Response
Test Condition	V_{CE} = 5V H As Shown			V_{CE} = 10V	I_C = 100 μA	I_E = 100 μA	I_L = 1 mA, R_L = 100 ohms, V_{CC} = 5V	I_C = 1 mA	
Symbol	I_L			I_D	BV_{CEO}	BV_{ECO}	t_r	$V_{CE(SAT)}$	θ
Unit	mA			nA	Volts	Volts	μSec	Volts	Degrees
	Min.	Max.	H	Max.	Min.	Min.	Typical	Max.	Typical
OP300	0.8	—	1	250	15	5	20	1.1	24
OP301	0.8	2.4	1	250	15	5	20	1.1	24
OP302	1.8	5.4	1	250	15	5	20	1.1	24
OP303	3.6	12.0	1	1.0 μA	15	5	20	1.1	24
OP304	7.0	21.0	1	1.0 μA	15	5	20	1.1	24
OP305	14.0	43.0	1	1.0 μA	15	5	20	1.1	24

For Case Types See Vol.2•922

LIGHT EMITTING DIODES

.935 Micrometer Radiation

Parameter	Optical Power		Beam Angle	Forward Drop		Reverse Breakdown	Radiation Risetime	Forward Cur. Continuous	Case Type
Test Condition	@ I_F mA		Half Power Points	@ I_F mA		I_R = 10 mA		25°C	
Symbol	P_O		θ	V_F		BV_R	t_r		
Unit	mW		Degrees	Volts		Volts	μSec	mA	
	Min.	I_F	Typical	Max.	I_F	Min.	Typical	Max.	
OP122	0.25	50	18	1.6	50	2.0	.7	100	5
OP123	0.4	50	18	1.6	50	2.0	.7	100	5
OP124	1.0	50	18	1.6	50	2.0	.7	100	5
OP131	3.3	100	10	1.75	100	2.0	.7	200	2

OPTOELECTRONIC REFLECTIVE READHEAD ASSEMBLIES

Case Type 6

Parameter	Light Current			Dark Current		Collector Breakdown	Emitter Breakdown	Current Risetime	Saturation Voltage	Forward Drop	
Test Condition	V_{CE} = 5.0V White Bond Paper			V_{CE} = 5.0V		I_C = 100 μA	I_F = 100 μA	V_{CE} = 5.0V, R_L = 1K, I_L = 0.8 mA	I_C = 1 mA	@ I_F mA	
Symbol	I_L @ 0.20"			I_D		BV_{CEO}	BV_{ECO}	t_r	$V_{CE(SAT)}$	V_F	
Unit	mA			nA		Volts	Volts	μSec	Volts	Volts	
	Min.	Max.	I_F	Max.	I_F	Min.	Min.	Typical	Max.	Max.	I_F
OPB125	2	10	40	250	0	15	5	20	1.1	1.6	50
OPB253	.025	.25	40	100	0	25	5	2.5	0.4	1.6	50

OPTOELECTRONIC ENCODER ASSEMBLIES

Case Type 7

Parameter	Light Current		Dark Current	Collector Breakdown	Emitter Breakdown	Current Risetime	Saturation Voltage	Forward Drop	
Test Condition	V_{CE} = 5.0V		V_{CE} = 25V	I_C = 100 μA	I_E = 100 μA	V_{CE} = 5.0V, R_L = 1K, I_L = 0.8 mA	I_C = 1 mA	@ I_F mA	
Symbol	I_L		I_D	BV_{CEO}	BV_{ECO}	t_r	$V_{CE(SAT)}$	V_F	
Unit	mA		μA	Volts	Volts	μSec	Volts	Volts	
	Min.	I_F mA	Max.	Min.	Min.	Typical	Max.	Max.	I_F
OPB120	0.80	40	.1	25	5	2.5	.4	1.6	50
OPB243	3.2	40	.3	15	3	20.0	1.1	1.6	50
OPB121	0.80	40	.1	25	5	2.5	.4	1.6	50

OPTICAL COUPLERS — ISOLATORS

Parameter	Collector Current On-State		Collector Current Off-State		Input Forward Voltage	Isolation Voltage	Risetime		Case Type
Test Condition	V_{CE} = 5V @ I_F mA		I_F = 0V$_{CE}$		I_F = 50 mA	Input to Output	V_{CC} = 5V, R_L = 100 ohms, @ I_F mA		
Symbol	I_C ON		I_C OFF		V_F		t_r		
Unit	mA		μA		Volts	KV	μSec		
	Min.	I_F	Max.	V_{CE}	Max.	Min.	Typical	I_F	
OP1030	4.0	10	1.0	10	1.6	5	20	10	8
OP1031	4.0	4.0	1.0	10	1.6	5	20	4.0	8
OP1060	.40	15	0.1	10	1.6	5	2.5	15	8
OP1061	1.5	15	0.1	10	1.6	5	3.5	15	8
OP1090	.002	40	.01	30	1.6	5	0.5	40	8
OP1050-10	.01	30	.01	10	1.6	10	0.5	30	9
OP1053-10	2.0	20	1.0	10	1.6	10	20	20	9
OP1056-10	0.8	20	.025	10	1.6	10	3.5	20	9
OP1050-50	.01	30	.01	10	1.6	50	0.5	30	10
OP1053-50	2.0	20	1.0	10	1.6	50	20	20	10
OP1056-50	0.8	20	.025	10	1.6	50	3.5	20	10
OP1040	.40	15	0.1	10	1.6	15	2.5	15	11

LIGHT SENSOR AND EMITTER ARRAYS & PAIRS

Parameter	Light Current			Dark Current	Collector Breakdown	Emitter Breakdown	Power Output		Forward Drop		Element No. & Spacing		Case Type
Test Condition	V_{CE} = 5V, H As Shown			V_{CE} = 10V	I_L = 100 μA	I_E = 100 μA	@ I_F mA		@ I_F μA				
Symbol	$\frac{I_L \text{ Min.}}{I_L \text{ Max.}}$ = 0.5 Min.			I_D	BV_{CEO}	BV_{ECO}	$\frac{P_O \text{ Min.}}{P_O \text{ Max.}}$ = 0.5		V_F				
Unit	mA			nA	Volts	Volts	mW		Volts		Inches		
	Min.	I_F	H	Max.	Min.	Min.	Min.	I_F	Max.	I_F	±.003	Non-Cumulative	
OPA505	0.8		20	100	25	5					6	.100	12
OPE505							.25	50	1.6	50	6	.100	12
OPB505	1.6-6.4	30		Paired OPA505 and OPE505 — Sensor to Emitter Spacing —								.100	12
OPA508	0.8		20	100	25	5					9	.100	13
OPE508							.25	50	1.6	50	9	.100	13
OPB508	1.6-6.4	30		Paired OPA508 and OPE508 — Sensor to Emitter Spacing —								.100	13
OPA512	0.8		20	100	25	5					14	.250	14
OPE512							.25	50	1.6	50	14	.250	14
OPB512	1.6-6.4	30		Paired OPA512 and OPE512 — Sensor to Emitter Spacing —								.100	14
OPA518	0.8		20	100	25	5					20	.087	15
OPE518							.25	50	1.6	50	20	.087	15
OPB518	1.6-6.4	30		Paired OPA518 and OPE518 — Sensor to Emitter Spacing —								.100	15

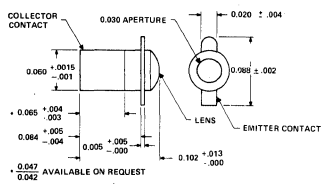
For Case Types See Vol.2•922

OPTRON, INC.

1201 Tappan Circle
Carrollton, Texas 75006
214/242-6571

PHYSICAL DESCRIPTION

Case Type 1



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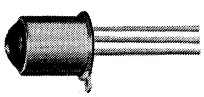

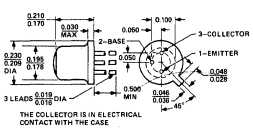

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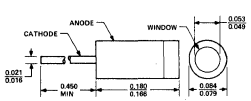

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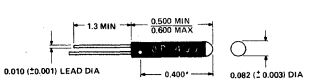
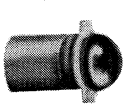
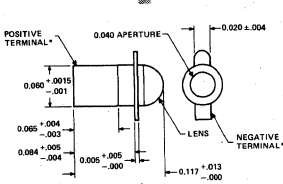


NOTE: POSITIVE TERMINAL IDENTIFIED BY RED DOT
*BODY DIA. IS 0.081 -0.003 WITHIN THIS ZONE AND NON-CUM. TOLERANCE WITH RESPECT TO CENTER LINE OF BARREL.

Case Type 5





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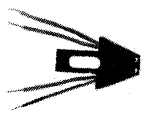

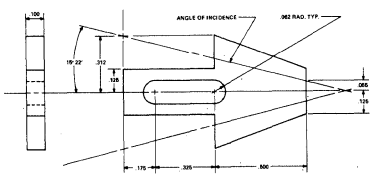

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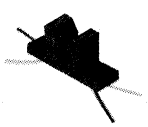

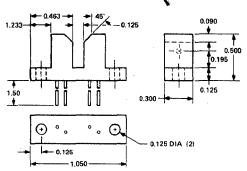

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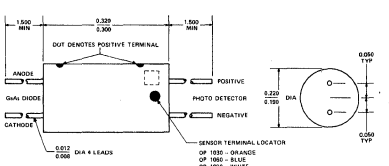

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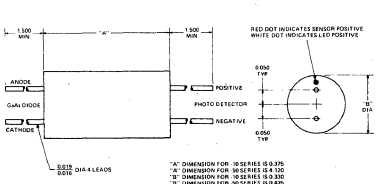

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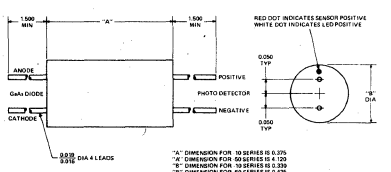

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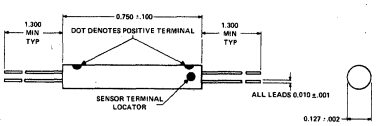

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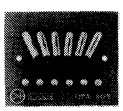

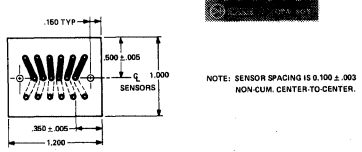

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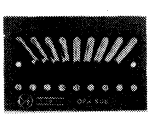

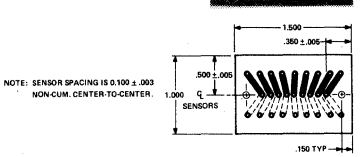

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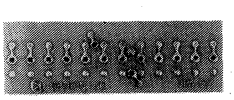
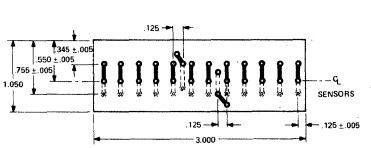
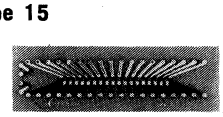
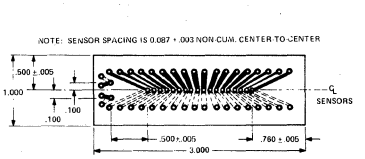




NOTE: SENSOR SPACING IS 0.250 ± .003 NON-CUM. CENTER-TO-CENTER

Case Type 15



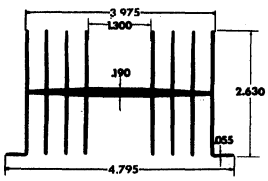


TOR™ HEAT SINKS

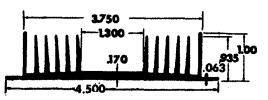
Complete in-house fabrication capabilities for custom and standard configurations

- Hole patterns fabricated to specific requirements
- Choice of finish

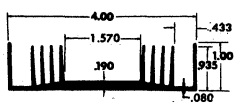
Over 100 standard heat sink extrusions



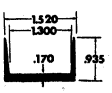
900
H.D.S. 48.3 sq"/1"
T.R. 1.1°C/W



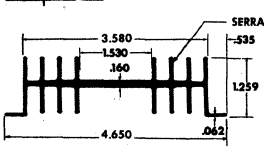
1101
H.D.S. 27.2 sq"/1"
T.R. 2.2°C/W



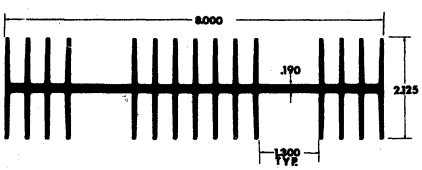
1105
H.D.S. 23.9 sq"/1"
T.R. 2.7°C/W



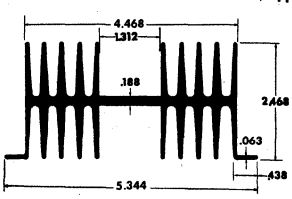
1111
H.D.S. 6.3 sq"/1"
T.R. 4.7°C/W



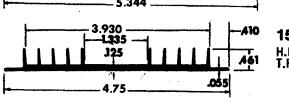
1512
H.D.S. 34.3 sq"/1"
T.R. 2.6°C/W



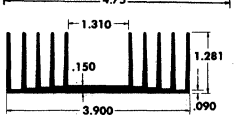
1537
H.D.S. 73.5 sq"/1"
T.R. 0.92°C/W



1568
H.D.S. 54 sq"/1"
T.R. 1.45°C/W



1576
H.D.S. 16.2 sq"/1"
T.R. 3.3°C/W



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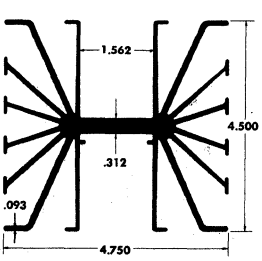
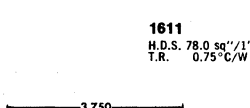
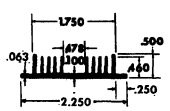
H.D.S. 30.7 sq"/1"
T.R. 2.0°C/W



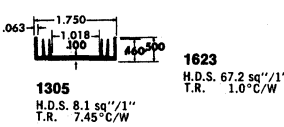
1726
H.D.S. 71.4 sq"/1"
T.R. 0.85°C/W



1200
H.D.S. 36.2 sq"/1"
T.R. 2.35°C/W



1301
H.D.S. 12.0 sq"/1"
T.R. 5.4°C/W

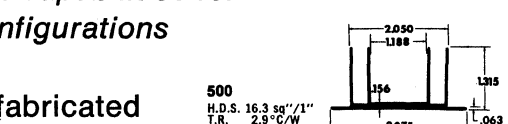


1305
H.D.S. 8.1 sq"/1"
T.R. 7.45°C/W

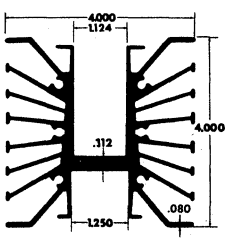
H.D.S. = Heat Dissipating Surface in²/in.

Thermal Resistance (T.R.) is calculated per 3" section.

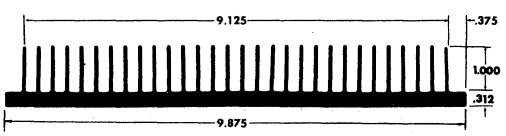
Write for complete listing and specifications



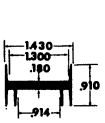
500
H.D.S. 16.3 sq"/1"
T.R. 2.9°C/W



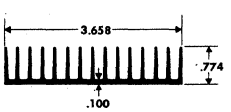
1647
H.D.S. 63.6 sq"/1"
T.R. 0.95°C/W



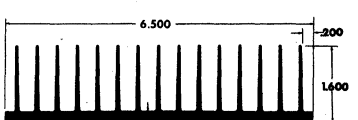
1611
H.D.S. 78.0 sq"/1"
T.R. 0.75°C/W



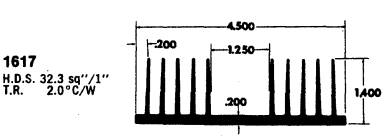
1212
H.D.S 7.6 sq"/1"
T.R. 4.8°C/W



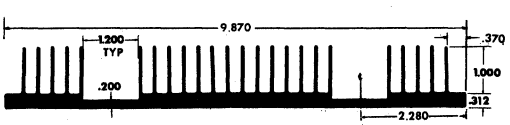
1612
H.D.S. 26.7 sq"/1"
T.R. 2.2°C/W



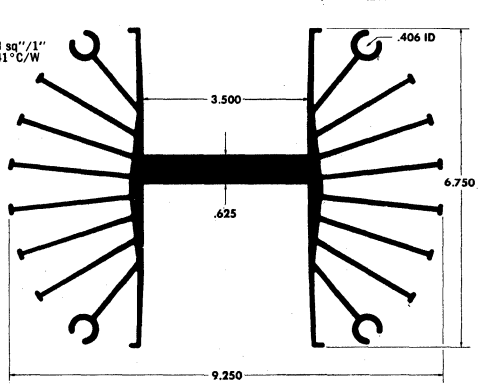
1615
H.D.S. 54.2 sq"/1"
T.R. 0.9°C/W



1617
H.D.S. 32.3 sq"/1"
T.R. 2.0°C/W



1623
H.D.S. 67.2 sq"/1"
T.R. 1.0°C/W



1727
H.D.S. 118.3 sq"/1"
T.R. 0.41°C/W

TOR HEAT SINK DIVISION / PRECISION DIPBRAZE TOR, INC.

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SILICON AND SELENIUM

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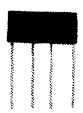
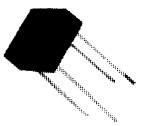
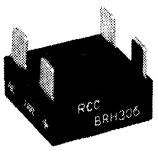
SILICON ASSEMBLIES — FEATURING STATE OF THE ART "GLASSIVATED," DIFFUSED, AVALANCHE DIODE CELLS AND WELDED CONSTRUCTION

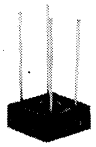
SILICON BRIDGE RECTIFIERS

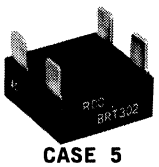

CASE 1


CASE 2



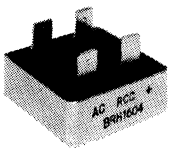
CASE 3


CASE 4



CASE 5 (Threaded Insert)

CASE 6

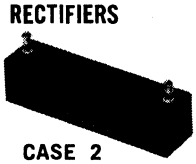


CASE 7

2 AMP/50°C 50 Apk SURGE		2 AMP/55°C 50 Apk SURGE		3 AMP/55°C 50 Apk SURGE		3 AMP/55°C 50 Apk SURGE		PEAK REVERSE VOLTAGE (PER ELEMENT)	6 AMP/55°C 50 Apk SURGE		6 AMP/55°C 50 Apk SURGE		6 AMP/55°C 125 Apk SURGE		16 AMP/65°C 125 Apk SURGE	
Type No.	Case	Type No.	Case	Type No.	Case	Type No.	Case	Volts Peak	Type No.	Case	Type No.	Case	Type No.	Case	Type No.	Case
501-363-05	1	BRE2005	2	—	—	BRH/T300.5	3/5	50	BRE600.5/S	4/6	BRV600.5/T	3/5	BRH/T600.5	3/5	BRH1600.5	7
501-363-1	1	BRE201	2	—	—	—	—	100	BRE601/S	4/6	—	—	BRH/T601	3/5	BRH1601	7
501-363-2	1	BRE202	2	BRE302	4	BRH/T302	3/5	200	BRE602/S	4/6	BRV602/T	3/5	BRH/T602	3/5	BRH1602	7
501-363-4	1	BRE204	2	BRE304	4	BRH/T304	3/5	400	BRE604/S	4/6	BRV604/T	3/5	BRH/T604	3/5	BRH1604	7
501-363-6	1	BRE206	2	BRE306	4	BRH/T306	3/5	600	BRE606/S	4/6	BRV606/T	3/5	BRH/T606	3/5	BRH1606	7
—	—	BRE208	2	BRE308	4	BRH/T308	3/5	800	BRE608/S	4/6	BRV608/T	3/5	BRH/T608	3/5	BRH1608	7
—	—	—	—	—	—	BRH/T310	3/5	1000	—	—	BRV610/T	3/5	—	—	—	—
—	—	—	—	—	—	BRH/T315	3/5	1500	—	—	BRV615/T	3/5	—	—	—	—

SILICON HIGH VOLTAGE RECTIFIERS

CASE 1


CASE 2

CASE 3

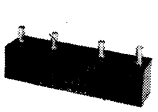
WE'VE MOVED!

RCC IS NOW LOCATED IN UNION, NEW JERSEY. PLEASE NOTE OUR NEW ADDRESS SHOWN ABOVE.

0.2 AMP/25°C 2.5Apk SURGE			0.5 AMP/25°C 50Apk SURGE			1.0 AMP/55°C 50Apk SURGE			1.0 AMP/55°C 80Apk SURGE			1.0 AMP/55°C 50Apk SURGE			1.0 AMP/25°C 80Apk SURGE		
Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV	Type No.	Case	PRV
IN1731	1	1500	RC1731	1	1500	RC5482	3	2000	IN5482	3	2000	RC5477	2	5000	IN5477	2	5000
IN1732	1	2000	RC1732	1	2000	RC5483	3	3000	IN5483	3	3000	RC5478	2	6000	IN5478	2	6000
IN1733	1	3000	RC1733	1	3000	RC5484	3	4000	IN5484	3	4000	RC5479	2	7000	IN5479	2	7000
IN1734	1	5000	RC1734	1	5000	RC5485	3	5000	IN5485	3	5000	RC5480	2	8000	IN5480	2	8000
—	—	—	—	—	—	—	—	—	—	—	—	RC5481	2	10,000	IN5481	2	10,000

SILICON H.V. BRIDGE RECTIFIERS 1.5 AMP/75°C — 50A SURGE

Type No.	PRV (Per) Element)
BRHV1502	2000
BRHV1503	3000
BRHV1504	4000
BRHV1505	5000
BRHV1506	6000



SILICON TUBE RETRO — FIT RECTIFIERS

HVK1109/866 0.5 AMP/55°C 50Apk Surge 10,000Vpk/PRV	HVK1110/872 1.25 AMP/55°C 60Apk Surge 10,000Vpk/PRV

SILICON INTEGRAL CONTROLLED BRIDGE RECTIFIERS

3 AMP/40°C 20Apk Surge	
Type No.	PRV
BCS300.5	50
BCS301	100
BCS302	200
BCS304	400

SELENIUM ASSEMBLIES — FEATURING "NON-BARRIER" / "NON-AGING" CELL STRUCTURES

SELENIUM H.V. RECTIFIERS

Type No.	*PRV Vpk	*Max. D.C. Output MAdc	Dimensions In Inches Length	Diam.
303-248	8000	1.5	2 1/16	.200
303-351	10,000	4.0	2 3/16	.225
303-541	15,000	1.5	2 3/4	.200
303-347	15,000	4.0	2 15/16	.225
303-539	20,000	1.5	2 3/4	.283
303-356	25,000	4.0	4 1/8	.225

*Sine Wave Resistive Load.

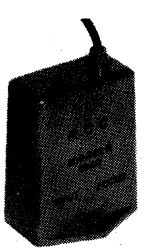
BRIDGE RECTIFIERS FOR SOLENOID, MOTOR, RELAY & BATTERY CHARGER APPLICATIONS

CASE 1
CASE 2

Type No.	Case	Max. AC Input Vrms	Max. DC Output MAdc	Approximate Dimensions (In Inches)
301-173	2	33	120	1/4 x 1/4 x 1/4
301-267	2	33	160	3/8 x 1/4 x 3/8
301-172	2	33	200	3/8 x 3/8 x 3/8
302-137	1	130	100	5/8 x 5/8 x 5/16
302-235	1	250	80	5/8 x 5/8 x 5/16

ASSEMBLIES FOR COLOR TV APPLICATIONS

VOLTAGE MULTIPLIERS



SEMTECH
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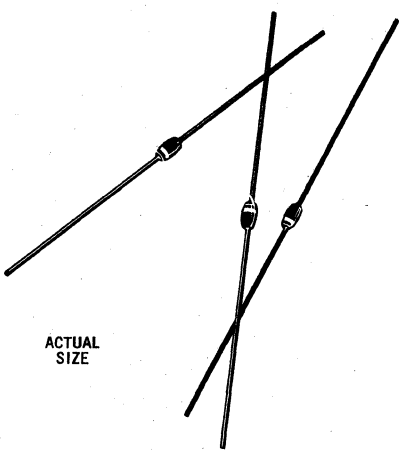
METOXILITE SILICON RECTIFIERS — ALSO AVAILABLE TO NEW MSFC/NASA AND MILITARY SPECIFICATIONS (JAN & TX)

200 TO 1000 VOLTS
LOW REVERSE LEAKAGE
SOLID INTERNAL CONSTRUCTION
SUPERIOR THERMAL SHOCK RESISTANCE
FOR NEW PACKAGING DESIGN

A multi-purpose, high current axial lead silicon rectifier, ideally suited to maximize small electronic package designs. Metoxilite (fused metal oxides) is fused to the metallurgically bonded junction/tungsten-pin assembly forming a "tough" subminiature package. Hermetically sealed and designed to meet stringent temperature cycling, humidity and other environmental requirements per MIL-STD-750A. A general purpose rectifier for use in military, space, industrial and consumer product applications, such as: power supplies, AC to DC converters and control circuits.

1 AMP 55°C/NO HEAT SINK
3 AMP/MIL STANDARD 750



MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS

Type No.	Peak Inverse Voltage	RMS Voltage	DC Blocking Voltage	Average Rectified Current 55°C	Average Rectified Current 100°C	Max. Static Forward Volt @ 1A 25°C	Max. Static Reverse Current 25°C	Max. Static Reverse Current 100°C	Recurrant Surge	One Cycle Surge	Recovery Time ① Max.	Recovery Time ① Typ.
	Volts	Volts	Volts	MA	MA	Volts	UA	UA	Amps	Amps	Usec	Usec
S2M	200	140	200	1000	750	1.2	1	25	10	50	2	1
S4M	400	280	400	1000	750	1.2	1	25	10	50	2	1
S6M	600	420	600	1000	750	1.2	1	25	10	50	2	1
S8M	800	560	800	1000	750	1.2	1	25	10	50	2	1
S0M	1000	700	1000	1000	750	1.2	1	25	10	50	2	1

TECHNICAL BULLETIN R69

FAST RECOVERY NANOSECOND REVERSE RECOVERY

S2F	200	140	200	1000	750	1.2	1	25	6	25	.150	100
S4F	400	280	400	1000	750	1.2	1	25	6	25	.150	100
S6F	600	420	600	1000	750	1.2	1	25	6	25	.250	175
S8F	800	560	800	1000	750	1.2	1	25	6	25	.300	200
S0F	1000	700	1000	1000	750	1.2	1	25	6	25	.500	250

TECHNICAL BULLETIN R68

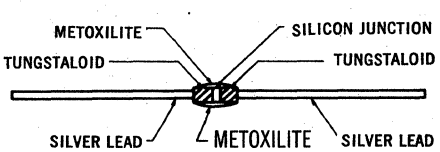
Operating and storage temperature —193.8°C to +200°C

① Recovery conditions: 0.5 amp forward current to 1.0 amp reverse current. Recovery time measured when rectifier recovers to.25 amp.

(1N) TYPE

Device Type ①	Reverse Voltage V_R	Reverse Voltage V_{RM}(wkg)	Forward Current ② Free Air 55°C	Reverse Current (Max.) I_R 25°C	Reverse Current (Max.) I_R 100°C	Instantaneous Forward Voltage V_F @ I_F= 1.0Adc	Repetitive Surge Current	1 Cycle Surge Current tp=8.3m Sec.	Reverse Recovery Time ③ Trr	Thermal Impedance θJ—L d=0	Thermal Impedance θJ—L d=.37
	Vdc	V(pk)	A	UAdc	UAdc	Vdc	A(pk)	I_F(surge) A(pk)	μSec Max. Typ.	°C/Watt	°C/Watt
1N5614	200	200	1.0	0.5	25	1.2	10	50	2	1	21	38
1N5616	400	400	1.0	0.5	25	1.2	10	50	2	1	21	38
1N5618	600	600	1.0	0.5	25	1.2	10	50	2	1	21	38
1N5620	800	800	1.0	0.5	25	1.2	10	50	2	1	21	38
1N5622	1000	1000	1.0	0.5	25	1.2	10	50	2	1	21	38

TECHNICAL BULLETIN R76

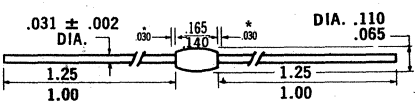


LEAD MATERIAL: 99.9% PURE SILVER
IN ACCORDANCE WITH MIL-S-13282A, GRADE A
THERMAL IMPEDANCE = 133°C/W/IN.

FAST RECOVERY NANOSECOND REVERSE RECOVERY

1N5615	200	200	1.0	0.5	25	1.2	6	25	.150	.100	21	38
1N5617	400	400	1.0	0.5	25	1.2	6	25	.150	.100	21	38
1N5619	600	600	1.0	0.5	25	1.2	6	25	.250	.175	21	38
1N5621	800	800	1.0	0.5	25	1.2	6	25	.300	.200	21	38
1N5623	1000	1000	1.0	0.5	25	1.2	6	25	.500	.250	21	38

TECHNICAL BULLETIN R77



*LEAD DIAMETER UNCONTROLLED IN THIS AREA

All temperatures are local ambient, 25°C unless otherwise specified.

NOTES: ① Types 1N5614, 16, 18, 20, 22 available in accordance with MIL-S-19500/427 (EL). Types 1N5615, 17, 19, 21, 23 available in accordance with MIL-S-19500/429 (EL).

② The 1.0 amp rating @ 55°C requires no heat sinking, special mounting, or forced air across the body of the device.

③ Recovery conditions: 0.5 amp forward current to —1.0 amp reverse current recovery time measured when rectifier recovers to —.25 amp. See Semtech Applications note and test procedure for details.

Operating and Storage Temperature —193.8°C to +200°C

For all types on this page: THERMAL RESISTANCE from junction to heat sink θJL = 38°C/W with (d) length of lead from body to heat sink .375 inches.

Semtech reserves the right to change specifications without notice.

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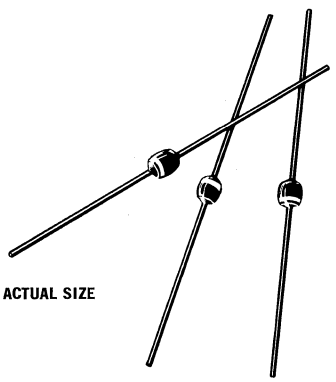
METOXILITE SILICON RECTIFIERS

HIGH CURRENT AXIAL LEADS

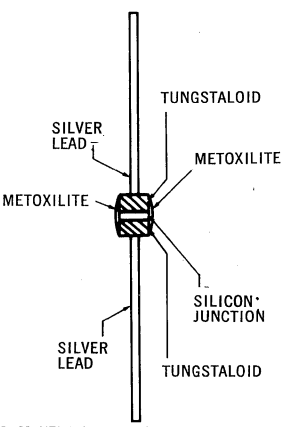
3 AMP 55°C/NO HEAT SINK
6 AMP/MIL STANDARD 750



ACTUAL SIZE

Type ①	Peak Inverse Voltage	RMS Voltage	DC Blocking Voltage	Average Rectified Current		Max. Static Forward Volt @ 3A	Max. Static Reverse Current		Recurrent Surge	One Cycle Surge	Recovery Time ②	
				55°C	100°C	25°C	25°C	100°C			Max.	Typ.
	Volts	Volts	Volts	Amps	Amps	Volts	μA	μA	Amps	Amps	μsec	μsec
MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS												
3SM2	200	140	200	3	2	1.0	1	20	25	150	2	1
3SM4	400	280	400	3	2	1.0	1	20	25	150	2	1
3SM6	600	420	600	3	2	1.0	1	20	25	150	2	1
3SM8	800	560	800	3	2	1.1	1	20	25	150	2	1
3SM0	1000	700	1000	3	2	1.1	1	20	25	150	2	1
TECHNICAL BULLETIN R67												
FAST RECOVERY NANOSECOND REVERSE RECOVERY												
3SF1	100	70	100	3	2	1.1	1	20	25	150	.150	.100
3SF2	200	140	200	3	2	1.1	1	20	25	150	.150	.100
3SF4	400	280	400	3	2	1.1	1	20	25	150	.150	.100
TECHNICAL BULLETIN R66												
LO-VF FAST RECOVERY (t_{rr}) 100 NANOSECONDS												
3L03	30	28	30	3	2	0.9	1	20	25	150	.100	.080
3L05	50	35	50	3	2	0.9	1	20	25	150	.100	.080
TECHNICAL BULLETIN R93												

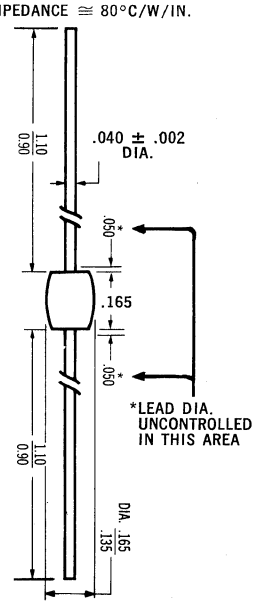
For all types on this page: THERMAL RESISTANCE from junction to heat sink θJL = 20°C/W with (d) length of lead from body to heat sink .375 inches.



LEAD MATERIAL: 99.9% PURE SILVER
IN ACCORDANCE WITH MIL-S-13282A, GRADE A
THERMAL IMPEDANCE ≅ 80°C/W/IN.

(1N) TYPE

MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS												
1N5550	200	140	200	3	2	1.0	1	20	25	150	2	1
1N5551	400	280	400	3	2	1.0	1	20	25	150	2	1
1N5552	600	420	600	3	2	1.0	1	20	25	150	2	1
1N5553	800	560	800	3	2	1.1	1	20	25	150	2	1
1N5554	1000	700	1000	3	2	1.1	1	20	25	150	2	1
TECHNICAL BULLETIN R78												
FAST RECOVERY NANOSECOND REVERSE RECOVERY												
1N5415	50	35	50	3	2	1.1	1	20	25	150	.150	.100
1N5416	100	70	100	3	2	1.1	1	20	25	150	.150	.100
1N5417	200	140	200	3	2	1.1	1	20	25	150	.150	.100
1N5418	400	280	400	3	2	1.1	1	20	25	150	.150	.100
1N5419	500	350	500	3	2	1.1	1	20	25	150	.250	.200



All temperatures are local ambient, 25°C unless otherwise specified. TECHNICAL BULLETIN R79

NOTES: ① Types 1N5550-54 available in accordance with MIL-S-19500/420 (USAF).
Types 1N5415-19 available in accordance with MIL-S-19500/411 (EL).

② Recovery conditions: 0.5 amp forward current to 1.0 amp reverse current.
Recovery time measured when rectifier recovers to .25 amp.

The 3 amp rating @ 55°C requires no heat sinking, special mounting, or forced air across the body of the device.

Operating and storage temperature −193.8°C to +200°C.

Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

METOXILITE LO-CURRENT SILICON RECTIFIERS

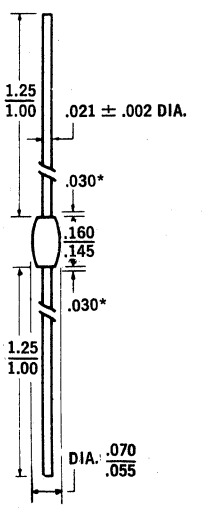
Metoxilite is Semtech's new multipurpose high current axial lead silicon rectifier, ideally suited for small electronic package design. Through utilization of new design and manufacturing techniques, the Metoxilite device provides the ultimate in hermeticity and ruggedness. The metal oxides which form the outer case material are fused directly to the high temperature metallurgically bonded assembly. The Metoxilite device exceeds environmental requirements of current military and space program specifications. A general purpose rectifier suitable for all applications.

MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS

Device Type	Reverse Voltage		Forward Current	Reverse Current (Max.)		Instantaneous Forward Voltage	Repetitive Surge Current	1 Cycle Surge Current tp = 8.3 ms	Reverse Recovery Time 1	
			Free Air	I_R		V_F @ I_F =			Trr	
	V_R	V_{RM}(wkg)	55°C	UA dc		0.5 Adc		A (pk)	μs	
	Vdc	V (pk)	A	25°C	100°C	Vdc	A (pk)	I_F(Surge)	Max.	Typ.
M2	200	200	0.5	.100	7	1.1	5	25	2	1
M4	400	400	0.5	.100	7	1.1	5	25	2	1
M6	600	600	0.5	.100	7	1.1	5	25	2	1
M8	800	800	0.5	.100	7	1.1	5	25	2	1
M0	1000	1000	0.5	.100	7	1.1	5	25	2	1

TECHNICAL BULLETIN R99

LEAD MATERIAL: 99.9% PURE SILVER IN ACCORDANCE WITH MIL-S-13282A, GRADE A



*Lead diameter uncontrolled in this area.

FAST RECOVERY

Device Type	Reverse Voltage		Forward Current	Reverse Current (Max.)		Instantaneous Forward Voltage	Repetitive Surge Current	1 Cycle Surge Current tp = 8.3 ms	Reverse Recovery Time 1	
			Free Air	I_R		V_F @ I_F =			Trr	
	V_R	V_{RM}(wkg)	55°C	UA dc		0.5 Adc		A (pk)	ns	
	Vdc	V (pk)	A	25°C	100°C	Vdc	A (pk)	I_F(Surge)	Max.	Typ.
F1	100	100	0.5	.250	15	1.1	3	12.5	150	100
F2	200	200	0.5	.250	15	1.1	3	12.5	150	100
F4	400	400	0.5	.250	15	1.1	3	12.5	150	100
F5	500	500	0.5	.250	15	1.1	3	12.5	150	100

TECHNICAL BULLETIN R100

(1N) TYPE

Device Type	Reverse Voltage		Forward Current	Reverse Current (Max.)		Instantaneous Forward Voltage	Repetitive Surge Current	1 Cycle Surge Current tp = 8.3 ms	Reverse Recovery Time 1	
			Free Air	I_R		V_F @ I_F =			Trr	
	V_R	V_{RM}(wkg)	55°C	UA dc		0.5 Adc		A (pk)	μs	
	Vdc	V (pk)	A	25°C	100°C	Vdc	A (pk)	I_F(Surge)	Max.	Typ.
1N645	225	275	0.5	0.2	15	1.0	5	25	2	1
1N646	300	360	0.5	0.2	15	1.0	5	25	2	1
1N647	400	480	0.5	0.2	20	1.0	5	25	2	1
1N648	500	600	0.5	0.2	20	1.0	5	25	2	1
1N649	600	720	0.5	0.2	25	1.0	5	25	2	1

TECHNICAL BULLETIN R101

All temperatures are local ambient, 25°C unless otherwise specified.

NOTES: 1 Recovery Conditions: 0.5 amp forward current to −1.0 amp reverse current. Recovery time measured when rectifier recovers to −.25 amp. See Semtech Applications note and test procedure for details.

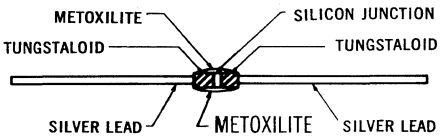
Operating and Storage Temperature −193.8°C to +200°C.

Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

METOXILITE LOW DYNAMIC IMPEDANCE SILICON VOLTAGE REGULATORS

RADIATION RESISTANT



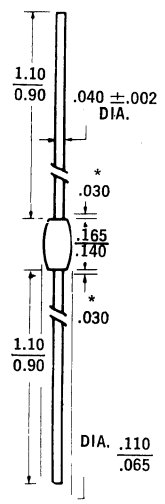
This new series of devices offers significantly lower dynamic impedance when compared at the same operating current to those presently available. For a given dynamic impedance requirement, these regulator diodes can be operated at a lower bias current. Regulation, ripple reduction and efficiency will be improved when these devices are used as regulators. Cased in Metoxilite, they provide the ultimate in hermeticity and ruggedness. The metal oxides which form the outer case are fused directly to the high temperature metallurgically bonded assembly. This Metoxilite device exceeds requirements of current military and space program specifications.

LEAD MATERIAL: 99.9% PURE SILVER IN ACCORDANCE WITH MIL-S-13282A, GRADE A
THERMAL IMPEDANCE = 133°C/W/IN.

Type No.	* Nominal Voltage	5 Watt * Min. Breakdown	5 Watt * Max. Voltage	5 Watt I_R Test	5 Watt Z_R	3 Watt I_R Test Current	3 Watt Z_R	1 Watt I_R Test Current	1 Watt Z_R	Reverse Leakage V_R Test	Reverse Leakage I_S	* TCBV	I_R Max.
	V	V	V	MA	Ohms	MA	Ohms	MA	Ohms	V	uA	°C	MA
SX6.8	6.8	6.46	7.14	175	.75	110	1.0	37	1.5	5.2	150	.05	700
SX7.5	7.5	7.13	7.87	175	.75	100	1.0	34	1.5	5.7	100	.06	630
SX8.2	8.2	7.79	8.61	150	.75	95	1.0	31	1.5	6.2	50	.06	580
SX9.1	9.1	8.65	9.55	150	1.0	82	1.5	28	2.0	6.9	25	.06	520
SX10	10	9.50	10.50	125	1.5	75	2.0	25	2.5	7.6	25	.07	475
SX11	11	10.45	11.55	125	1.5	68	2.0	23	2.5	8.4	10	.07	430
SX12	12	11.40	12.60	100	1.5	62	2.0	21	2.5	9.1	10	.07	395
SX13	13	12.35	13.65	100	2.0	58	2.5	19	3.0	9.9	10	.08	365
SX15	15	14.25	15.75	75	2.5	50	3.5	17	4.0	11.4	5	.08	315
SX16	16	15.20	16.80	75	2.5	46	3.5	15.5	4.0	12.2	5	.08	294
SX18	18	17.10	18.90	65	2.5	42	3.5	14.0	4.0	13.7	5	.085	264
SX20	20	19.0	21.0	65	2.5	37	3.5	12.5	4.0	15.2	2	.085	237
SX22	22	20.9	23.1	50	2.5	34	3.5	11.5	4.0	16.7	2	.085	216
SX24	24	22.8	25.2	50	3.0	31	4.0	10.5	5.0	18.2	2	.09	198
SX27	27	25.7	28.3	50	3.0	28	4.0	9.5	5.0	20.6	2	.09	176
SX30	30	28.5	31.5	40	3	25	6	8.5	11	22.8	2	.09	158
SX33	33	31.4	34.6	40	4	20	7	7.5	12	25.1	2	.035	144
SX36	36	34.2	37.8	30	5	20	7	7.0	13	27.4	2	.095	132
SX39	39	37.1	40.9	30	5	20	8	6.5	14	29.7	2	.095	132
SX43	43	40.9	45.1	30	6	15	9	6.0	15	32.7	2	.095	110
SX47	47	44.7	49.3	25	7	15	10	5.5	18	35.8	2	.095	100
SX51	51	48.5	53.5	25	8	15	11	5.0	20	38.8	2	.095	92
SX56	56	53.2	58.8	20	9	10	12	4.5	22	42.6	2	.095	84
SX62	62	58.9	65.1	20	10	10	15	4.0	25	47.1	2	.100	76
SX68	68	64.6	71.4	20	15	10	30	3.7	45	51.7	2	.100	70
SX75	75	71.3	78.7	20	20	10	35	3.3	65	56.0	2	.100	63
SX82	82	77.9	86.1	15	30	10	40	3.0	90	62.2	2	.100	58
SX91	91	86.5	95.5	15	35	8	50	2.8	125	69.2	2	.100	52.5
SX100	100	95.0	105.0	12	40	5	60	2.5	150	76.0	2	.100	47.5
SX110	110	104.5	115.0	12	55	5	100	2.5	200	83.6	2	.100	43
SX120	120	114.0	126.0	10	70	5	200	2.0	250	91.2	2	.100	39.5

*The voltage parameters specified are for the 5 watt rating

TECHNICAL BULLETIN X1

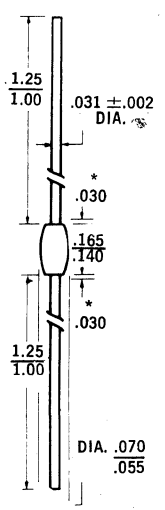


*LEAD DIAMETER UNCONTROLLED IN THIS AREA

METOXILITE RADIATION RESISTANT RECTIFIERS

Type No.	Peak Inverse Voltage	RMS (Sine Wave) Voltage	DC Blocking Voltage	Average Rectified Current	Typical Static Forward Voltage @ 1A	Maximum Static Reverse Current @ PIV		Recurrent Surge	One Cycle Surge	T_{rr} (1)
	Volts	Volts	Volts	55°C - MA	25°C - Volts	25°C - μA	100°C - μA	Amps	Amps	μsec
R1	100	70	100	1000	1.2	1.0	25	5	25	.300
R2	200	140	200	1000	1.2	1.0	25	5	25	.300
R3	300	210	300	1000	1.2	1.0	25	5	25	.300
R4	400	280	400	1000	1.2	1.0	25	5	25	1.0

TECHNICAL BULLETIN R98



Operating and Storage Temperature −193.8°C +200°C

(1) Recovery Conditions are: 0.5 amps forward to 1.0 amps reverse. Recovery measured when rectifier recovers to −0.25 amps.

Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

JAN TYPE SILICON RECTIFIERS

Semtech Corporation provides a multipurpose Hermetic Seal Silicon Rectifier incorporating advance design and engineering techniques never before available to the electronics industry at a nominal cost. This new rectifier utilizes solid internal construction with a package combining high mechanical strength, superior thermal shock resistance, rugged hermetic seal, high dielectric strength and excellent thermal conductivity properties.

REFER TO INFORMATION ON METOXILITE SILICON RECTIFIERS FOR DEVICES THAT ARE AVAILABLE TO NEW MSFC/NASA AND MILITARY SPECIFICATIONS. (PAGE 7)

GENERAL PURPOSE MIL-S-19500/286C including TX and TXV

NOTE: 1 T_{rr} 2 μsec.

Type No.	Peak Inverse Voltage	RMS (Sine Wave) Voltage	DC Blocking Voltage	Average Rectified Current		Forward Voltage @ 3A (pk)		Max. Static Reverse Current @ PIV		If(Surge)* Second at 1/120	One Cycle Surge	Approx. Max. Altitude (Without Derating)
				100°C	150°C	Max.	Typ.	25°C	150°C			
	Amps	Volts	Volts	MA	MA	Volts	Volts	μA	μA	Amps	Amps	Feet
JAN 1N4245	200	140	200	1000	300	1.3	1	1	150	25	50	100,000
JAN 1N4246	400	280	400	1000	300	1.3	1	1	150	25	50	100,000
JAN 1N4247	600	420	600	1000	300	1.3	1	1	150	25	50	100,000
JAN 1N4248	800	560	800	1000	300	1.3	1	1	150	25	50	70,000
JAN 1N4249	1000	700	1000	1000	300	1.3	1	1	150	25	50	70,000

*T_A = +150°C if (surge = 10 Adc) 10 surges of 8.0 msec duration each, at intervals of 1 minute. I_O = 300 mAdc. TECHNICAL BULLETIN R90

1 Recovery conditions: 0.5 amp forward current to 1.0 amp reverse current
Recovery time measured when rectifier recovers to .25 amps.

FAST RECOVERY MIL-S-19500/359B (USAF) including TX

Type No.	Rated PIV & DC Blocking Voltage Vr/Vrm (wkg.)	Avalanche Breakdown Voltage @ 50 μA	Max. Average Rectified Current		Static Forward Voltage @ 1 ADC	Max. Static Reverse Current		Max. Junction Capacitance	Max. Recurrent Peak Current	if (surge) tp = 8.3 mSec 2	Recovery Time 1
		25°C	55°C	100°C	Max.	25°C	150°C	12V DC	55°C	100°C	Max.
	Volts dc/pk	Volts Min.	Amps	Amps	Volts	μAdc	μAdc	Picofarads	Amps	Amps	Nsec.
JAN 1N4942	200	220	1.0	.75	1.3	1.0	200	45	6	15	150
JAN 1N4944	400	440	1.0	.75	1.3	1.0	200	35	6	15	150
JAN 1N4946	600	660	1.0	.75	1.3	1.0	200	25	6	15	250
JAN 1N4947	800	880	1.0	.75	1.3	1.0	200	20	6	15	250
JAN 1N4948	1000	1100	1.0	.75	1.3	1.0	200	15	6	15	500

2 10 surges, 1 surge/minute superimposed on I_O = 750mA. TECHNICAL BULLETIN R89

1 Recovery conditions: 0.5 amp forward current to 1.0 amp reverse current
Recovery time measured when rectifier recovers to .25 amps.

supplied to MIL-S-19500/279A including TX

Type No.	V_r Peak Inverse Voltage	V_{RM} (Wkg.)	Average Rectified Current		Forward Voltage @ 1A	Max. Static Reverse Current @ PIV		*If (surge) (at:1/120 sec.)
			T_A = 100°C	T_A = 150°C	(pk)	25°C	150°C	
	V (pk)	V (pk)	MA	MA	Volts	μA	μA	Amps
JAN 1N3611	240	200	1000	300	1.1	1	300	30
JAN 1N3612	480	400	1000	300	1.1	1	300	30
JAN 1N3613	720	600	1000	300	1.1	1	300	30
JAN 1N3614	920	800	1000	300	1.1	1	300	30
JAN 1N3957	1150	1000	1000	300	1.1	1	300	30

All temperatures are local ambient, 25°C unless otherwise specified. TECHNICAL BULLETIN R40

Operating Ambient Temperature −65°C to +175°C

Storage Temperature −65° to +200°C

Barometric Pressure, Reduced 8 mm Hg — 1N3611, 1N3612 and 1N3613; 54 mm Hg — 1N3614; 87 mm Hg — 1N3957.

*T_A = +150°C if (surge = 30 Adc) 10 surges of 8.0 msec duration each, at intervals of 1 minute. I_O = 300 mAdc.

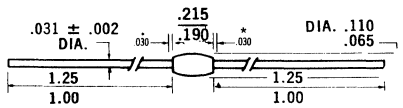
Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

SEMTECH METOXILITE SUB-MINIATURE HIGH VOLTAGE SILICON RECTIFIERS

Available in Metoxilite, Semtech's new sub-miniature multi-purpose high voltage axial lead silicon rectifier, ideally suited for small electronic package design. The Metoxilite device exceeds environmental requirements of current military and space program specifications.

LEAD MATERIAL: 99.9% PURE SILVER IN ACCORDANCE WITH MIL-S-13282A, GRADE A



*LEAD DIAMETER UNCONTROLLED IN THIS AREA

Type No.	Peak Inverse Voltage	RMS (Sine Wave) Voltage	DC Blocking Voltage	Average Rectifier Current			Maximum Static Forward Voltage	Maximum Static Reverse Current @ PIV		Recurrent Surge	One Cycle Surge	*Reverse Recovery Time
							100 MA					Trr
	Volts	Volts	Volts	55°C MA	100°C MA	150°C MA	25°C Volts	25°C μA	100°C μA	Amps	Amps	Max.
MEDIUM RECOVERY												
SM20	2000	1400	2000	250	150	50	3.5	1	25	2.5	10	
SM25	2500	1750	2500	250	150	50	3.5	1	25	2.5	10	
SM30	3000	2100	3000	250	150	50	3.5	1	25	2.5	10	
FAST RECOVERY												
S15F	1500	1050	1500	250	150	50	4.0	1	25	2.5	10	300 ns
S20F	2000	1400	2000	250	150	50	4.0	1	25	2.5	10	300 ns
S25F	2500	1750	2500	250	150	50	4.0	1	25	2.5	10	300 ns
JAN can be supplied to meet MIL-S-19500/279A												
1N3643	1000	700	1000	250	150	—	3.5	1	20	2.5	14	—
1N3644	1500	1050	1500	250	150	—	3.5	1	20	2.5	14	—
1N3645	2000	1400	2000	250	150	—	3.5	1	20	2.5	14	—
1N3646	2500	1750	2500	250	150	—	3.5	1	20	2.5	14	—
1N3647	3000	2100	3000	250	150	—	3.5	1	20	2.5	14	—

TECHNICAL BULLETIN R94

TECHNICAL BULLETIN R95

*Reverse Recovery (Trr) Conditions.
50 MA forward current to 100 MA reverse current.
Recovery time measured when rectifier recovers to 25 MA.

Operating Temperature −65°C to +175°C
Storage Temperature −193.8°C to +200°C

Operating Temperature −65°C to +175°C
Storage Temperature −193.8°C to +200°C
Altitude Operation (Barometric Pressure Reduced) 40,000 ft.

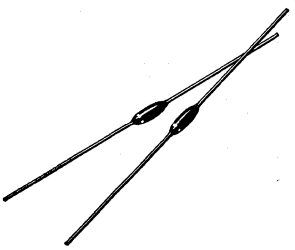
TECHNICAL BULLETIN R55

Semtech reserves the right to change specifications without notice.

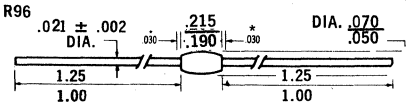
SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

"MINISTAC" HIGH VOLTAGE SILICON RECTIFIERS

Semtech offers "Ministac" a sub-miniature multipurpose high voltage silicon rectifier. Cylindrical in design with insulated case and silver leads for simple handling and installation. Better electrical characteristics obtained by Semtech's unique construction. Hermetically sealed and designed to meet requirements of military, industrial and consumer-product applications. Ideally suited for low current high voltage applications and multiplier circuits.



LEAD MATERIAL: 99.9% PURE SILVER IN ACCORDANCE WITH MIL-S-13282A, GRADE A



OUTLINE 01

METOXLITE MEDIUM RECOVERY (OUTLINE 01)

Type No.	Peak Inverse Voltage	Max. Static Forward Voltage	Average Rectified Current (Milliamps)			Max. Static Reverse Current @ PIV (μAdc)		One Cycle Surge	Recurrent Surge	Max. Recovery Time 1 trr	Max. Junction Capacitance @ 100 Volts
	Volts	@ 125 MA Volts	55°C	100°C	150°C	25°C	100°C	Amps	Amps	Nsec.	Picofarads
M20	2000	5	125	67	10	.100	7.0	7	1.25	2000	2.0
M30	3000	5	125	67	10	.100	7.0	7	1.25	2000	2.0
M40	4000	5	125	67	10	.100	7.0	7	1.25	2000	2.0
M50	5000	5	125	67	10	.250	10.0	7	1.25	2000	2.0

1 Recovery conditions: 50 MA forward current to 100 MA reverse current. TECHNICAL BULLETIN R96
Recovery time measured when rectifier recovers to 25 MA.
Operating and Storage Temperature −193.8°C to +200°C

METOXILITE FAST RECOVERY NANOSECOND REVERSE RECOVERY (OUTLINE 01)

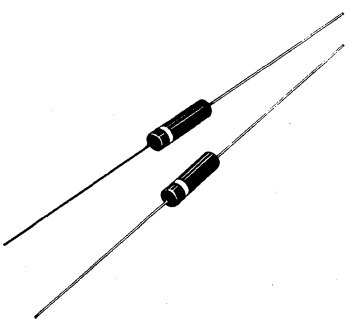
		@ 100 MA									
F15	1500	5	100	50	5	.100	7.0	5	1.25	250	2.0
F20	2000	5	100	50	5	.100	7.0	5	1.25	250	2.0
F25	2500	5	100	50	5	.100	7.0	5	1.25	250	2.0
F30	3000	5	100	50	5	.250	10.0	5	1.25	250	2.0

1 Recovery conditions: 50 MA forward current to 100 MA reverse current. TECHNICAL BULLETIN R97
Recovery time measured when rectifier recovers to 25 MA.
Operating and Storage Temperature −193.8°C to +200°C

"SEMPAC" MEDIUM RECOVERY (OUTLINE 02)

		@ 10 MA									
SCM30	3000	15	10	5	0	.100	2.0	2	.100	500	1.0
SCM40	4000	15	10	5	0	.100	2.0	2	.100	500	1.0
SCM50	5000	15	10	5	0	.100	2.0	2	.100	500	1.0
SCM60	6000	15	10	5	0	.100	2.0	2	.100	500	1.0
SCM70	7000	15	10	5	0	.100	2.0	2	.100	500	1.0

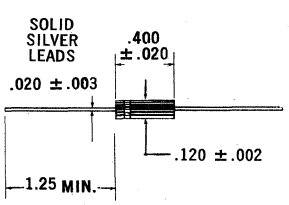
1 Recovery conditions: 5 MA forward current to 10 MA reverse current. TECHNICAL BULLETIN R62
Recovery time measured when rectifier recovers to 2.5 MA.
Operating and Storage Temperature −55°C to +150°C



"SEMPAC" FAST RECOVERY (OUTLINE 02)

		@ 10 MA									
SFM30	3000	15	10	5	0	.100	2.0	2	.100	100	1.0
SFM40	4000	15	10	5	0	.100	2.0	2	.100	100	1.0
SFM50	5000	15	10	5	0	.100	2.0	2	.100	150	1.0
SFM60	6000	15	10	5	0	.100	2.0	2	.100	250	1.0
SFM70	7000	15	10	5	0	.100	2.0	2	.100	250	1.0

1 Recovery conditions: 5 MA forward current to 10 MA reverse current. TECHNICAL BULLETIN R61
Recovery time measured when rectifier recovers to 2.5 MA.
Operating and Storage Temperature −55°C to +150°C



OUTLINE 02

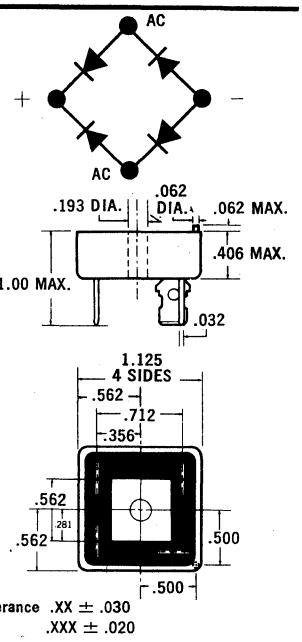
Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

"ALPAC"® SILICON BRIDGE RECTIFIERS

Semtech Corporation introduces "ALPAC" a complete line of Single Phase Silicon Bridge Rectifier circuits. Designed in Aluminum Cases to provide maximum thermal conductivity and simple installation. "ALPAC" universal terminals, insulated from case, provide a 3 way electrical connection: fast disconnect, wire wrap around and hole wire insert for soldering.

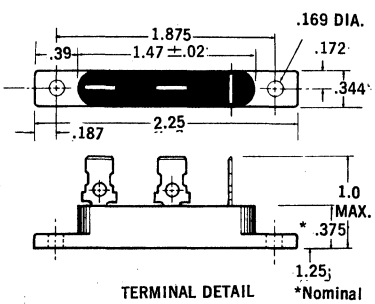
Internally the device utilizes the Semtech high performance solid double heat sink junctions designed for mechanical strength and eliminating the use of solders for improved reliability. The bridges are designed for utilization in power supplies, AC to DC converters and motor control circuits.



Type No.	PIV Per Leg	Sine Wave RMS Input Voltage Max.	Average DC Output Amps TC = Case Temp. (°C)			Average DC Output/Leg TA = Ambient Temp. (No Heat Sink) (°C)			Peak 1 Cycle Fwd. Surge	Peak Recurrent Fwd.	VF Max. Per Leg @ 3A DC	Reverse Current (I_R Max. @ PIV) (°C)		Data Sheet No.
			55	100	125	25	55	100			25°C	25	100	
	Volts	Volts	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Volts	μA	μA	
SCBA05	50	35	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3
SCBA1	100	70	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3
SCBA2	200	140	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3
SCBA3	300	210	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3
SCBA4	400	280	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3
SCBA6	600	420	25	18.5	12.5	6.0	5.0	3.0	150	75	1.0	5	100	MB3

Maximum thermal impedance junction to mounting surface 1.5°C/Watt.
Maximum operating and storage temperature —55°C to +150°C.

ALSO AVAILABLE IN FAST RECOVERY
TECH BULLETIN MB15

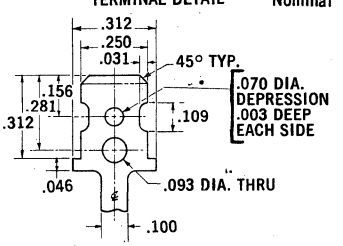


"ALPAC" DOUBLERS AND CENTER TAPS

AVAILABLE IN FAST RECOVERY
TECH BULLETIN MB17 & 18

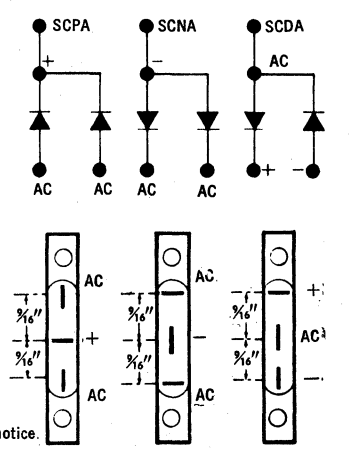
Semtech Corporation introduces "Alpac," a series of Doublers and Center taps, Rectifier circuits. Designed in Aluminum Cases to provide maximum thermal conductivity and simple installation. "Alpac" terminals are insulated from case. The Universal Terminals provide a 3 way electrical connection: fast disconnect, wire wrap around and hole wire insert for soldering. Internally the device utilizes the Semtech high performance solid double heat sink junctions.

The devices are designed to replace stud rectifiers and provide simple, economical and reliable packaging.



TERMINAL ORIENTATION

Type No.	PIV Per Leg DC or Recurrent	Sine Wave RMS Input Voltage Max.	Average DC Output/Leg TC = Case Temp. (°C)			Average DC Output Amps TA = Ambient Temp. (No Heat Sink) (°C)			Peak 1 Cycle Fwd. Surge	Peak Recurrent Fwd.	VF Max. Per Leg @ 3A DC	I_R Max. Per Leg @ PIV (°C)		Data Sheet No.
			55	100	125	25	55	100			25°C	25	100	
	Volts	Volts	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Amps	Volts	μA	μA	
SCDA05	50	35	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA05	50	35	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA05	50	35	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCDA1	100	70	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA1	100	70	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA1	100	70	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCDA2	200	140	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA2	200	140	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA2	200	140	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCDA3	300	210	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA3	300	210	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA3	300	210	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCDA4	400	280	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA4	400	280	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA4	400	280	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCDA6	600	420	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCPA6	600	420	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4
SCNA6	600	420	15	10	5	5	4	2.5	150	75	1.0	5	100	MB4



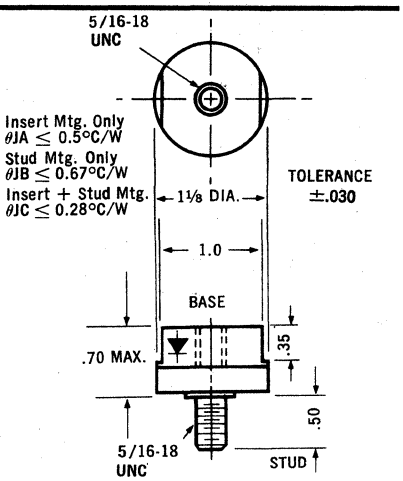
Maximum thermal impedance junction to mounting surface 5.0°C/Watt.
Maximum operating and storage temperature —55°C to +150°C. Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

"CUPAC" 150 SILICON POWER RECTIFIERS

Semtech Corporation introduces "CuPac" 150, a new series of high current silicon rectifiers with fast recovery characteristics. OFHC** insert base and stud allow the internal "Metoxilite" rectifiers to be heat sunk from cathode, anode or both. The secondary Diallyl Phthalate case provides a long external leakage path necessary for P.I.V. to 600 volts.

This series has been specifically designed for high frequency, high power industrial, military and space applications.



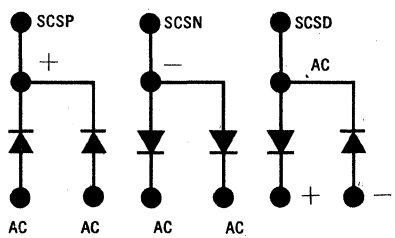
FAST RECOVERY (t_{rr}) 200 NANOSECONDS
(600 VOLTS, trr 400 ns)

Type No.	Peak Inverse Voltage	* V_F @ 100A T_J 25°C	* V_F @ 100A T_J 100°C	Max. Static Rev. Current @ PIV 25°C	Max. Static Rev. Current @ PIV 100°C
	Volts	Volts	Volts	μA	MA
SCSF05	50	1.4	1.35	25	1
SCSF1	100	1.4	1.35	25	1
SCSF2	200	1.4	1.35	25	1
SCSF4	400	1.4	1.35	25	1
SCSF6	600	1.4	1.35	25	1

MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS

Type No.	Peak Inverse Voltage	* V_F @ 100A T_J 25°C	* V_F @ 100A T_J 100°C	Max. Static Rev. Current @ PIV 25°C	Max. Static Rev. Current @ PIV 100°C
	Volts	Volts	Volts	μA	MA
SCSM05	50	1.22	1.17	25	1
SCSM1	100	1.22	1.17	25	1
SCSM2	200	1.22	1.17	25	1
SCSM4	400	1.22	1.17	25	1
SCSM6	600	1.22	1.17	25	1

For reverse polarity, add "R" after Type No.
"CUPAC" also available in DOUBLERS and CENTER TAPS, 3-PHASE ½ WAVE BRIDGE TECHNICAL BULLETIN R75
* V_F is measured at pulse I_F duration = 1.0 millisecond.



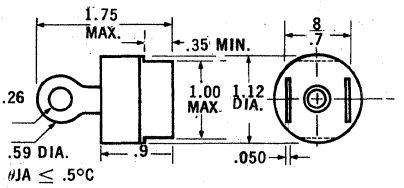
DOUBLERS AND CENTER TAPS

FAST RECOVERY (t_{rr}) 200 NANOSECONDS
(600 VOLTS, trr 400 ns)

Type No.	Peak Inverse Voltage Per Leg	* V_F @ 50A T_J 25°C	* V_F @ 50A T_J 100°C	Max. Reverse Current Per Leg 25°C	Max. Reverse Current Per Leg 100°C
	55°C Volts	Volts	Volts	μA	μA
SCSDF05	50	1.4	1.35	13	500
SCSPF05	50	1.4	1.35	13	500
SCSNF05	50	1.4	1.35	13	500
SCSDF1	100	1.4	1.35	13	500
SCSPF1	100	1.4	1.35	13	500
SCSNF1	100	1.4	1.35	13	500
SCSDF2	200	1.4	1.35	13	500
SCSPF2	200	1.4	1.35	13	500
SCSNF2	200	1.4	1.35	13	500
SCSDF4	400	1.4	1.35	13	500
SCSPF4	400	1.4	1.35	13	500
SCSNF4	400	1.4	1.35	13	500
SCSDF6	600	1.4	1.35	13	500
SCSPF6	600	1.4	1.35	13	500
SCSNF6	600	1.4	1.35	13	500

MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS

Type No.	Peak Inverse Voltage Per Leg	* V_F @ 50A T_J 25°C	* V_F @ 50A T_J 100°C	Max. Reverse Current Per Leg 25°C	Max. Reverse Current Per Leg 100°C
	25°C Volts	Volts	Volts	μA	μA
SCSDM05	50	1.22	1.17	13	500
SCSPM05	50	1.22	1.17	13	500
SCSNM05	50	1.22	1.17	13	500
SCSDM1	100	1.22	1.17	13	500
SCSPM1	100	1.22	1.17	13	500
SCSNM1	100	1.22	1.17	13	500
SCSDM2	200	1.22	1.17	13	500
SCSPM2	200	1.22	1.17	13	500
SCSNM2	200	1.22	1.17	13	500
SCSDM4	400	1.22	1.17	13	500
SCSPM4	400	1.22	1.17	13	500
SCSNM4	400	1.22	1.17	13	500
SCSDM6	600	1.22	1.17	13	500
SCSPM6	600	1.22	1.17	13	500
SCSNM6	600	1.22	1.17	13	500

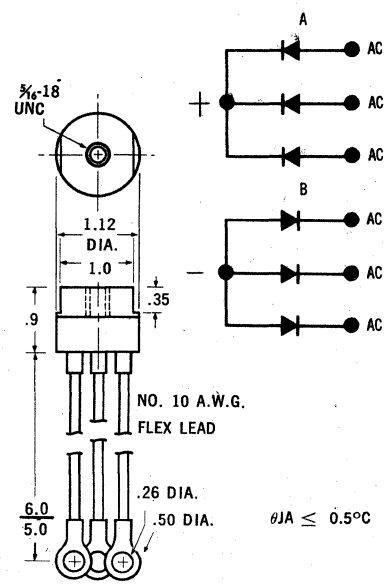


Maximum Operating & Storage Temperature —55°C to +150°C.
Mounting Torque
35-40 Inch Lbs.
**OFHC—Oxygen Free Hard Copper
* V_F is measured at pulse I_F duration = 1.0 millisecond.

TECHNICAL BULLETIN MB25
Standard part comes with No. 8 A.W.G. Flex Leads
Add letter W after Type No.
—Add Letter L after type number to specify lug type.
Recovery conditions: 0.5 amp forward current to 1.0 amp reverse current. Recovery time measured when rectifier recovers to .25 amp and performed on each diode prior to assembly.

3-PHASE ½ WAVE BRIDGE

Semtech Corporation introduces a new series of "CuPac" 150 high current silicon 3 phase ½ wave bridges with fast recovery characteristics. OFHC** insert base allows the internal "Metoxilite" rectifiers to be heat sunk. The secondary Diallyl Phthalate case provides a long external leakage bath necessary for P.I.V. to 600 volts.



FAST RECOVERY (t_{rr}) 200 NANOSECONDS
(600 VOLTS, trr 400 ns)

Type No.	Peak Inverse Voltage Per Leg	* V_F @ 33A T_J 25°C	* V_F @ 33A T_J 100°C	Reverse Current Per Leg @ PIV 25°C	Reverse Current Per Leg @ PIV 100°C
	25°C Volts	Volts	Volts	μA	μA
SCSHF05	50	1.4	1.35	10	350
SCSHF1	100	1.4	1.35	10	350
SCSHF2	200	1.4	1.35	10	350
SCSHF4	400	1.4	1.35	10	350
SCSHF6	600	1.4	1.35	10	350

MEDIUM RECOVERY (t_{rr}) 2 MICROSECONDS

Type No.	Peak Inverse Voltage Per Leg	* V_F @ 33A T_J 25°C	* V_F @ 33A T_J 100°C	Reverse Current Per Leg @ PIV 25°C	Reverse Current Per Leg @ PIV 100°C
	25°C Volts	Volts	Volts	μA	μA
SCSHM05	50	1.22	1.17	10	350
SCSHM1	100	1.22	1.17	10	350
SCSHM2	200	1.22	1.17	10	350
SCSHM4	400	1.22	1.17	10	350
SCSHM6	600	1.22	1.17	10	350

For Negative Polarity, Add "N" After Type No.
Semtech reserves the right to change specifications without notice.
*V_F is measured at pulse I_F duration = 1.0 millisecond.

TECHNICAL BULLETIN MB26

Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

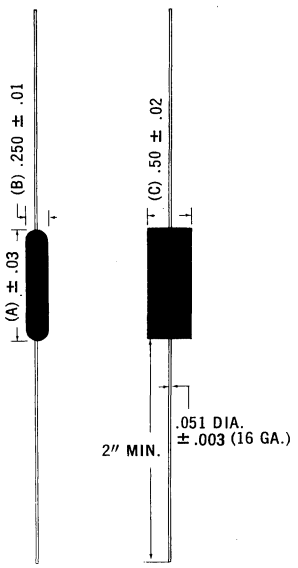
"SLIMPAC" HIGH VOLTAGE-HIGH CURRENT SILICON RECTIFIERS

The Semtech's "Slimpac" is a new high density high voltage high current silicon rectifier for use in industrial and military applications which require small, lightweight rectifiers without compromise on the required high reliability criteria. Designed and tooled to be efficiently mass produced, "Slimpac" can be used economically in existing applications. The rectifier can be utilized in all standard, single and polyphase rectifier circuits. Designed to be corona free, the unit is capable of meeting stringent electrical, mechanical, and environmental specifications.

Type No.	Peak Inverse Voltage	Average Rectified Current 55°C	Average Rectified Current 100°C	One Cycle Surge Current 25°C	One Cycle Surge Current 100°C	Reverse Current @ PIV 25°C	Reverse Current @ PIV 100°C	Max. Forward Voltage 25°C	Max. Case Size (A)	Data Sheet No.
	Volts	Amps	Amps	Amps	Amps	μA	μA	500 MA	Inches	
SCH5000	5000	.5	.33	50	25	0.1	15	7	1.125	H46
SCH7500	7500	.5	.33	50	25	0.1	15	10	1.625	H46
SCH10000	10000	.5	.33	50	25	0.1	15	14	2.000	H46
SCH12500	12500	.5	.33	50	25	0.1	15	17	2.375	H46
SCH15000	15000	.5	.33	50	25	0.1	15	20	2.750	H46
SCH20000	20000	.5	.33	50	25	0.1	15	27	3.500	H46
SCH25000	25000	.5	.33	50	25	0.1	15	33	4.250	H46
MEDIUM RECOVERY **(t_{rr}) 1 MICROSECOND										
SCHF5000	5000	.5	.33	50	25	0.1	15	7	1.125	H47
SCHF7500	7500	.5	.33	50	25	0.1	15	10	1.625	H47
SCHF10000	10000	.5	.33	50	25	0.1	15	14	2.000	H47
SCHF12500	12500	.5	.33	50	25	0.1	15	17	2.375	H47
SCHF15000	15000	.5	.33	50	25	0.1	15	20	2.750	H47
SCHF20000	20000	.5	.33	50	25	0.1	15	27	3.500	H47
SCHF25000	25000	.5	.33	50	25	0.1	15	33	4.250	H47
FAST RECOVERY **(t_{rr}) 150 NANOSECONDS										
SCF2500	2500	.5	.33	25	12.5	0.1	15	6	1.125	H47
SCF5000	5000	.5	.33	25	12.5	0.1	15	12	2.000	H47
SCF7500	7500	.5	.33	25	12.5	0.1	15	18	2.750	H47
SCF10000	10000	.5	.33	25	12.5	0.1	15	24	3.500	H47
SCF12500	12500	.5	.33	25	12.5	0.1	15	30	4.250	H47

**T_{RR} Reverse Recovery is measured on each junction prior to manufacture of assembly.
0.5 Amp forward current to 1.0 Amp reverse current. Recovery time measured when rectifier recovers to .25 Amp.
Operating and storage temperature —55°C to +150°C

H-46 & H-47 TYPES



"SLIMPAC SR."

ALSO AVAILABLE IN FAST RECOVERY

Type No.	Peak Inverse Voltage	Average Rectified Current 55°C	Average Rectified Current 100°C	One Cycle Surge Current 25°C	One Cycle Surge Current 100°C	Reverse Current @ PIV 25°C	Reverse Current @ PIV 100°C	Max. Forward Voltage 25°C	Case Size Inches	Data Sheet No.
	Volts	Amps	Amps	Amps	Amps	μA	μA	@ 1 Amp	A	
SCHS2500	2500	2	1.2	150		10	120	5	1.5	H48
SCHS5000	5000	2	1.2	150		10	120	10	2.5	H48
SCHS7500	7500	2	1.2	150		10	120	15	3.5	H48
SCHS10000	10000	2	1.2	150		10	120	20	4.5	H48
SCHS12500	12500	2	1.2	150		10	120	25	5.5	H48
SCHS15000	15000	2	1.2	150		10	120	30	6.5	H48

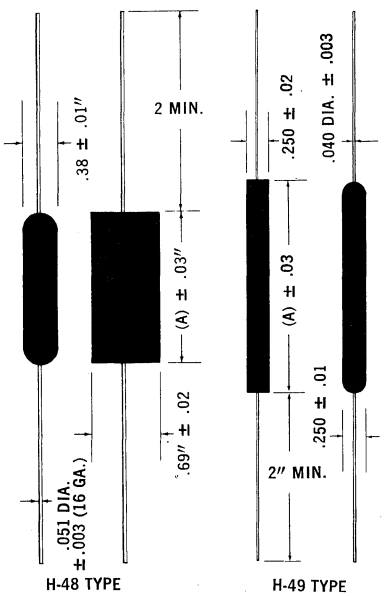
Operating and storage temperature —55°C to +150°C

"SLIMPAC JR."

@ 50 MA

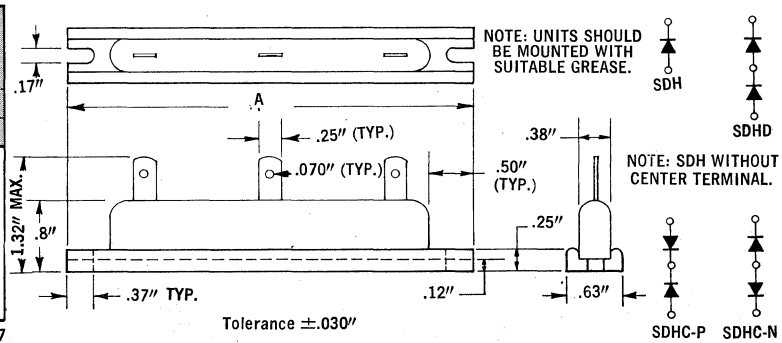
SCHJ15K	15000	.050	.030	4	2	0.1	25	20	1.5	H49
SCHJ22.5K	22500	.050	.030	4	2	0.1	25	30	2	H49
SCHJ30K	30000	.050	.030	4	2	0.1	25	40	2.5	H49
SCHJ37.5K	37500	.050	.030	4	2	0.1	25	50	3	H49
SCHJ45K	45000	.050	.030	4	2	0.1	25	60	3.5	H49

Operating and storage temperature —55°C to +150°C



"KV-PAC" HIGH VOLTAGE SILICON RECTIFIERS, DOUBLERS AND CENTER TAPS

Type No.	Peak Inverse Voltage Per Leg	Average Rectified Current	One Cycle Surge Current	Reverse Current @ PIV	Case Length
	55°C	55°C Mtg.	55°C	25°C	(A)
	Volts	Amps	Amps	μA	Inches
SDH10K	10KV	0.6	35	10	3.36
SDH15K	15KV	0.6	35	10	4.04
SDHC5K	5KV	1.2	35	10	3.36
SDHD5K	5KV	1.2	35	10	3.36
SDHC10K	10KV	1.2	35	10	4.72
SDHD10K	10KV	1.2	35	10	4.72
SDHC15K	15KV	1.2	35	10	6.09
SDHD15K	15KV	1.2	35	10	6.09



TECHNICAL BULLETIN MB27

On Center Tap Add Suffix P for Positive Output, N for Negative Output
Operating and Storage Temperature —55°C to +150°C

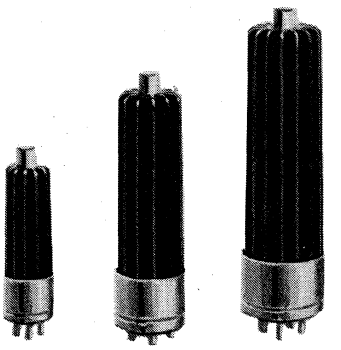
Semtech reserves the right to change specifications without notice.

SEMTECH
CORPORATION 652 Mitchell Road, Newbury Park, California 91320 (805) 498-2111, (213) 628-5392 / TWX: 910-336-1264

"TUBE-PAC" HIGH VOLTAGE SILICON RECTIFIERS

"Tube-Pac" is Semtech's new line of silicon, high-voltage rectifiers intended as a direct plug-in replacement part for most popular mercury-vapor and vacuum glass tube-type rectifiers.

Designed to last the life of the equipment, Semtech's "Tube-Pac" are smaller, corona free, dissipate heat more effectively and eliminate filament power. No special adaptors are required to use Semtech's "Tube-Pac."



STR (SEMTECH TUBE REPLACEMENT PRECEEDS STANDARD EIA TUBE TYPE NUMBER).

GAS TUBE REPLACEMENTS

Type	PIV - KV	Io Amp	Filament Connection
STR3B25	4.5	0.5	1
STR3B28	10	0.5	1
STR4B32	10	1.25	1
STR249C	10	0.5	1
STR575A	15	2.5	2
STR576A	25	0.5	2
STR250R	60	0.25	2
STR253	15	0.35	2
STR577	25	0.3	2
STR593	25	0.3	1
STR615	2	2.5	1
STR635	1	6.4	3
STR672A	2.5	3.2	2

Type	PIV - KV	Io Amp	Filament Connection
STR816	7.5	.13	2
STR866A	10	0.5	1
STR872A	10	1.25	2
STR5544	1.5	3.2	2
STR5560	1.5	2.5	4
STR5720	1.0	2.5	4
STR6587	16	0.23	2
STR6693	15	5	
STR6807	1.5	6.4	2
STR6808	1.5	6.4	2
STR6894	20	2.5	2

Type	PIV - KV	Io Amp	Filament Connection
STR6895	20	2.5	2
STR7018	2	2.5	1
STR7019	1	6.4	2
STR7454	25	6.5	1
STR7789	15	0.4	2
STR7790	20	1.0	2
STR7792	25	2.0	2
STR8008	10	1.25	2
STR8080	25	2.5	2
STR8253	20	0.25	2
STR8434	20	1.8	2
STR8435	20	1.8	2

TECHNICAL BULLETIN H57

VACUUM TUBE REPLACEMENTS*

NOTE: FOR OTHER THAN POWER FREQUENCY REQUIREMENTS, UTILIZE DESIGNATION STF IN PLACE OF STR.

Type	PIV - KV	Io MA	Filament Connection
STR561	25	750	3
STR561F	25	750	3
STR578	40	150	1
STR578F	40	150	1
STR579B	20	30	2
STR579BF	20	30	2
STR582	7	210	1
STR582F	7	210	1
STR583	17	60	7
STR583F	17	60	7
STR705WA	30	150	1
STR705WAF	30	150	1
STR836	5	250	1
STR836F	5	250	1
STR1616	6	130	1
STR1616F	6	130	1
STR5575	150	160	1
STR5575F	150	160	1
STR5576	150	400	1

Type	PIV - KV	Io MA	Filament Connection
STR5576F	150	400	1
STR5825	60	2	1
STR5825F	60	2	1
STR5973	75	1000	1
STR5973F	75	1000	1
STR8013A	55	20	1
STR8013AF	55	20	1
STRF8020	40	100	1
STRF8020F	40	100	1
STR23102	75	240	1
STR2-25A	25	50	1
STR2-25F	25	50	1
STR2-50A	30	80	1
STR2-50AF	30	80	1
STR2-150D	30	250	2
STR2-150DF	30	250	2
STR2-240A	25	500	1
STR2-240AF	25	500	1
STR2-450A	30	1000	2

Type	PIV - KV	Io MA	Filament Connection
STR2-450AF	30	1000	2
STR2X1000A	25	1250	1
STR2X1000AF	25	1250	1
STR2-2000A	75	750	1
STR2-2000AF	75	750	1
STR3B24WA	20	60	2
STR3B24WAF	20	60	2
STR3B29	16	70	4
STR3B29F	16	70	4
STR4831	20	300	1
STR4B31F	20	300	1
STRX80	40	750	2
STRX80F	40	750	2
STR371B	25	300	2
STR371BF	25	300	2
STR543	30	1000	1
STR543F	30	100	1
STR558	15	300	2
STR558F	15	300	2

*WHEN ORDERING VACUUM TUBE REPLACEMENTS, PLEASE SUPPLY PERTINENT ELECTRICAL PARAMETERS FOR THE SPECIFIC APPLICATION.

TECHNICAL BULLETIN H57

SHOULD YOU REQUIRE A RECTIFIER TUBE REPLACEMENT NOT LISTED, PLEASE CONTACT OUR LOCAL REPRESENTATIVE.

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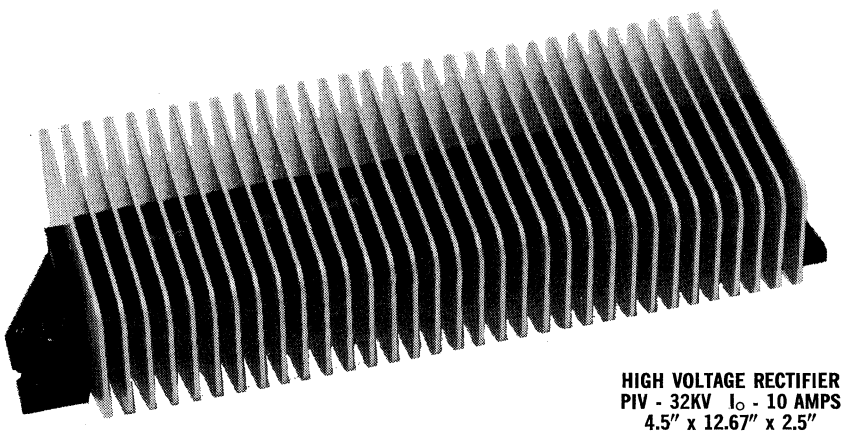
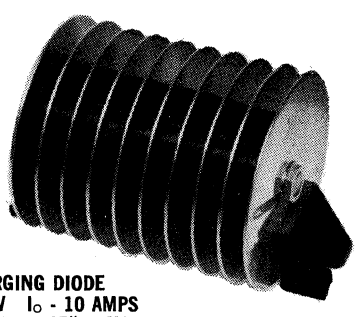
SPECIAL "STACPAC" HIGH POWER SILICON RECTIFIERS

"STACPAC", a new concept in power rectifier stacks for use in high voltage, high current applications. Unique in design, "STACPAC" completely eliminates all the external component parts and solder joints usually found in devices of this type. All components are encapsulated and connected to aluminum discs, that in turn, serve as compensation, cooling fins and corona protection. Internally, "STACPAC" utilizes the Semtech "METOXILITE" Silicon Rectifiers.
"STACPAC" was designed specifically to streamline packaging, replace multiple stud rectifiers and auxiliary compensation in high voltage, high current applications. Semtech has immediate capability to produce special high current — high voltage assemblies up to and exceeding 500K volts. Please contact our representatives for further details.

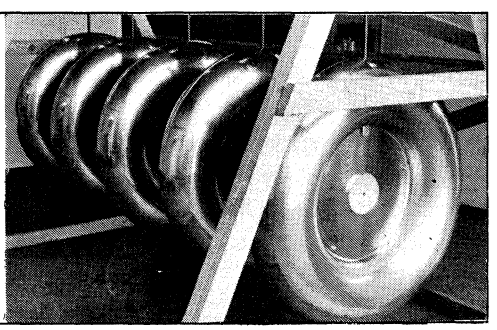


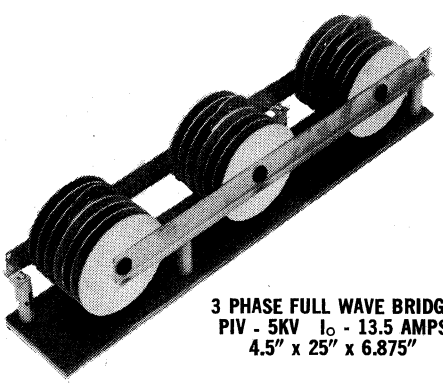
HIGH VOLTAGE RECTIFIER
PIV - 32KV I_O - 10 AMPS
4.5" x 12.67" x 2.5"



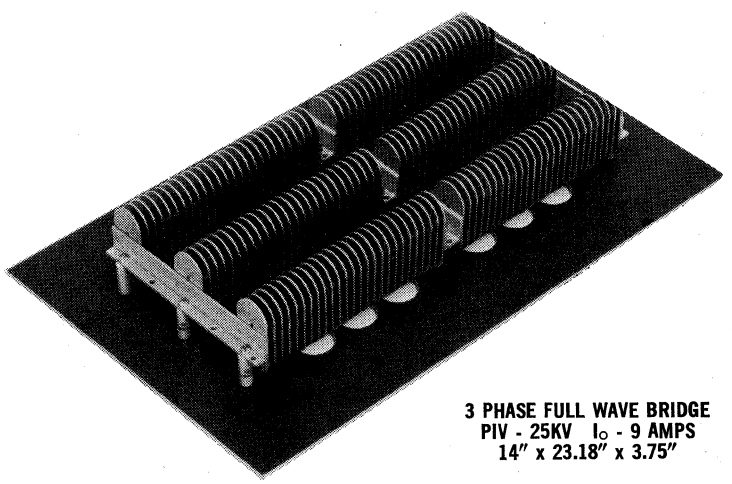
CHARGING DIODE
PIV - 7KV I_O - 10 AMPS
4.5" DIA. 7.25" LONG

HIGH VOLTAGE RECTIFIER
PIV 820 KV
Io AMPS = 3.0 AMPS
DIA. 40" — 9' LONG





3 PHASE FULL WAVE BRIDGE
PIV - 5KV I_O - 13.5 AMPS
4.5" x 25" x 6.875"



3 PHASE FULL WAVE BRIDGE
PIV - 25KV I_O - 9 AMPS
14" x 23.18" x 3.75"

Semtech reserves the right to change specifications without notice.

Sensitrode®

the most reliable rectifier available today!

sensitrode reliability features:

hermetically sealed −195°C to +300°C temperature range

• lowest leakage

The Sensitrode process provides reverse leakage currents as low as 0.1 microamps at peak inverse voltage.

• true avalanche characteristics

Due to the extremely low surface leakage, avalanche breakdown in the Sensitrode rectifier occurs uniformly across the entire junction area offering the best protection possible against transient voltage spikes.

• high operating & storage temperature

Sensitrode glass passivated rectifier chips are metallurgically brazed to the leads allowing maximum operating junction temperature of 200°C and maximum storage temperature of 300°C. Conventional rectifier chips are soldered to the leads and passivated with organic materials limiting their maximum operating temperature to 150°C and storage temperature to 200°C.

• temperature cycling & thermal shock

The unique Sensitrode method of glass passivation makes possible the widest range of temperature cycling available. The glass formula used provides the closest match to the thermal coefficient of silicon.

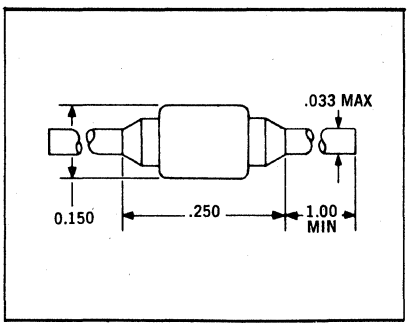
life-time warranty

The Sensitrode rectifier is unconditionally warranteed for the life of the equipment. For specific warrantee conditions, write or call factory.

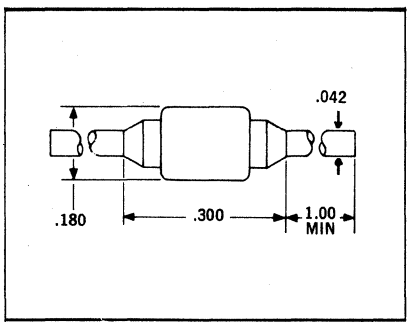
sensitrode samples

For your free Sensitrode evaluation sample, write request on your company letterhead.

PACKAGE OUTLINE "A"



PACKAGE OUTLINE "B"



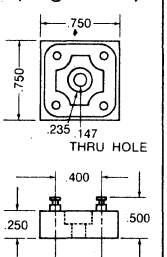
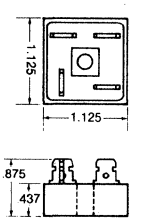
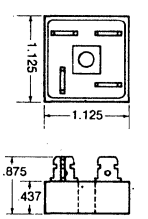
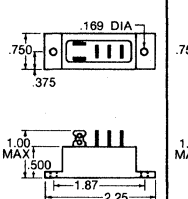
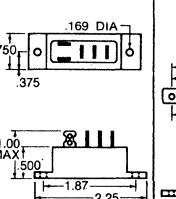
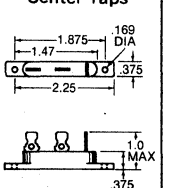
GENERAL PURPOSE

Type	Peak* Inverse Voltage (Volts)	Max. Fwd. Curr. @ 75°C (Amps)	Max. One Cycle Surge (Amps)	Trr Micro Seconds	Package Outline
SRS 105 thru SRS 1100	50 thru 1000	1.0	60	5	A
SRS 205 thru SRS 2100	50 thru 1000	2.0	100	5	A
SRS 305 thru SRS 3100	50 thru 1000	3.0	150	5	B

FAST RECOVERY

Type	Peak* Inverse Voltage (Volts)	Max. Fwd. Curr. @ 75°C (Amps)	Max. One Cycle Surge (Amps)	Trr Micro Seconds	Package Outline
SRSFR 105 thru SRSFR 1100	50 thru 1000	1.0	50	.1	A
SRSFR 205 thru SRSFR 2100	50 thru 1000	2.0	80	.15	A
SRSFR 305 thru SRSFR 3100	50 thru 1000	3.0	125	.2	B

sensitrode power bridge rectifiers

MAXIMUM RATINGS	S6A05 SERIES (Single Phase)	S12A05 SERIES (Single Phase)	S25A05 SERIES (Single Phase)	S15A-3-05 SERIES (3-Phase)	S25A-3-05 SERIES (3-Phase)	SSCDA-05 SERIES SSCPA-05 SERIES SSCNA-05 SERIES Doublers and Center Taps
						
	(ALUMINUM)	(ALUMINUM)	(ALUMINUM)	(ALUMINUM)	(ALUMINUM)	(ALUMINUM)
PIV per leg Volts	50 to 1000V *	50 to 1000V *	50 to 1000V *	50 to 1000V *	50 to 1000V *	50 to 1000V *
Average forward current DC Amps	6 Amps @ 55°C	12 Amps @ 55°C	25 Amps @ 55°C	15 Amps @ 55°C	25 Amps @ 55°C	15 Amps @ 55°C
Pk 1 cycle fwd surge Amps	100A	200A	300A	250A	300A	300A
Oper Temp Range	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C	−55°C to +175°C

RSM Sensitrode Bridge Rectifiers are available in both general purpose and fast recovery versions. For complete specifications and unit pricing, call or write:

SENSITRODE SAMPLES:
For your free Sensitrode Bridge Rectifier evaluation sample, write request on your company letterhead.

RSM

Sensitron Semiconductor Division
221 West Industry Court • Deer Park, N. Y. 11729
Tel: (516) 586-7600 Telex: 96-7737

*Voltages above 1000V available, consult factory.

silicon power rectifiers/jan/jantx

Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Cur. @ T_A (°C) (Amps)	Max. Peak Reverse Cur. @ PIV @ 25°C (μa)	Max. ½ Cycle Surge @ T_A (°C) & I_O (Amps) (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_F (Amps) (Volts)	Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Cur. @ T_A (°C) (Amps)	Max. Peak Reverse Cur. @ PIV @ 25°C (μa)	Max. ½ Cycle Surge @ T_A (°C) & I_O (Amps) (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_F (Amps) (Volts)
1N3189	200	1.0 @ 100	5	30 @ 25 & .250	1 @ .750	1N4249	1000	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3
1N3190	400	1.0 @ 100	5	30 @ 25 & .250	1 @ .750	1N5550	200	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9
1N3191	600	1.0 @ 100	5	30 @ 25 & .250	1 @ .750	1N5551	400	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9
1N4245	200	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3	1N5552	600	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9
1N4246	400	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3	1N5553	800	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9
1N4247	600	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3	1N5554	1000	3.0 @ 55	1	100 @ 55 & 2	1.2 @ 9
1N4248	800	1.0 @ 100	1	25 @ 100 & 1*	1.3 @ 3						

*10 surges of 1/120 sec. duration.

Contact the RSM representative in your area for data on additional JEDEC devices and epoxy rectifier types that are available.

fast recovery silicon power rectifiers/jan/jantx

Type	Peak Inverse Voltage (Volts)	Max. Full Cycle Average Forward Cur. @ T_A (°C) (Amps)	Max. ½ Cycle Surge @ T_A (°C) & I_O (Amps)	Max. Forward Voltage Drop DC @ 25°C @ I_F (Volts) (Amps)	t_{rr} nsec
1N4942	200	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	150
1N4944	400	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	150
1N4946	600	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	250
1N4947	800	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	250
1N4948	1000	1.0 @ 55	15 @ 100 & .75*	1.3 @ 1	500
1N5186	100	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	150
1N5187	200	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	200
1N5188	400	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	250
1N5190	600	3.0 @ 25	80 @ 150 & .700	1.5 @ 9†	400

*10 surges of 1/120 sec. duration. †Peak voltage at i_F pulsed, with 1/120 sec. duration pulses at 2% duty cycle.

npn silicon power transistors/jan/jantx

Type JAN	V_{CEO} (Volts)	I_C (Amps)	Power Dissipation (W @ Tc°C)	Package	$\theta_{J\text{-}C}$ °C/W	V_{EBO} (Volts)	Type JAN	V_{CEO} (Volts)	I_C (Amps)	Power Dissipation (W @ Tc°C)	Package	$\theta_{J\text{-}C}$ °C/W	V_{EBO} (Volts)
2N389	60	3	85 @ 25	TO-53	2.2	10	•2N1485	40	3	25 @ 25	TO-8	7	12
2N424	80	3	85 @ 25	TO-53	2.2	10	•2N1486	55	3	25 @ 25	TO-8	7	12
2N1016B	100	7.5	150 @ 45	TO-82	0.7	25	2N1487	40	6	75 @ 25	TO-3	2.33	10
2N1016C	150	7.5	150 @ 45	TO-82	0.7	25	2N1488	55	6	75 @ 25	TO-3	2.33	10
2N1016B	200	7.5	150 @ 45	TO-82	0.7	25	2N1489	40	6	75 @ 25	TO-3	2.33	10
2N1047A	80	5	40 @ 25	TO-57	—	10	2N1490	55	6	75 @ 25	TO-3	2.33	10
2N1048A	120	5	40 @ 25	TO-57	—	10	•2N1722	80	5	50 @ 100	TO-53	1.5	10
2N1049A	80	5	40 @ 25	TO-57	—	10	•2N1724	80	5	50 @ 100	TO-61	1.5	10
2N1050A	120	5	40 @ 25	TO-57	—	10	•2N3055	70	15	117 @ 25	TO-3	1.5	7
•2N1483	40	3	25 @ 25	TO-8	7	12	2N3442	140	10	117 @ 25	TO-3	1.5	7
•2N1484	55	3	25 @ 25	TO-8	7	12							

•TX version available.

For information on additional JEDEC types and high voltage, high gain triple diffused mesa devices, contact the local RSM representative.

single diffused mesa power transistors

These rugged single diffused mesa transistors exhibit low saturation voltage and are extremely well suited in applications where freedom from secondary breakdown is desirable. All devices are 100% safe operating area tested (S.O.A.R.) at maximum BV_{CEO}, wattage, and I_C condition for one second.

Type	BV_{CEO} (Volts)	V_{EBO} (Volts)	h_{FE} Min./Max. @ I_C (Amps)	V_{CE} (SAT) (Volts) @ I_C (Amps)	$\theta_{J\text{-}C}$ °C/W	I_C (Amps)	Power Dissipation (W @ Tc °C)	Package
2N3054	90	7	25/100 @ .5	1.0 @ .5	6	4	29 @ 25	TO-66
2N3441	140	7	25/100 @ .5	1 @ .5	6	3.0	29 @ 25	TO-66
2N3442	140	7	20/70 @ 3	1 @ 3	1.5	10	117 @ 25	TO-3
2N3771	40	5	15/60 @ 15	2 @ 15	1.17	30	150 @ 25	TO-3
2N3772	60	7	15/60 @ 10	1.4 @ 10	1.17	30	150 @ 25	TO-3
2N3773	140	7	15/60 @ 8	1.4 @ 8	1.17	30	150 @ 25	TO-3
2N4347	120	7	20/70 @ 2	1 @ 2	1.5	10	100 @ 25	TO-3
2N4348	120	7	15/60 @ 5	1.0 @ 5	1.17	30	120 @ 25	TO-3

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

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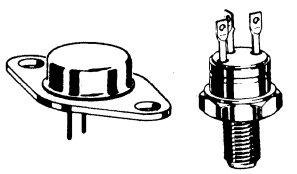
SILICON TRANSISTORS, RECTIFIERS, DIODES

SOLID STATE DEVICES, INC. produces a wide selection of popular, "off the shelf" semiconductor devices which will meet a wide variety of applications in military and commercial electronic equipment. SSDI also manufactures and stocks many silicon semiconductor devices not listed here. Refer to the D.A.T.A. BOOK for complete listings.

TRANSISTORS

SILICON DIFFUSED PNP POWER TRANSISTORS UP TO 30A IC, VCEO = 80V IN TO3, TO5, TO59 AND TO66 JEDEC OUTLINES.

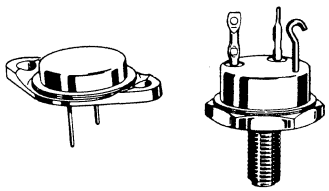
2N3719-20
2N3740-41
2N3789-92
2N3867-68
2N4234-36
2N4398-99
2N4898-4900
2N4901-09
2N5001
2N5003
2N5005
2N5007



2N5009
2N5147,49,51,53
2N5323
2N5333
2N5384-85
2N5404-7
2N5679-80
2N5867-68
2N5871-72
2N5875-76
2N5879-80
2N5883-84

SILICON DIFFUSED NPN POWER TRANSISTORS UP TO 30A IC, VCEO = 140V IN TO3, TO5, TO59 AND TO66 JEDEC OUTLINES.

2N2657-58
2N2850-56
2N2890-93
2N2984-94
2N3054-55
2N3138-41
2N3232-34
2N3265-66
2N3418-21
2N3713-16
2N3766-67
2N3771-73
2N3878-79
2N4000-5
2N4111-14
2N4225-26
2N4231-33
2N4237-39



2N4910-15
2N5000
2N5002
2N5004
2N5006
2N5008
2N5067-69
2N5083-85
2N5148,50,52,54
2N5301-3
2N5334-39
2N5681-82
2N5869-70
2N5873-74
2N5877-78
2N5881-82
2N5885-86

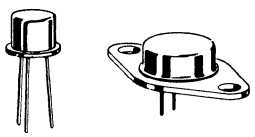
SILICON DIFFUSED PNP HI VOLTAGE TRANSISTORS UP TO 1A IC, VCEO = 400V IN MD14, TO5 JEDEC OUTLINES.

2N3743
2N4929-31
2N5091
2N5093

2N5094
2N5100
2N5281-82

SILICON DIFFUSED NPN HI VOLTAGE TRANSISTORS UP TO 1A 1C AND VCEO = 1KV IN MD14, TO5 AND TO66 JEDEC OUTLINES.

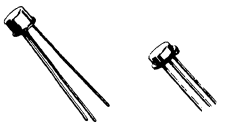
2N3114
2N3439-40
2N3498-3501
2N3590-93
2N3712
2N3738-39
2N3742
2N4063-64
2N4296-98
2N4926-27



2N5010-15
2N5058-59
2N5092
2N5095
2N5097
2N5098
2N5099
2N5101
2N5252-53
2N5279-80

SILICON DIFFUSED SMALL SIGNAL PNP CHOPPERS IN TO5, TO18, TO46 JEDEC OUTLINES.

2N941-46
2N1917-22
2N2002-7
2N2162-67
2N2185-88
2N2274-81



2N2332-7
2N2944-46
2N3060-61
2N3217-19
2N3910-15
2N5229-31

UNIJUNCTION TRANSISTORS IN A TO5 JEDEC OUTLINE PN-TYPES.

2N489,A,B,C, — 2N494,A,B,C
2N1671,A,B,C,
2N2160

SILICON DIFFUSED SMALL SIGNAL PNP TRANSISTORS IN A TO46 JEDEC OUTLINE.

2N2459-62
2N2514-22
2N2590-3
2N2597-2605

2N2599A-2600A
2N2604-5A
2N3579-82
2N3798-99

DARLINGTON TRANSISTORS FEATURING ULTRA HIGH GAIN TO 10A IC, VCEO = 200V IN TO18, TO72 AND TO82 JEDEC OUTLINES.

2N997-999
2N2226-33
2N2723-25
2N2785

DIODES AND RECTIFIERS

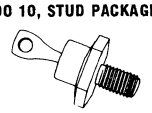
HERMETICALLY SEALED AXIAL LEAD RECTIFIERS TO 3 AMPS, 3000 VOLTS.

1N3611-14
1N3644-47
1N4245-49
1N4383-85
1N5059-62

1N5197-5201
1N5400-08
1N5550-54
1N5614-22
1N5624-27

DO 4 AND DO 5, DO 8, DO 9, DO 10, STUD PACKAGES TO 275 AMPS, 2000 VOLTS.

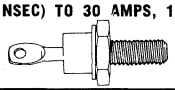
1N1183,A-1190,A
1N1200,A-1206,A
1N2535-2545
1N2546-2556
1N2565-2575
1N2576-2586



1N2598-2608
1N3085-3092
1N3164-3170
1N3263-3269
1N3288-3296,A
1N4044-4056

FAST RECOVERY (100 NSEC) TO 30 AMPS, 1000 VOLTS.

1N3874-3893
1N3909-3913
1N4942-4948



1N5186-5190
1N5415-5420
1N5615-5623

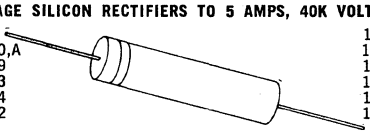
TEMPERATURE COMPENSATED REFERENCE ZENERS.

1N429,A-430,A,B
1N1735,A-1742,A
1N2163,A-2171,A

1N2620-24,B
1N2765,A-2770,A
1N4057,A-4085,A

HIGH VOLTAGE SILICON RECTIFIERS TO 5 AMPS, 40K VOLTS.

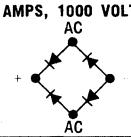
1N596-598
1N1133-1150,A
1N1237-1239
1N1406-1413
1N1730-1734
1N1745-1762



1N2382-2385,A
1N2482-2484
1N2630-2636
1N2878-2900
1N2914-2924
1N5595-5604

BRIDGE RECTIFIER ASSEMBLIES — TO 50 AMPS, 1000 VOLTS.

SDA 117 series, 2A to 1K V
SDA 129 series, 15A to 1K V
SDA 130 series, 25A to 1K V
SDA 132 series, 50A to 1K V
SDA 138 series, 5A to 1K V

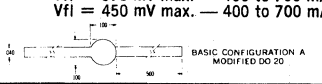


ION IMPLANTED DIODES AND RECTIFIERS EPION™

The Ion Implanted fast recovery rectifiers and diodes listed below are produced by a newly developed Ion Implantation process. They feature fast switching types from 500 milliamps to 30 amperes and voltages up to 100 volts. A variety of package sizes are available from DO 20 to DO 5. High efficiency at frequencies of 10 MHz and higher are standard with typical recovery times of 9 nanoseconds.

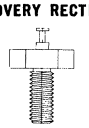
SWITCHING DIODES.

HSA	Vfl = 275 mV max. — 200 to 600 mA	Trr = 3 nsec
HSB	Vfl = 375 mV max. — 400 to 700 mA	Trr = 9 nsec
HSC	Vfl = 450 mV max. — 400 to 700 mA	Trr = 9 nsec



FAST RECOVERY RECTIFIERS.

HSR-0	Io = 1 Amp	Trr = 9 nsec
HSR-1	Io = 1.5 Amps	Trr = 9 nsec
HSR-2	Io = 3 Amps	Trr = 10 nsec
HSR-3	Io = 8 Amps	Trr = 15 nsec
HSR-4	Io = 20 Amps	Trr = 20 nsec
HSR-5	Io = 30 Amps	Trr = 25 nsec



SSDI
SOLID STATE DEVICES INCORPORATED
14830 VALLEY VIEW AVENUE
LA MIRADA, CALIFORNIA 90638
(213) 921-9660

solitron devices, inc.
256 Oak Tree Road, Tappan, N.Y. 10983 (914) 359-5050 TWX: 710-576-2654
8808 Balboa Ave., San Diego, Calif. 92123 (714) 278-8780 TWX: 910-335-1221
1177 Blue Heron Blvd., Riviera Beach, Fla. 33492 (305) 848-4311 TWX: 510-952-7610

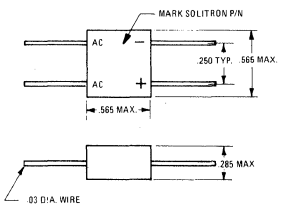
Leader in silicon power transistors and rectifiers; microwave film resistors, DC blocks, pill terminations.

rectifier assemblies

1.5 Amp. F799 Series

8.3 msec. surge rating 50 Amp.

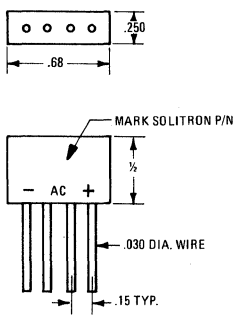
P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
F799-1	100	1.1	1.0
F799-2	200	1.1	1.0
F799-3	300	1.1	1.0
F799-4	400	1.1	1.0
F799-5	500	1.1	1.0
F799-6	600	1.1	1.0
F799-6	600	1.1	1.0
F799-8	800	1.1	1.0
F799-10	1000	1.1	1.0



2 Amp. F903C Series

8.3 msec. surge rating 75 Amp.

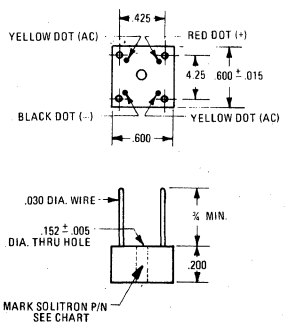
P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
F903C-20	50	1.0	1.0
F903C-21	100	1.0	1.0
F903C-22	200	1.0	1.0
F903C-23	300	1.0	1.0
F903C-24	400	1.0	1.0
F903C-25	500	1.0	1.0
F903C-26	600	1.0	1.0
F903C-28	800	1.0	1.0



2 Amp. K760 Series

8.3 msec. surge rating 50 Amp.

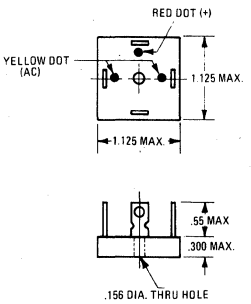
P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
K760-1	100	1.0	1.0
K760-2	200	1.0	1.0
K760-4	400	1.0	1.0
K760-6	600	1.0	1.0
K760-8	800	1.0	1.0
K760-10	1000	1.0	1.0



5 Amp. K595 Series

8.3 msec. surge rating 50 Amp.

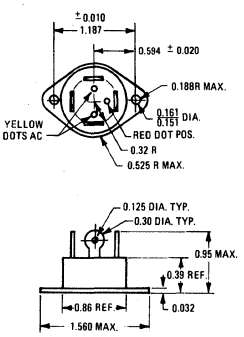
P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
K595-1	100	1.1	1.0
K595-2	200	1.1	1.0
K595-3	300	1.1	1.0
K595-4	400	1.1	1.0
K595-5	500	1.1	1.0
K595-6	600	1.1	1.0
K595-7	700	1.1	1.0
K595-8	800	1.1	1.0



10 Amp.* BHC Series

8.3 msec. surge rating 100 Amp.

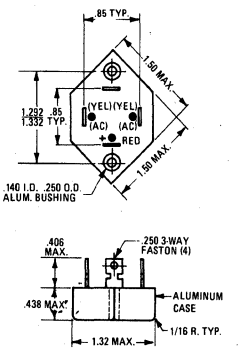
P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
BHC0001	100	1.2	25
BHC0002	200	1.2	25
BHC0003	300	1.2	25
BHC0004	400	1.2	25
BHC0005	600	1.2	25



15 Amp.* E814 Series

8.3 msec. surge rating 250 Amp.

P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
E814-0	50	1.0	25
E814-1	100	1.0	25
E814-2	200	1.0	25
E814-3	300	1.0	25
E814-4	400	1.0	25
E814-5	500	1.0	25
E814-6	600	1.0	25



*Output current defined by specified case temperature (Tc).
Detailed specification sheets available upon request.

solitron devices, inc.
256 Oak Tree Road, Tappan, N.Y. 10983 (914) 359-5050 TWX: 710-576-2654
8808 Balboa Ave., San Diego, Calif. 92123 (714) 278-8780 TWX: 910-335-1221
1177 Blue Heron Blvd., Riviera Beach, Fla. 33492 (305) 848-4311 TWX: 510-952-7610

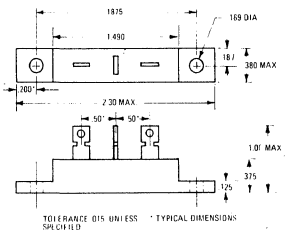
Leader in silicon power transistors and rectifiers; microwave film resistors, DC blocks, pill terminations.

25 Amp.* J-527 Series

8.3 msec. surge rating 300 Amp.

J-527-A (Common Anode)
J-527-C (Common Cathode)
J-527-D (Voltage Doubler)

P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
J527-0 (A,C,D)	50	1.0	25
J527-1 (A,C,D)	100	1.0	25
J527-2 (A,C,D)	200	1.0	25
J527-3 (A,C,D)	300	1.0	25
J527-4 (A,C,D)	400	1.0	25
J527-5 (A,C,D)	500	1.0	25
J527-6 (A,C,D)	600	1.0	25

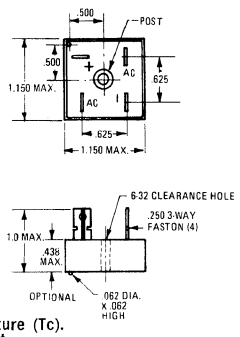


25 Amp.* J775 Series Full Wave Bridge

8.3 msec. surge rating 300 Amp.
(LP Series with locating pin optional)

P/N	PIV/LEG (volts)	V_F/LEG (volts)	I_R/LEG Max. (μA)
J775-0 (LP)	50	1.0	25
J775-1 (LP)	100	1.0	25
J775-2 (LP)	200	1.0	25
J775-3 (LP)	300	1.0	25
J775-4 (LP)	400	1.0	25
J775-5 (LP)	500	1.0	25
J775-6 (LP)	600	1.0	25

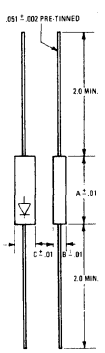
*Output current defined by specified case temperature (Tc).
Detailed specification sheets available upon request.



5 Amp. F927 Series

8.3 msec. surge rating 50 Amp.

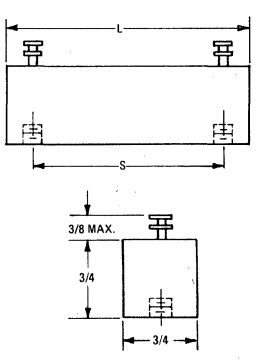
P/N	PIV	V_F Max. (volts)	I_R Max. (μA)
F927-11	5KV	7	0.5
F927-21	7.5KV	10	0.5
F927-31	10KV	14	0.5
F927-41	12.5KV	17	0.5
F927-51	15KV	20	0.5
F927-61	20KV	27	0.5
F927-71	25KV	33	0.5



.75 - 1.1 Amp. SLD Series

8.3 msec. surge rating 50 Amp.

P/N	PIV	V_F Max. (volts)	I_R Max. (μA)
SLD5	5KV	9	5.0
SLD10	10KV	17	5.0
SLD15	15KV	25	5.0
SLD20	20KV	34	5.0
SLD25	25KV	42	5.0
SLD30	30KV	50	5.0
SLD35	35KV	59	5.0
SLD40	40KV	67	5.0
SLD45	45KV	75	5.0
SLD50	50KV	84	5.0



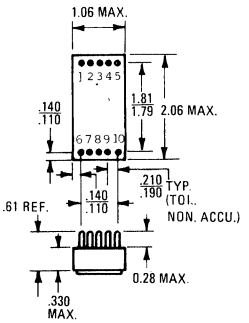
Power Hybrid Modules

15 Watt Hybrid Audio Amplifier

(Class B)

P/N	BHA0002
Rated Output Power	15W RMS
Frequency Response	25-20,000 Hz
Power Gain	60db
Input Voltage	.35V RMS
Quiescent Current	7 MA
Efficiency	60%
Distortion @ 1 KHz	1%
Input Impedance	18K ohms

Detailed specification sheet available.

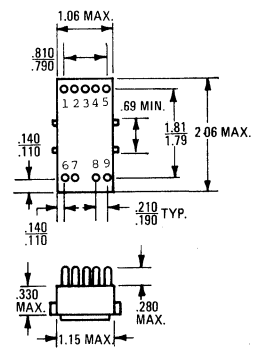


5 Watt Hybrid Audio Amplifier

(Class B)

P/N	BHA0004
Rated Output Power	5W RMS
Frequency Response	25-15,000 Hz
Power Gain	85db
Input Voltage	20MV RMS
Quiescent Current	20 MA
Efficiency	65%
Distortion @ 1 KHz	2%
Input Impedance	20K ohms

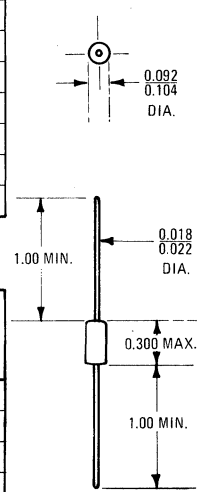
Detailed specification sheet available.



Temperature Compensated Reference Diodes

JEDEC Type	Reference Voltage	Max. TC I_Z (%/°C)	Max. DYN. Resistance	Max. mv @ 7.5 mA −55°C to +25°C		Izm (ma)
1N821	6.2	.01	15	50	46	60
1N821A	6.2	.01	10	50	46	60
1N823	6.2	.005	15	25	23	60
1N823A	6.2	.005	10	25	23	60
1N825	6.2	.002	15	10	9.2	&0
1N825A	6.2	.002	10	10	9.2	60
1N827	6.2	.001	15	5	4.6	60
1N827A	6.2	.001	10	5	4.6	60

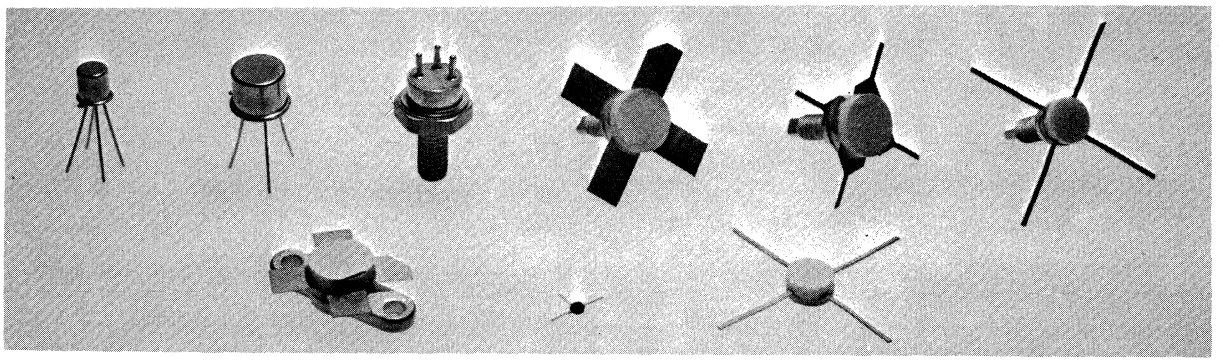
Consult factory for types not listed.



Noise Diodes

P/N	Frequency	Typ. C (μfd)c	Typ. RL (ohms)	Min. Out- (μv/ root cyc.)
SD10W	10 Hz to 20 KHz	1	20K	1.5
SD10WE	10 Hz to 100 KHz	22	2.2K	1.5
SD10WEE	10 Hz to 500 KHz	68	600	1.5
SD20	100 Hz to 3 MHz	68	600	0.1
SD20L	100 Hz to 10 MHz	68	600	0.1
SD20LE	100 Hz to 25 MHz	100	50	0.05
SD20LEE	100 Hz to 100 MHz	100	50	0.05
SD4	1MHz to 500 MHz	0.1	50	0.03

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)



RF POWER TRANSISTORS

Solid State Scientific is a recognized leader in the development and production of RF power semiconductor devices for mobile, marine and avionics communications and for CATV applications. This chart represents the largest selection of RF Power devices from a single source. Since our line of devices is continually expanding, we suggest you contact the factory for special applications.

JEDEC RF POWER TRANSISTORS

SSSI Number	Package	Description
2N3375	TO-60	3.0 watts min. at 400 MHz – 28 V
2N3553	TO-39	2.5 watts min. at 175 MHz – 28 V
2N3632	TO-60	13.5 watts min. at 175 MHz – 28 V
2N3733	TO-60	10 watts min. at 400 MHz – 28 V
2N3866	TO-39	1.0 watt min. at 400 MHz – 28 V
2N3924	TO-39	4.0 watts min. at 175 MHz – 13.6 V
2N3926	TO-60	7.0 watts min. at 175 MHz – 13.6 V
2N3927	TO-60	12.0 watts min. at 175 MHz – 13.6 V
2N4427	TO-39	1.0 watt min. at 175 MHz – 13.6 V
2N4428	TO-39	750 mW min. at 500 MHz – 28 V
2N4429	MT59	1.0 watt min. at 1.0 GHz – 28 V
2N4430	MT66	2.5 watts min. at 1.0 GHz – 28 V
2N4431	MT66	5.0 watts min. at 1.0 GHz – 28 V
2N4440	TO-60	5.0 watts min. at 400 MHz – 28 V
2N5016	TO-60	15.0 watts min. at 400 MHz – 28 V
2N5090	TO-60	1.2 watts min. at 400 MHz – 28 V
2N5109	TO-39	Wideband amplifier – CATV – 28 V
2N5589	MT71	3.0 watts min. at 175 MHz – 13.6 V
2N5590	MT72	10.0 watts min. at 175 MHz – 13.6 V
2N5591	MT72	25.0 watts min. at 175 MHz – 13.6 V
2N5635	MT71	2.5 watts min. at 400 MHz – 28 V
2N5636	MT71	7.5 watts min. at 400 MHz – 28 V
2N5637	MT72	20.0 watts min. at 400 MHz – 28 V
2N5641	MT71	7.0 watts min. at 175 MHz – 28 V
2N5642	MT72	20.0 watts min. at 175 MHz – 28 V
2N5643	MT72	40.0 watts min. at 175 MHz – 28 V
2N6080	MT72	4.0 watts min. at 175 MHz – 12.5 V
2N6081	MT72	15.0 watts min. at 175 MHz – 12.5 V
2N6082	MT72	25.0 watts min. at 175 MHz – 12.5 V
2N6083	MT72	30.0 watts min. at 175 MHz – 12.5 V
2N6084	MT72	40.0 watts min. at 175 MHz – 12.5 V

NON-JEDEC RF POWER TRANSISTORS

SSSI Number	Package	Description
SD1023	TO-60	Dual chip 2N3866 – 28 V
SD1031	TO-46	1.0 watt min. at 400 MHz – 28 V
SD1032	TO-46	2N3866 with f_t = 1.2 GHz
SD1038	TO-39	2N3866 with f_t = 1.2 GHz
SD1043	MT59	2N5109 chip/Stripline package
SD1045	TO-39	1.0 watt min. at 175 MHz – 13.6 V
SD1100	TO-39	Wideband amplifier – 0.5 W min. at 0.75 GHz
SD1115	MT59	Hi-gain VHF/UHF amplifier – 1.0 W max. at 1.7 GHz
SD1120	MT66	3.0 watts min. at 1.0 GHz – 28 V
SD1156	TO-131	1.5 watts min. at 175 MHz – 12.5 V
SD1174	TO-39	3.0 watts min. at 175 MHz – 13.6 V
SD1177	MT59	3.0 watts min. at 175 MHz – 13.6 V
SD1180	TO-39	1.8 watts typ. at 400 MHz – 28 V
SD1263	MT81	4.0 watts min. at 470 MHz – 12.5 V
SD1270	TO-39	1.0 watt min. at 470 MHz – 12.5 V

CATV

SSSI Number	Package	Description
SD1005	MT59	Broadband linear amplifier
SD1006	TO-39	Broadband linear amplifier
SD1116	MT59	Broadband linear amplifier
SD1118	TO-60	Broadband linear amplifier
SD1119	TO-39	Broadband linear amplifier
SD1232	TO-39	Broadband linear amplifier

SOLID STATE SCIENTIFIC INC.

MONTGOMERYVILLE, PA. 18936 ■ (215) 855-8400 ■ TWX-510-661-7267

Thermalloy
P.O. BOX 34829/2021 W. VALLEY VIEW LANE/DALLAS, TEXAS 75234
214-243-4321 / TWX 910-860-5542

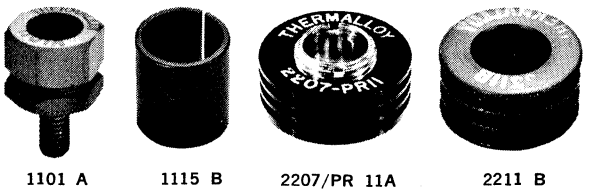
TO-5 HEAT SINKS

Part No. [1]	Package	R_θ [2] Typ.	1-24	25-99	100-499
1101 A	TO-5	8	1.05	.85	.65
1115 B	TO-5	48	*	*	.10
2207/PR 11	TO-5	40	1.55	1.25	1.05
2211 B	TO-5	48	.35	.28	.26
2215 B	TO-5	41	1.20	.95	.75
2225 B	TO-5	45	**	.20	.18
2226 B	TO-5	50	**	.19	.17
2227 B	TO-5	30	**	.25	.23
2228 B	TO-5	40	**	.25	.23
2230 B5	TO-5	30	*	*	.16

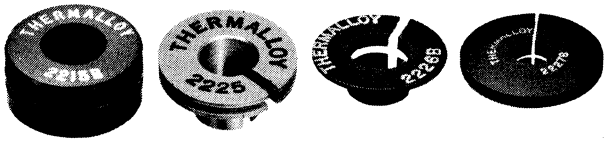
MEDIUM POWER HEAT SINKS

			1-49	50-99	100-499
6025 B [3]	Plastic	26	.28	.23	.18
6103 B	TO-3	7	.56	.45	.41
6106 B-13	Plastic	16	.26	.21	.16
6107 B-14	Plastic	18	.19	.15	.13
6166 B/Base	TO-66	11	.29	.23	.21

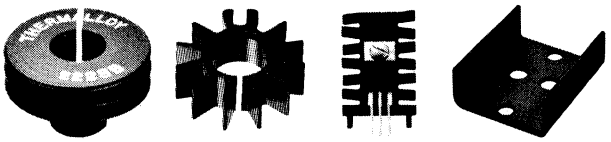
(1) Suffixes indicate finish. A = Hard Anodize; B = Black Chromate. Many also available in Gold Chromate or unfinished
(2) °C per Watt Natural Convection
(3) Also available nickel-plated
* Sold in even hundreds only
** 25 pc minimum order



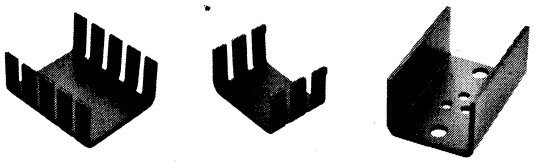
1101 A | 1115 B | 2207/PR 11A | 2211 B



2215 B | 2225 B | 2226 B | 2227 B

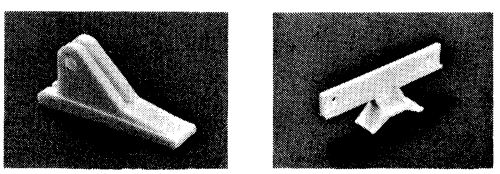


2228 B | 2230 B-5 | 6025 B | 6103 B


6106 B-13 | 6107 B-14 | 6166 B-Body

CARD PULLERS and EJECTORS

Part No.	Description	1-24	25-99	100-249
5005-8	Card Ejector	.35	.28	.22
5005-9	Card Puller	.35	.28	.25

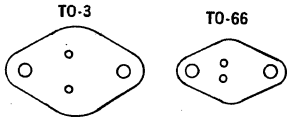

5005 - 8 | 5005 - 9

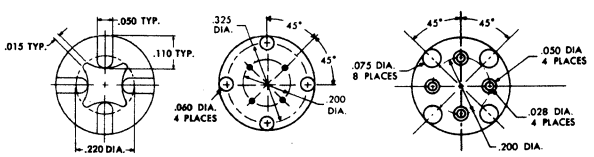
TRANSISTOR MOUNTING PADS

Part No. 7717–	Package [2]	DIA.	THK.	100-400	500-900	1000-4900
3 N [1]	TO-5	.344	.075	5.50/C	4.00/C	3.00/C
4 N	TO-5	.375	.075	5.50/C	4.00/C	3.00/C
5 N	TO-5	.350	.125	5.50/C	4.00/C	3.00/C
6 N	Dual TO-5	.375	.175	6.00/C	5.00/C	4.00/C
7 N	TO-18 **	.350	.038	5.50/C	4.00/C	3.00/C
8 N	8 lead IC	.375	.075	6.00/C	5.00/C	4.00/C
15 N	TO-5	.350	.020	5.50/C	4.00/C	3.00/C
16 N	TO-18	.200	.020	5.50/C	4.00/C	3.00/C
18 N	TO-18	.200	.100	5.50/C	4.00/C	3.00/C
19 N	8 lead IC	.500	.275	12.00/C	10.00/C	9.00/C
22 N	TO-5 **	.344	.075	5.50/C	4.00/C	3.00/C
44 N	TO-18 **	.305	.125	5.50/C	4.00/C	3.00/C
46 N	TO-18	.200	.060	5.50/C	4.00/C	3.00/C
107 N [3]	8 lead IC **	.430	.130	12.00/C	10.00/C	9.00/C

(1) Suffix "N" indicates nylon. For DAP add $1.00/C on all pads except —19 & —107, add $2.00/C for less than 1000 quantity.
(2) 3 or 4 leads unless otherwise specified.
(3) Configuration same as 19N
* For 3 leads
** Lead spreader

TO-3 TO-66





7717-3N | 7717-4N | 7717-5N

7717-7N | 7717-8N 7717-6N | 7717-15N

7717-16N | 7717-18N | 7717-19N

7717-22N | 7717-44N | 7717-46N

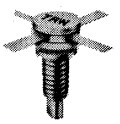
INSULATORS

Part No.	Material	Package	100-400	500-900	1000-4900
43-03-3	.002" Thermafilm	TO-3	6.00	3.50	2.00
43-66-2	.002" Thermafilm	TO-66	6.00	3.50	2.00
			1-49	50-99	100-499
4703 A	Hard Anodized	TO-3	.40	.25	.15
4003	BeO	TO-3	1.56	1.25	.98
4066	BeO	TO-66	1.19	.95	.70

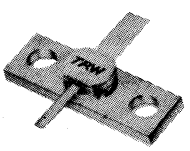
TRW® SEMICONDUCTORS

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

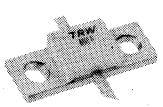
RF COMMUNICATIONS



ULTRA-CERAMIC



MLP



MRA

TRW MICROWAVE TRANSISTORS

Since TRW designed, developed and registered the first 2N4428-29-30-31 series, its world leadership in the microwave transistor field has been unquestioned. In 1968, the 2N5481-82-83 series gave industry its first high power, 2 GHz chain of devices available from a distributor's shelf. Subsequent developments range from the 10 and 20 watt 2N5595-96 series, to electrically rugged (VSWR protected) 1 and 2 GHz units to the new 3 GHz series. These devices are available in a variety of TRW package designs including the TO-117, TO-129, Microstrip, Ultra-Ceramic, and HLP (hermetic-low parasitic).

TRW Type	fo(GHz)	Amp. PO*(W)	Min. Efficiency	Gain (dB)	Case	Remarks
2N4429	1	1.0	35%	5.0	TO-117	General Purpose Oscillator/Amplifier
2N4430	1	2.5	35%	5.0	TO-129	General Purpose Oscillator/Amplifier
2N4431	1	5.0	35%	5.0	TO-129	General Purpose Oscillator/Amplifier
2N5764	1	3.0	40%	6.0	†UL-Cer	Ruggedized (VSWR Protected)
2N5765	1	5.0	40%	6.0	†UL-Cer	Ruggedized (VSWR Protected)
2N5595	1	10.0	55%	6.0	UL-Cer	General Purpose, High Power
2N5596	1	20.0	55%	5.0	UL-Cer	General Purpose, High Power
2N5715	2	.25	15%**	10.0	Mi-Stp	High Gain Oscillator/Amplifier
2N4976	2	1.0	25%	5.0	TO-129	General Purpose Oscillator/Amplifier
2N5481	2	1.0	25%	6.0	UL-Cer	General Purpose Oscillator/Amplifier
2N5482	2	2.5	30%	5.0	UL-Cer	General Purpose Oscillator/Amplifier
2N5483	2	5.0	33%	4.0	UL-Cer	General Purpose Oscillator/Amplifier
2N5766	2	1.0	30%	8.0	†UL-Cer	For Common Base Amplifier Service
2N5767	2	2.5	30%	8.0	††UL-Cer	For Common Base Amplifier Service
2N5768	2	5.0	33%	7.0	††UL-Cer	For Common Base Amplifier Service
TRW2010	2	10.0	33%	7.0	HLP-8	For Common Base Amplifier Service
TRW2005	2	5.0	33%	7.0	HLP-8	For Common Base Amplifier Service
TRW2003	2	2.5	33%	8.0	HLP-8	For Common Base Amplifier Service
TRW2001	2	1.0	30%	8.0	HLP-8	For Common Base Amplifier Service
PT6669	3	0.3	15%**	6.0	HLP-8	For Common Base Amplifier Service
2N6194	3	1.0	25%	5.0	HLP-8	For Common Base Amplifier Service
2N6195	3	2.5	25%	5.0	HLP-8	For Common Base Amplifier Service
2N6196	3	5.0	30%	5.0	HLP-8	For Common Base Amplifier Service

*As grounded emitter amplifier unless otherwise specified.
**In class "A" service. † VSWR protected. ††3:1 VSWR protected.

TRW MICROAMP TRANSISTORS

TRW now introduces to the microwave industry the microwave amplifier which is disguised as a transistor. The MICroAMP allows the design engineer to obtain power bandwidth and efficiency. The MICroAMP has a 50Ω input and input VSWR of less than 2.0:1.

MAXIMUM RATINGS (@ 25°C) ALL MRA SERIES

V_{CBO} 45V Symbol	V_{CES} 45V Characteristic	V_{EBO} 3.5V Test Conditions	T_{STG} & T_J −65°C to +200°C Value
BV_{EBO}	Emitter to Base Voltage	I_E = 1 mA, I_C = 0	4 VDC
BV_{CBO}	Collector to Base Voltage	I_C = 2.5 mA, I_E = 0	45 VDC
BV_{CES}	Collector to Emitter Voltage	I_C = 5.0 mA	45 VDC
BV_{CEO}	Collector to Emitter Voltage	I_C = 5.0 mA, I_B = 0	30 VDC
h_{FE}	DC Current Gain	V_{CE} = 5.0, I_C = 100 mA	20-150

DETAILED SPECIFICATIONS

TRW Type	Frequency GHz f1	Frequency GHz f2	Instantaneous Bandwidth (Min.)	Power Output (Watts) Min. @	Power In (Watts)	Gain (dB)	θjc °C/W	Broadband Efficiency Min.	C_{ob} (28V)	Ic (Amps) Max.
MRA0610-3	0.6	1.0	50%	3.0	0.3	10.0	8.0	50%	4.5 pf	0.35
MRA0610-18	0.6	1.0	50%	18.0	3.0	9.5	2.5	50%	14.0 pf	1.4
MRA1014-2	1.0	1.4	33%	2.0	0.2	10.0	8.0	50%	4.5 pf	0.35
MRA1014-12	1.0	1.4	33%	12.0	2.0	7.8	2.5	50%	14.0 pf	1.4
MRA1417-2	1.4	1.7	20%	2.0	0.2	10.0	8.0	45%	4.5 pf	0.35
MRA1417-11	1.4	1.7	20%	11.0	2.0	7.4	2.5	45%	14.0 pf	1.4
MRA1720-2	1.7	2.0	16%	2.0	0.25	9.0	8.0	40%	4.5 pf	0.35
MRA1720-9	1.7	2.0	16%	9.0	2.0	6.5	3.5	40%	14.0 pf	1.4
MRA2023-1.5	2.0	2.3	14%	1.5	0.25	7.8	11.0	35%	4.0 pf	0.35
MRA2023-3	2.0	2.3	14%	3.0	0.60	6.0	8.0	35%	5.0 pf	0.7
MRA2023-6	2.0	2.3	14%	6.0	1.5	6.0	5.0	35%	7.5 pf	1.4
MRA2327-1.5	2.3	2.7	16%	1.5	0.2	7.5	11.0	35%	3.5 pf	0.35
MRA2327-5	2.3	2.7	16%	5.0	1.5	5.0	5.0	35%	7.5 pf	1.0
MRA2731-1.5	2.7	3.1	14%	1.5	0.3	7.0	11.0	30%	3.5 pf	0.35
MRA2731-5.0	2.7	3.1	14%	5.0	1.5	5.0	5.0	30%	7.5 pf	1.0

NOTE: Powers are nonsaturated minimums.

TRW® SEMICONDUCTORS

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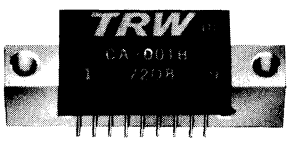
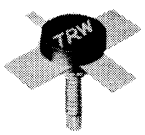
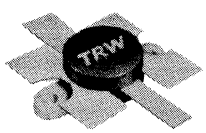
RF COMMUNICATIONS



CA



B-BAND



J-ZERO

TO-60

TO-39

TRW MICROELECTRONIC LINEAR BROADBAND RF AMPLIFIERS

CA801/601: Thin film hybrid integrated circuit techniques give these amplifiers exceptional performance characteristics in a wide variety of applications. The CA801 operates Class A for use in instrumentation, radio and wideband power amplifiers. CA601 amplifiers are designed for very low cross modulation, second order beat and noise demanded by CATV systems. V_{CC} for all units is 24 volts.

TRW Type	Power Out	Frequency (MHz)	Gain (dB)	Impedance (Ohms)	Noise (dB)	Harmonic Distortion
CA801	400 mW	10-400 ± 1 dB	25	50	12	down 30 dB
CA860	500 mW	10-200 ± 1 dB	29	50	12	down ?? dB
CA870	400 mW	100-400 ± 1 dB	29	50	12	down ?? dB
CA880	250 mW	5-500 ± 1 dB	26	50	12	down ?? dB

*NCTA Standards, −57 dB Crossmodulation, 12 channels Flat.

225-400 MHz BROADBAND MEDIUM AND HIGH POWER TRANSISTORS

TRW Type	Frequency (MHz)	Power (Watts)	Gain (dB)	V_{CC}	V_{CBO}	I_C (Max.)	θi (°C/W)	Package
2N5773	400	1.5	11	28	65	0.5	35.0	TO-117
PT5749*	400	5.0	8	28	65	1.5	9.5	B-Band-2
PT5750*	400	10.0	7	28	65	1.7	6.0	B-Band-2
J02005	400	20.0	6	28	65	3.0	4.5	B-Band-2
J02000	400	30.0	6	28	60	6.0	2.5	B-Band-2
J02001	400	40.0	5	28	60	9.0	1.5	J-zero
J02007	400	50.0	6.5	28	60	14.0	1.4	J-zero
J02009	400	20.0**	7.5	28	60	7.0	1.3	J-zero
J02401	400	35.0	7	28	60	9.0	1.5	J-zero

*These devices fulfill requirements for the 2N5635, 2N5636 and 2N5637 respectively.

TRW 28V COMMUNICATIONS TRANSISTORS

VHF/UHF POWER RF TRANSISTORS — GENERAL APPLICATION

The transistors listed below find wide applications as oscillators, amplifiers, and drivers in the VHF/UHF region. Typical equipment applications are: Sonobuoy, Rescue Beacon, CATV, military tactical radio, ECM, Mobile Base Stations, and various civil communications applications.

TRW Type	Frequency	Power (Watts)	Gain (dB)	V_{CC}	V_{CBO}	V_{CEO}	I_C (Max.) (Amps)	θi (°C/W)	Package
2N1506A	70	1.5	10	28	80	50	0.5	50.0	TO-5
2N5071	76	24.0	9	24	65	30	3.3	2.5	TO-60
PT5602	80	5.0	11	25	60	40	0.5	17.0	TO-117
PT5603	80	13.0	10	25	60	40	2.0	7.0	TO-117
PT6731	80	50.0	10	25	80	50	6.0	2.7	DIA-4L
PT6732	80	30.0	11	25	70	40	4.0	2.5	TO-128
2N4933	88	20.0	7.6	24	70	35	3.3	2.5	TO-60
2N5102	136	15.0	4	24	90	35	3.3	2.5	TO-60
2N2887	150	2.5	9	45	100	80	1.2	7.0	TO-61
PT3500	150	2.5	10	28	60	40	0.5	35.0	TO-39
PT6728	150	80.0	7	28	65	45	8.0	1.75	DIA-2L
PT6729	150	120.0	6	28	65	45	10.0	1.5	DIA-4L
2N3632	175	13.5	6	28	65	40	3.0	7.6	TO-60
2N4127	175	13.5	7	25	60	40	2.0	7.0	TO-117
2N4128	175	24.0	6	25	60	40	4.0	4.3	TO-117
2N5109	200	1.2	11	15	40	20	0.4	50.0	TO-39
2N3866	250	1.5	12	28	55	30	0.5	50.0	TO-39
2N4428	500	0.75	10	28	55	35	0.4	50.0	TO-39
2N5177	500	25.0	5	28	55	35	4.0	4.4	DIA-2L
2N5178	500	50.0	4	28	55	35	8.0	2.5	DIA-2L

TRW SINGLE SIDEBAND LINEAR TRANSISTORS

TRW offers the only complete line of transistors for reliable SSB service. The 12.5V types withstand open and short circuit loads at 16V operation. The 28V types withstand 3:1 load VSWR. All types provide I.M.D. of —30dB across the 2-30MHz band.

TRW Type	Frequency	Power PEP	Gain (dB)	V_{CC}	V_{CBO}	V_{CEO}	I_C (Max.) (Amps)	θi (°C/W)	Package
PT5604	15	1.0	23 18 20	28 12.5 28	60	40	0.5	35.0	TO-39
	30	1.0	15	12.5					
PT5740	15	15	14	12.5	40	18	5	1.75	TO-128
	30		17						

Power is PEP for intermodulation distortion of −32 dB or less.

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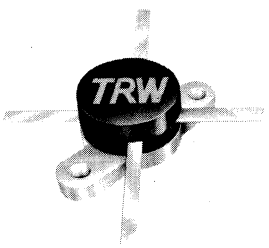
RF COMMUNICATIONS



DIA-4L

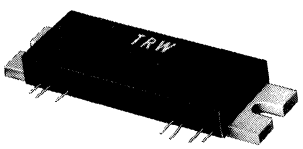
TRW SINGLE SIDEBAND LINEAR TRANSISTORS (CONT'D)

TRW Type	Frequency	Power PEP	Gain (dB)	V_{CC}	V_{CBO}	V_{CEO}	I_C (Max.) (Amps)	θj (°C/W)	Package
PT5741	15 30	30	16 13	12.5	40	18	8	1.25	TO-128
PT5742	15 30	60	16 13	12.5	40	18	12	0.9	DIA-4L
PT6619	15 30	10 5 10 5	23 18 20 15	28 12.5 28 12.5	60	40	—	7.0	TO-117
2N5707	28	20	14	28.0	70	50	4.0	2.5	TO-128
2N5708	28	40	13	28.0	70	50	6.0	1.75	TO-128
2N5709	28	80	13	28.0	70	50	12.0	1.25	DIA-4L
PT6665*	28	80	13	28.0	70	50	12.0	1.25	DIA-4L
2N5070	30	25.0	13	28.0	65	30	3.3	2.5	TO-60

Power is PEP for intermodulation distortion of −32 dB or less. *Same as 2N5709 with emitter connected to case.

TRW MICROELECTRONIC BROADBAND UHF POWER AMPLIFIERS

TRW announces a first in power at frequency technology with the introduction of two microelectronic broadband amplifier modules. These modules feature: 50 Ohm input and output impedance, operate off 12V batteries, cover the complete mobile UHF radio bands, are capable of withstanding infinite VSWR at 14V and are stable under all operating conditions of voltage and drive. Some of the advantages of using these modules are improved reliability, size reduction, reduction of production labor, shorter design cycles and cost savings.



MX

TRW Type	Frequency MHz	Power Output @ 12.6V (W)	Power Input (mW)	Operating Temperature	Storage Temperature	Power Derating −30 to +70°C	Minimum Efficiency
MX7.5	403-512	7.5	125	−30°C to	−30°C to	2.0 dB	33%
MX12.0	403-512	12.0	150	+80°C	+100°C	2.0 dB	35%

[1] The amplifiers will be supplied in the following frequency ranges per customer request 403-420 MHz, 420-440 MHz, 440-470 MHz and 470-512 MHz. Harmonic Content (Min.): 30 dB.

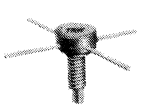
TRW LOW VOLTAGE MOBILE RADIO AND INDUSTRIAL RF POWER TRANSISTORS

TRW . . . First in Power Frequency Technology and first to offer a complete line of ELECTRICALLY RUGGEDIZED transistors for both AM and FM service in all the U. S. and European communications bands. Simplified, single device output circuitry operating directly from 12.5V battery potentials with output powers to 40 watts are possible. Survival is assured in the face of sudden infinite VSWR's without the aid of expensive protective circuitry.

30-50 MHz, FM SERVICE

TRW Type	Power Output (W)	Power Input (W)	Frequency (MHz)	Gain (dB)	Voltage (V)	Package
2N5687	1.5	.03	50	17.0	12.5	TO-39
2N5688	5.0	0.2	50	14.0	12.5	TO-117
2N5689	10.0	0.9	50	10.5	12.5	TO-117
2N5690	25.0	3.5	50	8.5	12.5	TO-128
2N5691	40.0	6.0	50	8.0	12.5	DIA-4L

50-88 MHz, FM SERVICE



TO-117

PT3501	1.0	0.04	88	14.0	12.5	TO-39
PT8717	2.2	0.1	88	13.5	12.5	TO-131
PT3503	5.0	0.3	88	8	12.5	TO-117
PT5695	10.0	1.2	88	9.2	12.5	TO-117
PT8769	15.0	1.5	88	10.0	12.5	B-Band-2
PT4555	25.0	6.2	88	6.0	12.5	TO-128
PT4556	40.0	11.0	88	5.5	12.5	DIA-4L
PT8771	40.0	11.0	88	5.5	12.5	SOE-2

150-175 MHz, FM SERVICE

TRW Type	Power Output (W)	Power Input (W)	Frequency (MHz)	Gain (dB)	Voltage (V)	Package
2N4427	1.0	0.1	175	10.0	12.5	TO-39
2N5913	1.75	0.1	175	12.4	12.5	TO-39
PT4537	2.5	0.1	175	14.0	12.5	TO-131
2N5589	3.0	0.45	175	8.2	13.6	SOE-1
2N6080	4.0	.25	175	12.0	12.5	SOE-2

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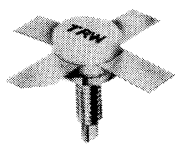
RF COMMUNICATIONS



SOE-2

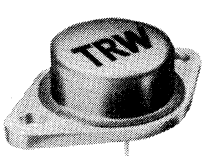
150-175 MHz, FM SERVICE (CONT'D)

TRW Type	Power Output (W)	Power Input (W)	Frequency (MHz)	Gain (dB)	Voltage (V)	Package
PT8725	5.5	1.2	175	6.2	13.5	Studless TO-129
PT4544	10.0	1.2	175	9.2	12.5	B-Band-1
2N5590	10.0	3.0	175	5.2	13.6	SOE-2
2N6081	15.0	3.5	175	6.4	12.5	SOE-2
PT5649	15.0	2.5	175	7.8	12.5	B-Band-2
J04020	20.0	2.5	175	9.0	12.5	J-ZERO
2N6082	25.0	6.0	175	6.2	12.5	SOE-2
PT8710	25.0	8.0	175	5.0	12.5	B-Band-2
2N5591	25.0	9.0	175	4.4	13.6	SOE-2
2N6083	30.0	8.0	175	5.7	12.5	SOE-2
J04030	30.0	5.0	175	7.8	12.5	J-ZERO
J04040	40.0	7.5	175	7.3	12.5	J-ZERO
2N6084	40.0	14.0	175	4.6	12.5	SOE-2

450-470 MHz, FM SERVICE

2N5697	0.25	0.06	470	6.2	12.5	TO-39
2N5698	1.0	0.2	470	7.0	12.5	TO-131
2N5644	1.0	0.2	470	7.0	12.5	SOE-2
PT8809	2.0	0.2	470	10.0	12.5	280-SOE
PT8740	2.0	0.6	470	5.2	12.5	TO-39
PT3537	2.5	0.74	470	5.3	12.5	TO-117
2N5645	4.0	1.0	470	6.0	12.5	SOE-2
PT8810	5.0	0.7	470	8.6	12.5	280-SOE
PT8741	5.0	1.0	470	7.0	12.5	B-Band-1
PT8743	7.0	2.0	470	5.4	12.5	B-Band-1
PT8811	10.0	2.5	470	6.1	12.5	280-SOE
2N5646	12.0	4.1	470	4.7	12.5	SOE-2
PT8742	12.0	4.0	470	4.8	12.5	B-Band-2
PT4535	25.0	11.0	470	3.5	12.5	B-Band-2
J03025	25.0	10.0	470	4.0	12.5	J-ZERO
J03030	30.0	12.0	470	4.0	12.5	J-ZERO
J03040	40.0	15.0	470	4.3	12.5	J-ZERO

SWITCHING TRANSISTORS



TO-3

TRW HIGH SPEED 6-AMP NPN SILICON SWITCHING TRANSISTORS

Typical Values: t_{on} = 200nsec, t_{off} = 300nsec @ 3A, C_{ob} = 400pF @ 10V, f_t = 30MHz

TRW Type	V_{CEO} Vdc	V_{CBO} Vdc	$V_{CE(sat)}$ @ Vdc	I_C Adc	I_B Adc	H_{FE} @	I_C Adc	V_{CE} Vdc	P_T @ T_C=25°C W	θ_{JC} °C/W	Pkg.
SVT350-3	350	350	0.8	3.0	0.6	15	3.0	5.0	75	1.5	TO-3
SVT400-3	400	400	1.0	3.0	0.6	15	3.0	5.0	75	1.5	TO-3
SVT450-3	450	450	1.2	3.0	0.6	15	3.0	5.0	75	1.5	TO-3

TRW HIGH SPEED 10-AMP NPN SILICON SWITCHING TRANSISTORS

Typical Values: t_{on} = 200nsec, t_{off} = 800nsec @ 1A, C_{ob} = 150pF @ 10V, f_t = 100MHz

SVT200-5	200	225	1.0	5.0	0.5	15	5.0	5.0	125	1.0	TO-3†
SVT250-5	250	275	1.0	5.0	0.5	15	5.0	5.0	125	1.0	TO-3†
SVT300-5	300	325	1.0	5.0	0.5	15	5.0	5.0	125	1.0	TO-3†
*SVT350-5	350	350	0.8	5.0	1.0	15	5.0	5.0	100	1.2	TO-3
*SVT400-5	400	400	0.8	5.0	1.0	15	5.0	5.0	100	1.2	TO-3
*SVT450-5	450	450	1.2	5.0	1.0	15	5.0	5.0	100	1.2	TO-3

*Typical Values: t_{on} = 200nsec, t_{off} = 300nsec @ 5A, C_{ob} = 450pF @ 10V, f_t = 30MHz.
†Also available in stud TO-63 and TO-61 isolated packages by designating suffix A and B respectively.

TRW HIGH SPEED 20-AMP NPN SILICON SWITCHING TRANSISTORS

Typical Values: t_{on} = 300nsec, t_{off} = 1μsec @ 2A, C_{ob} = 400pF @ 10V, f_t = 100MHz

SVT200-10	200	225	1.5	10.0	1.0	15	10.0	5.0	125	1.0	TO-3†
SVT250-10	250	275	1.5	10.0	1.0	15	10.0	5.0	125	1.0	TO-3†
SVT300-10	300	325	1.5	10.0	1.0	15	10.0	5.0	125	1.0	TO-3†

†Also available in stud TO-63 and TO-61 isolated packages by designating suffix A and B respectively.

TRW HIGH SPEED 30-AMP NPN SILICON SWITCHING TRANSISTORS

Typical Values: t_{on} = 350nsec, t_{off} = 1μsec @ 2A, C_{ob} = 600pF @ 10V, f_t = 100MHz

SVT200-20	200	225	2.00	20.0	2.0	15	20.0	5.0	125	1.0	TO-3†
SVT250-20	250	275	2.00	20.0	2.0	15	20.0	5.0	125	1.0	TO-3†
SVT300-20	300	325	2.50	20.0	2.0	15	20.0	5.0	125	1.0	TO-3†

†Also available in stud TO-63 and TO-61 isolated packages by designating suffix A and B respectively.

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DIODES

DO-14

TRW LVA DIODES

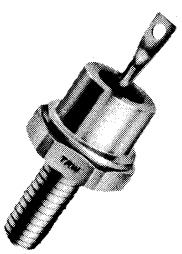
The LVA device exhibits considerably sharper breakdown characteristics than zeners in the 4-10V range. Above 10V the breakdown mechanism of zener regulators is avalanche which produces a very sharp knee and provides good voltage regulation. Below 10V the field emission phenomenon starts, and as the operating voltage decreases field emission accounts for an increasingly higher percentage of the device breakdown mechanism.

GENERAL PURPOSE LVA DIODES

TRW Type [1]	Nominal Zener Voltage @ I_Z	Maximum Dynamic Impedance[2] Z_Z @ I_Z		Maximum Noise Density @ 250μA	Maximum Reverse Leakage I_R @ V_R	
	Vdc	Ohms	mA	$\mu V/\sqrt{Hz}$	μA	Vdc
LVA43A	4.3	12	20	4	4.0	1.5
LVA47A	4.7	15	10	4	4.0	2.0
LVA51A	5.1	15	5	4	0.1	2.0
LVA56A	5.6	40	1	4	0.05	3.0
LVA62A	6.2	50	1	4	0.05	4.0
LVA68A	6.8	50	1	4	0.05	5.0
LVA75A	7.5	100	1	4	0.01	6.0
LVA82A	8.2	100	1	4	0.01	6.5
LVA91A	9.1	100	1	4	0.01	8.0
LVA100A	10.0	100	1	4	0.01	9.0

TRW TUNING VARACTOR DIODES — EIA "1N" TYPES

The EIA 1N5139 type tuning Varicap® is manufactured by a proprietary alloy process assuring consistent capacitance tracking and abrupt junction characteristics. These Varicaps are designed for tuning appliations where high Q's, consistent tracking, and low leakages are required. The 1N5139 types are suitable for military, industrial and commercial applications and are packaged in the DO-7 package. Supplied in ±10% and ±5% (Suffix "A") capacitance tolerances.



DO-4

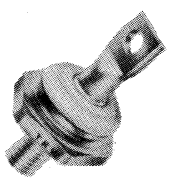
GENERAL ELECTRICAL CHARACTERISTICS (25°C unless noted) — TUNING VARICAP, EIA IN5139 SERIES

Symbol	Characteristics	IN 5139	IN 5140	IN 5141	IN 5142	IN 5143	IN 5144	IN 5145	IN 5146	IN 5147	IN 5148
V_{BR}	Reverse Breakdown Voltage (I_R = 100μA)	65V Min.									
P_d	Power Dissipation	400mW Max.									
T_{OP}	Operating Temperature	−65°C to +150°C.									
T_{stg}	Storage Temperature	−65°C to +150°C									
C_C	Case Capacitance	0.2pF Typ.									
L_C	Case and Lead Inductance	5nH Typ.									
MWV	Maximum Working Voltage	60V									
I_R	Reverse Current @ MWV	20nA Max.									
I_R	Reverse Current @ MWV (150°C)	20μA Max.									

ELECTRICAL CHARACTERISTICS (25°C unless noted) — TUNING VARICAP, EIA IN5139 SERIES

Symbol	Characteristics	IN 5139	IN 5140	IN 5141	IN 5142	IN 5143	IN 5144	IN 5145	IN 5146	IN 5147	IN 5148
C_T	Capacitance C-4Vdc, f = 1MHz (pF)	6.8	10	12	15	18	22	27	33	39	47
C_{CR}	Capacitance Ratio C-4/C-MWV (Min.)	2.7	2.8				3.2				
Q	Quality Factor Q-4Vdc, f = 50MHz (Min.)	350	300	250	250	200					

POWER SCHOTTKY DIODES



DO-5

These devices are designed for operation in low voltage, high current Power Supplies. Improved Barrier formation techniques allow operation at higher temperatures than previously possible.

TRW Type	Forward Current Rating (I_O)	Forward Voltage @ I_O	Min. Reverse Voltage (Tested @ 25mA)	Max. Reverse Current @ 20V & 25°C	Max. Reverse Current @ 20V & 125°C	Package (Cathode to Case)	Max. Reverse Recovery Time
SD51	25	.550	25V	12mA	50	DO-5	10nS
SD50	10	.550	25V	10mA	40	DO-4	10nS

Operating Temperature Range: −65°C to 150°C.

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DIODES

TRW HIGH SPEED POWER DIODES

TRW Type	Maximum Ratings @ 25°C				Std. Pkg. Style	Electrical Characteristics			
	I_F (Amps)	I_{surge} (Amps)	V_R (Volts)	θ_{JC} (°C/W)		$T_{RRmax.}$ (nsec)	$V_{Fmax.}$ @ I_F (Volts)	$BV_{min.}$ @ 1mA	$I_{Rmax.}$ @ PRV (μAmps)
SVD50-1	1	10	50	40[2]	A	20	1.0	60	5
SVD100-1	1	10	100	40[2]	A	20	1.0	120	5
SVD50-3	3	30	50	20[2]	B	20	1.0	60	10
SVD100-3	3	30	100	20[2]	B	20	1.0	120	10
SVD300-3	3	30	300	2.5	Mod. DO-4	70	1.5	360	10
SVD350-3	3	30	350	2.5	Mod. DO-4	70	1.5	420	10
SVD400-3	3	30	400	2.5	Mod. DO-4	70	1.5	480	10
SVD450-3	3	30	450	2.5	Mod. DO-4	70	1.5	540	10
SVD300-5	5	50	300	2.5	Mod. DO-4	70	1.5	360	10
SVD350-5	5	50	350	2.5	Mod. DO-4	70	1.5	420	10
SVD400-5	5	50	400	2.5	Mod. DO-4	70	1.5	440	10
SVD450-5	5	50	450	2.5	Mod. DO-4	70	1.5	540	10
SVD50-6	6	60	50	2.5	Mod. DO-4	25	1.0	60	75
SVD100-6	6	60	100	2.5	Mod. DO-4	25	1.2	120	75
SVD50-12	12	120	50	2.5	Mod. DO-4	25	1.0	60	125
SVD100-12	12	120	100	2.5	Mod. DO-4	25	1.2	120	125
1N5410	12	200	150	2.0	DO-4	70	1.0	175	100
SVD50-30	30	300	50	1.5	Mod. DO-5	35	1.0	60	200
SVD100-30	30	300	100	1.5	Mod. DO-5	35	1.2	120	200
1N5409	30	500	150	1.5	DO-5	70	1.2	175	100

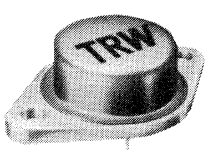
POWER DARLINGTON

MONOLITHIC HIGH VOLTAGE DARLINGTON FAMILY

FOR USE IN SWITCHING POWER SUPPLIES, SWITCHING REGULATORS, CONVERTERS/INVERTERS, MOTOR CONTROLS, DEFLECTION CIRCUITS AND AUTOMOTIVE IGNITIONS.

The SVT 6000 Series are NPN, High Voltage, High Gain, Monolithic Darlington amplifiers for use in high speed power circuits at switching frequencies to 40KHz and higher. The units are mounted in the EIA standard TO-3 package. An internal diode provides rapid device turn-off.

BV_{cbo} to 650 Volts . . . Switch times typ. 300 NanoSec.



TO-3

TRW Type	BV_{ce} (Sustaining)	I_C	V_{ce} (Sat)
SVT6060	300 Volts	20 Amps	2.0 Volts (I_c=20A, I_b=2A)
SVT6061	350 Volts	20 Amps	2.0 Volts (I_c=20A, I_b=2A)
SVT6062	400 Volts	20 Amps	2.0 Volts (I_c=20A, I_b=2A)
SVT6000	300 Volts	10 Amps	1.4 Volts (I_c=10A, I_b=500mA)
SVT6001	350 Volts	10 Amps	1.4 Volts (I_c=10A, I_b=500mA)
SVT6002	400 Volts	10 Amps	1.4 Volts (I_c=10A, I_b=500mA)
SVT6251	350 Volts	5 Amps	1.4 Volts (I_c=5A, I_b=500mA)
SVT6252	400 Volts	5 Amps	1.4 Volts (I_c=5A, I_b=500mA)
SVT6253	450 Volts	5 Amps	1.4 Volts (I_c=5A, I_b=500mA)

"All products on these pages are production parts and available from any of our industrial distributors. For the name of the local distributor serving you see the yellow pages of this volume or call toll-free 800-645-9200 (in New York State call collect (516) 294-0990)."

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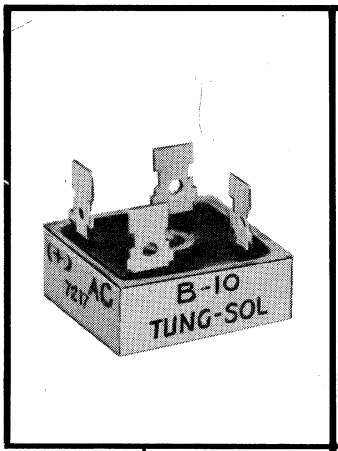
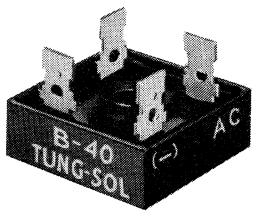
TUNG-SOL

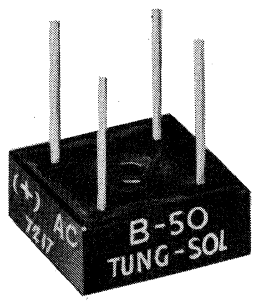
MODULAR RECTIFIER ASSEMBLIES



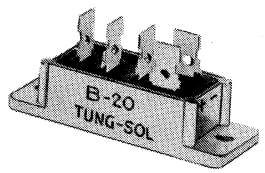
BRIDGE	B-10 SERIES 30 AMP
CENTER TAP	C-10 SERIES 30 AMP



BRIDGE	B-40 SERIES 15 AMP
CENTER TAP	C-40 SERIES 20 AMP



BRIDGE	B-50 SERIES 10 AMP
CENTER TAP	C-50 SERIES 15 AMP



BRIDGE	B-20 SERIES 35 AMP
HALF-WAVE	H-20 SERIES 35 AMP

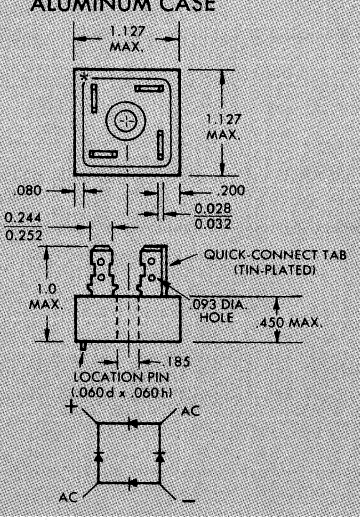
RATINGS AND CHARACTERISTICS

SINGLE PHASE BRIDGES

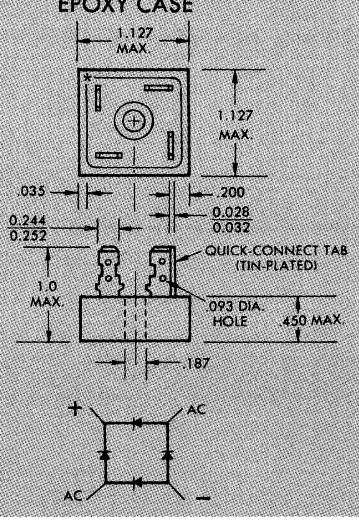
DC OUTPUT	SERIES	PRV RATINGS	SINGLE CYCLE SURGE (AT FULL LOAD)	MAXIMUM REVERSE CURRENT —PER DIODE—
30 A (75°C CASE)	B-10	50 V to 1,000 V	400 A	AT 25°C & RATED PRV 20 ua DC AT 100°C & RATED PRV 400 ua DC
15 A (75°C CASE)	B-40	50 V to 1,000 V	300 A	
10 A (75°C CASE)	B-50	50 V to 600 V	300 A	

MECHANICAL DATA

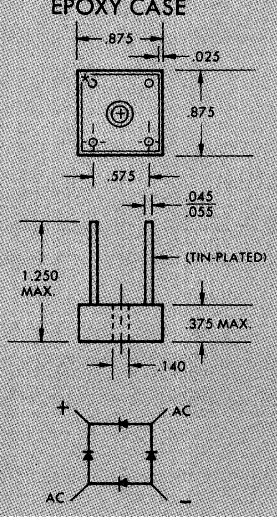
B-10 SERIES
ALUMINUM CASE



B-40 SERIES
EPOXY CASE



B-50 SERIES
EPOXY CASE



TUNG-SOL DIVISION / WAGNER ELECTRIC CORPORATION
630 WEST MT. PLEASANT AVE., LIVINGSTON, N.J. 07039

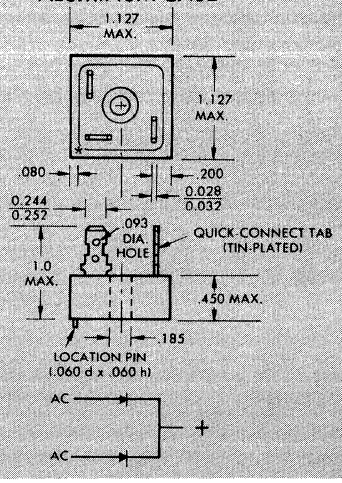
TUNG-SOL / MODULAR RECTIFIER ASSEMBLIES

SINGLE PHASE CENTER TAP ASSEMBLIES

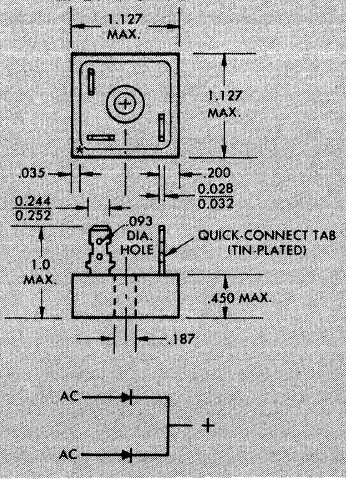
DC OUTPUT	SERIES	PRV RATINGS	SINGLE CYCLE SURGE (AT FULL LOAD)	MAXIMUM REVERSE CURRENT —PER DIODE—
30 A (100°C CASE)	C-10	50 V to 1,000 V	400 A	AT 25°C & RATED PRV 20 ua DC AT 100°C & RATED PRV 400 ua DC
20 A (100°C CASE)	C-40	50 V to 1,000 V	300 A	
15 A (100°C CASE)	C-50	50 V to 600 V	300 A	

MECHANICAL DATA

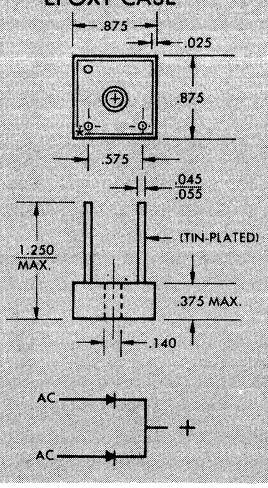
C-10 SERIES
ALUMINUM CASE



C-40 SERIES
EPOXY CASE



C-50 SERIES
EPOXY CASE

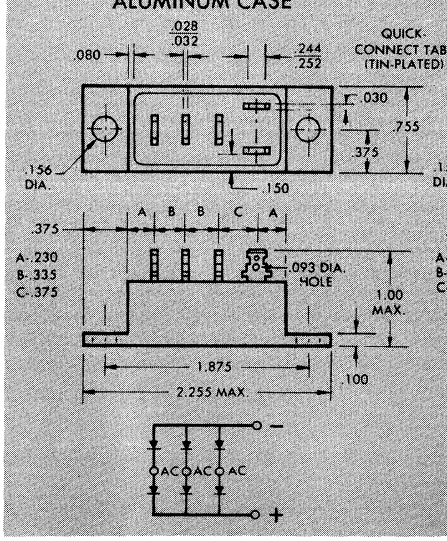


THREE PHASE BRIDGE — HALF WAVE RECTIFIERS

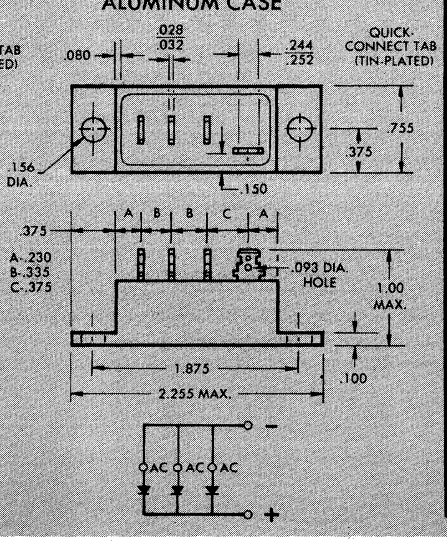
DC OUTPUT	SERIES	PRV RATINGS	SINGLE CYCLE SURGE (AT FULL LOAD)	MAXIMUM REVERSE CURRENT —PER DIODE—
35 A (75°C CASE)	B-20	50 V to 1,000 V	400 A	AT 25°C & RATED PRV 20 ua DC AT 100°C & RATED PRV 400 ua DC
35 A (100°C CASE)	H-20	50 V to 1,000 V	400 A	

MECHANICAL DATA

B-20 SERIES
ALUMINUM CASE



H-20 SERIES
ALUMINUM CASE



NOTES

1. PRV ratings are specified by letter designation following series number according to the following schedule: Z = 50 V, A = 100 V, B = 200 V, D = 400 V, F = 600 V, H = 800 V, K = 1,000 V.
2. * Asterisk indicates terminal connected to positive load.
3. All dimensions are in inches. Where a dimension is given without a tolerance, it should be considered nominal.
4. All center-tap assemblies and the three phase half wave assembly are available with negative output. Suffix "R" is added to the part number in those cases.
5. The use of a thermal compound between assembly and heatsink surface will assist in limiting case temperature rise.

For additional Tungsol Catalog Data on High and Low Voltage Silicon Rectifiers, Stacks and Assemblies, see Vol.2•954-2•956.
Also refer to Tungsol Catalog Data on Displays and Lamps, Vol.2•539-2•541.

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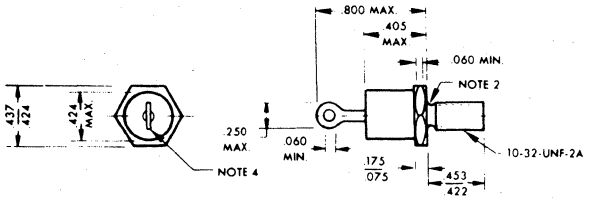
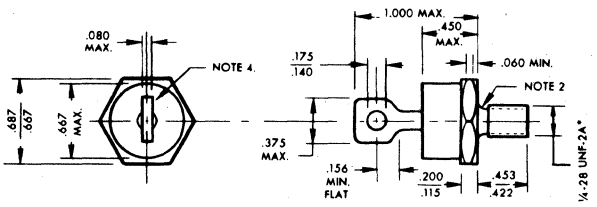
TUNG-SOL SILICON RECTIFIER STACKS AND ASSEMBLIES

RECTIFIERS

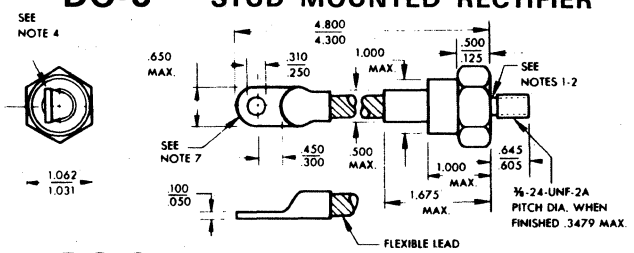
DO-4 STUD MOUNTED RECTIFIER



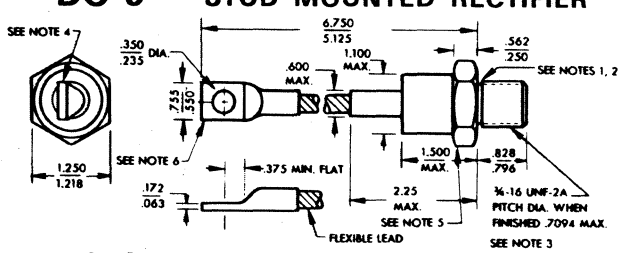
DO-5 STUD MOUNTED RECTIFIER



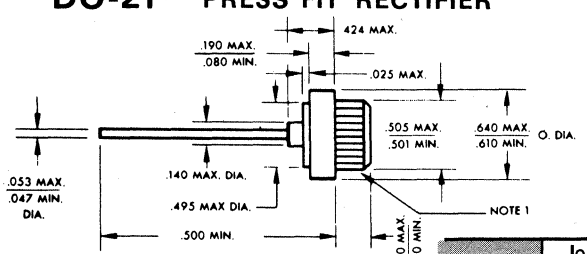
DO-8 STUD MOUNTED RECTIFIER



DO-9 STUD MOUNTED RECTIFIER



DO-21 PRESS FIT RECTIFIER

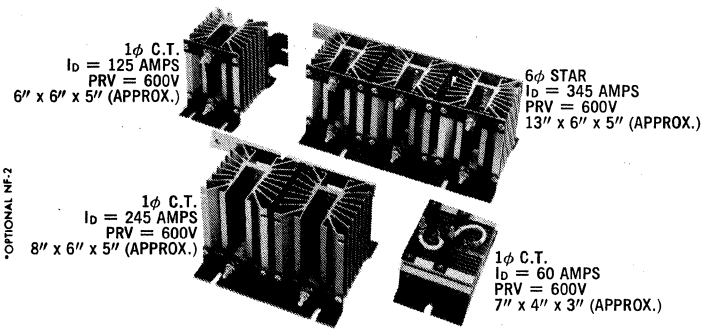


TUNG-SOL RECTIFIER ASSEMBLIES

Tung-Sol provides high voltage and high current assemblies for a wide variety of applications that involve both ordinary and extraordinary requirements.

Pictured here are several examples of these products.

Please consult Tung-Sol regarding your rectifier assembly needs.



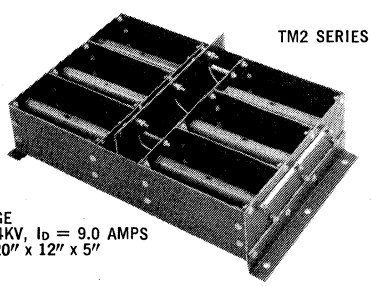
1ϕ C.T.
I_D = 125 AMPS
PRV = 600V
6″ x 6″ x 5″ (APPROX.)

6ϕ STAR
I_D = 345 AMPS
PRV = 600V
13″ x 6″ x 5″ (APPROX.)

1ϕ C.T.
I_D = 245 AMPS
PRV = 600V
8″ x 6″ x 5″ (APPROX.)

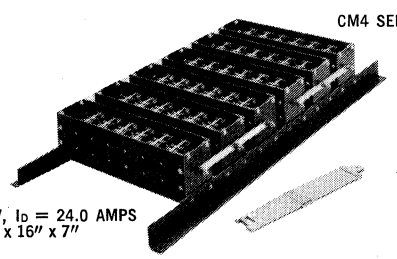
1ϕ C.T.
I_D = 60 AMPS
PRV = 600V
7″ x 4″ x 3″ (APPROX.)

TM2 SERIES



3ϕ BRIDGE
PRV = 14KV, I_D = 9.0 AMPS
DIM. — 20″ x 12″ x 5″

CM4 SERIES



3ϕ BRIDGE
PRV = 24KV, I_D = 24.0 AMPS
DIM. — 37″ x 16″ x 7″

JEDEC DO-4 CONSTRUCTION

NOTES:

1. Unit must not be damaged by torque of 15 in.-lb. applied to 10-32 NF 2B nut assembled on thread.
2. Dia. of unthreaded portion .189 max., 163 min.
3. Complete threads to extend to within 2½ threads of head.
4. Angular orientation of this terminal is undefined.
5. Max. pitch dia. of plated threads shall be basic pitch dia. (.1697) Ref. (Screw Thread Standards for Federal Services 1957) Handbook H28 1957 P1.

Type No.	I_O Amps (150°C Case)	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N1199A	12	50	3.0	240
1N1200A	12	100	3.0	240
1N1201A	12	150	3.0	240
1N1202A	12	200	3.0	240
1N1203A	12	300	3.0	240
1N1204A	12	400	3.0	240
1N1205A	12	500	3.0	240
1N1206A	12	600	3.0	240
1N3670A	12	700	0.9	240
1N3671A	12	800	0.9	240
1N3672A	12	900	0.9	240
1N3673A	12	1000	0.9	240
1N1199B	12	50	1.0	250
1N1200B	12	100	1.0	250
1N1201B	12	150	1.0	250
1N1202B	12	200	1.0	250

Type No.	I_O Amps (150°C Case)	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N1203B	12	300	1.0	250
1N1204B	12	400	1.0	250
1N1205B	12	500	1.0	250
1N1206B	12	600	1.0	250
1N4012	12	700	0.5	200
1N4013	12	800	0.5	200
1N4014	12	900	0.5	200
1N4015	12	1000	0.5	200
CONTROLLED DATA				
1N4506	12	200	2.5	240
1N4507	12	400	2.5	240
1N4508	12	600	2.5	240
1N4509	12	800	2.0	240
1N4510	12	1000	1.7	240

TUNG-SOL DIVISION / Wagner Electric Corporation
630 W. Mt. Pleasant Avenue, Livingston, N.J. 07039 / TWX: 710-994-4865 Phone: (201) 992-1100; (212) 732-5426

TUNG-SOL

JEDEC DO-5 CONSTRUCTION

NOTES:

1. Unit must not be damaged by torque of 30 in.-lb. applied to ¼-28 UNF-2B nut assembled on thread.
2. Dia. of unthreaded portion .249 max., .220 min.
3. Complete threads to extend to within 2½ threads of head.
4. Angular orientation of this terminal is undefined.
5. Max. pitch dia. of plated threads shall be basic pitch dia. (.2268) Ref. (Screw Thread Standards for Federal Services 1957) Handbook H28 1957 P1.

Type No.	Io (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N2793	5	50	5	75
1N2794	5	100	5	75
1N2795	5	150	5	75
1N2796	5	200	5	75
1N2797	5	250	5	75
1N2798	5	300	5	75
1N2799	5	350	5	75
1N2800	5	400	5	75
1N2021	10	150	5	110
1N2022	10	200	5	110
1N2023	10	300	5	110
1N2024	10	350	5	110
1N2025	10	400	5	110
1N3208	15	50	10	250
1N3209	15	100	10	250
1N3210	15	200	10	250
1N3211	15	300	10	250
1N3212	15	400	10	250
1N3213	15	500	10	250
1N1191	15	600	10	250
1N1198	18	600	5	220
1N1192	18	100	5	220
1N1193	18	150	5	220
1N1194	18	200	5	220
1N1195	18	300	5	220
1N1196	18	400	5	220
1N1197	18	500	5	220
1N1198	18	600	5	220
1N1191A	22	50	5.0	350
1N1192A	22	100	5.0	350
1N1193A	22	150	5.0	350
1N1194A	22	200	5.0	350
1N1195A	20	300	3.2	350
1N1196A	20	400	2.5	350
1N1197A	20	500	2.2	350
1N1198A	20	600	1.5	350
1N2154	25 (145°C)	50	5.0	400
1N2155	25 (145°C)	100	4.5	400
1N2156	25 (145°C)	200	4.0	400
1N2157	25 (145°C)	300	3.5	400
1N2158	25 (145°C)	400	3.0	400
1N2159	25 (145°C)	500	2.5	400
1N2160	25 (145°C)	600	2.0	400
1N1434	30 (25°C)	50	5	400
1N1435	30 (25°C)	100	5	400
1N1436	30 (25°C)	200	5	400
1N1437	30 (25°C)	400	5	400
1N1438	30 (25°C)	600	5	400

Type No.	Io (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N2282	35 (25°C)	300	5	400
1N2283	35 (25°C)	400	5	400
1N2284	35 (25°C)	500	5	400
1N2285	35 (25°C)	600	5	400
1N1183	35 (140°C)	50	10	500
1N1184	35 (140°C)	100	10	500
1N1185	35 (140°C)	150	10	500
1N1186	35 (140°C)	200	10	500
1N1187	35 (140°C)	300	10	500
1N1188	35 (140°C)	400	10	500
1N1189	35 (140°C)	500	10	500
1N1190	35 (140°C)	600	10	500
1N1183A	40	50	5.0	800
1N1184A	40	100	5.0	800
1N1185A	40	150	5.0	800
1N1186A	40	200	5.0	800
1N1187A	40	300	5.0	800
1N1188A	40	400	4.4	800
1N1189A	40	500	4.0	800
1N1190A	40	600	3.6	800
1N2446	45 (60°C)	50	5	500
1N2447	45 (60°C)	100	5	500
1N2448	45 (60°C)	150	5	500
1N2449	45 (60°C)	200	5	500
1N2450	45 (60°C)	250	5	500
1N2451	45 (60°C)	300	5	500
1N2452	45 (60°C)	350	5	500
1N2453	45 (60°C)	400	5	500
1N2454	45 (60°C)	500	5	500
1N2455	45 (60°C)	600	5	500
1N2456	45 (60°C)	700	5	500
1N2457	45 (60°C)	800	5	500
CONTROLLED AVALANCHE				
1N3968	50 (120°C)	200	2	600
1N3969	50 (120°C)	400	2	600
1N3970	50 (120°C)	600	2	600
1N3971	50 (120°C)	800	2	600
1N4136	50 (140°C)	200	12	750
1N4137	50 (140°C)	400	12	750
1N4138	50 (140°C)	600	12	750
CONTROLLED AVALANCHE				
1164B/BR	50	200	4.0	600
1164D/DR	50	400	3.0	600
1164F/FR	50	600	2.5	600
1164H/HR	50	800	2.0	600
1164K/KR	50	1000	2.0	600
1N2458	60 (60°C)	50	5	450
1N2459	60 (60°C)	100	5	450
1N2460	60 (60°C)	150	5	450
1N2461	60 (60°C)	200	5	450
1N2462	60 (60°C)	250	5	450
1N2463	60 (60°C)	300	5	450
1N2464	60 (60°C)	350	5	450
1N2465	60 (60°C)	400	5	450
1N2466	60 (60°C)	500	5	450
1N2467	60 (60°C)	600	5	450
1N2468	60 (60°C)	700	5	450
1N2469	60 (60°C)	800	5	450

Type No.	Io (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N2128	60 (100°C)	50	10	700
1N2129	60 (100°C)	100	10	700
1N2130	60 (100°C)	150	10	700
1N2131	60 (100°C)	200	10	700
1N2132	60 (100°C)	250	10	700
1N2133	60 (100°C)	300	10	700
1N2134	60 (100°C)	350	10	700
1N2135	60 (100°C)	400	10	700
1N2136	60 (100°C)	450	10	700
1N2137	60 (100°C)	500	10	700
1N2138	60 (100°C)	600	10	700

JEDEC DO-21 CONSTRUCTION

NOTES:

1. 50 T.P.I. Knurl.
2. MAXIMUM INSERTION PRESSURE: 1000 lbs. evenly distributed around the outer perimeter on top of the base.
3. Types 127350 and 127351: Terminal lead diameter equals 0.093″.

Type No.	Io (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N3491	18	50	10	300
1N3492	18	100	10	300
1N3493	18	200	8	300
1N3494	18	300	6	300
1N3495	18	400	4	300
1N3659	25	50	5.0	400
1N3660	25	100	4.5	400
1N3661	25	200	4.0	400
1N3662	25	300	3.5	400
1N3663	25	400	3.0	400
1N3664	25	500	2.5	400
1N3665	25	600	2.0	400
CONTROLLED AVALANCHE				
PZ140B/BR	25	200	4.0	400
PZ140D/DR	25	400	3.0	400
PZ140F/FR	25	600	2.0	400
PZ140H/HR	25	800	2.0	400
PZ140K/KR	25	1000	2.0	400
127350Z/ZR	35	50	5.0	500
127350A/AR	35	100	5.0	500
127350AZ/AZR	35	150	5.0	500
127350B/BR	35	200	5.0	500
127350C/CR	35	300	4.5	500
127350D/DR	35	400	4.0	500
127350E/ER	35	500	3.5	500
127350F/FR	35	600	3.0	500
127351Z/ZR	44	50	5.0	700
127351A/AR	44	100	5.0	700
127351AZ/AZR	44	150	5.0	700
127351B/BR	44	200	5.0	700
127351C/CR	44	300	4.5	700
127351D/DR	44	400	4.0	700
127351E/ER	44	500	3.5	700
127351F/FR	44	600	3.0	700

JEDEC DO-8 CONSTRUCTION

NOTES:

1. Complete threads to extend to within 2½ threads of head.
2. Dia. of unthreaded portion .373 max., .344 min.
3. Screw Thd. Standards for Federal Services (1957 Handbook H28 Pt. 1) apply to UNF-2A Thd.
4. Angular orientation of this terminal is undefined.
5. Unit will not be damaged by torque of 100 lb.-in. applied to a non-lubricated ⅜-24 UNF-2B nut assembled on thd.
6. A chamfer (or undercut) on one or both ends of hexagonal portions is optional.
7. Square or radius on end of terminal is optional.

Type No.	I_O (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N1396	70	50	15	1200
1N1397	70	100	15	1200
1N1398	70	150	15	1200
1N1399	70	200	15	1200
1N1400	70	300	15	1200
1N1401	70	400	15	1200
1N1402	70	500	15	1200
1N1403	70	600	15	1200
1N3289	100 (130°C)	200	24	1600
1N3290	100 (130°C)	300	24	1600
1N3291	100 (130°C)	400	24	1600
1N3292	100 (130°C)	500	21	1600
1N3293	100 (130°C)	600	17	1600
CH-10912Z/ZR	125	50	15	1750
CH-10912A/AR	125	100	15	1750
CH-10912AZ/AZR	125	150	15	1750
CH-10912B/BR	125	200	15	1750
CH-10912C/CR	125	300	15	1750
CH-10912D/DR	125	400	15	1750
CH-10912E/ER	125	500	15	1750
CH-10912F/FR	125	600	15	1750
1N2436	150 (75°C)	50	10	1200
1N2437	150 (75°C)	100	10	1200
1N2438	150 (75°C)	150	10	1200
1N2439	150 (75°C)	200	10	1200
1N2440	150 (75°C)	250	10	1200
1N2441	150 (75°C)	300	10	1200
1N2442	150 (75°C)	350	10	1200
1N2443	150 (75°C)	400	10	1200
1N2444	150 (75°C)	500	10	1200
1N2445	150 (75°C)	600	10	1200
1N4587	150 (110°C)	100	9.5	3000
1N4588	150 (110°C)	200	9.5	3000
1N4589	150 (110°C)	300	9.0	3000
1N4590	150 (110°C)	400	9.0	3000
1N4591	150 (110°C)	500	8.0	3000
1N4592	150 (110°C)	600	6.5	3000
CH-119Z/ZR	150	50	15.0	4000
CH-119A/AR	150	100	15.0	4000
CH-119AZ/AZR	150	150	13.0	4000
CH-119B/BR	150	200	13.0	4000
CH-119C/CR	150	300	12.0	4000
CH-119D/DR	150	400	10.0	4000
CH-119E/ER	150	500	8.5	4000
CH-119F/FR	150	600	7.0	4000

JEDEC DO-9 CONSTRUCTION

NOTES:

1. Complete threads to extend within 2½ threads of head.
2. Dia. of unthreaded portion .670 max., .660 min.
3. Screw Thd. Standards for Federal Services (1957 Handbook H28 Pt. 1) apply to UNF-2A Thd. (plated).
4. Angular orientation of this terminal is undefined.
5. A chamfer (or undercut) on one or both ends of hexagonal portions is optional.
6. Square or radius on end of terminal is undefined.

Type No.	I_O (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
1N1660	116 (120°C)	50	10	3000
1N1661	116 (120°C)	100	10	3000
1N1662	116 (120°C)	150	10	3000
1N1663	116 (120°C)	200	10	3000
1N1664	116 (120°C)	300	10	3000
1N1665	116 (120°C)	400	10	3000
1N1666	116 (120°C)	500	10	3000
1N3260	160 (125°C)	50	12	2000
1N3261	160 (125°C)	100	12	2000
1N3262	160 (125°C)	150	12	2000
1N3263	160 (125°C)	200	12	2000
1N3264	160 (125°C)	250	12	2000
1N3265	160 (125°C)	300	12	2000
1N3266	160 (125°C)	350	12	2000
1N3267	160 (125°C)	400	12	2000
1N3268	160 (125°C)	500	12	2000
1N3269	160 (125°C)	600	12	2000
1N3161	240 (120°C)	50	16	3000
1N3162	240 (120°C)	100	16	3000
1N3163	240 (120°C)	150	16	3000
1N3164	240 (120°C)	200	16	3000
1N3165	240 (120°C)	250	16	3000
1N3166	240 (120°C)	300	16	3000
1N3167	240 (120°C)	350	16	3000
1N3168	240 (120°C)	400	16	3000
1N3169	240 (120°C)	500	16	3000
1N3170	240 (120°C)	600	16	3000
1N1670	240 (120°C)	50	50	1800
1N1671	240 (120°C)	100	50	1800
1N1672	240 (120°C)	150	50	1800
1N1673	240 (120°C)	200	50	1800
1N1674	240 (120°C)	300	50	1800
1N1675	240 (120°C)	400	50	1800
1N1676	240 (120°C)	500	50	1800
1N2054	250 (100°C)	50	55	4500
1N2055	250 (100°C)	100	55	4500
1N2056	250 (100°C)	150	55	4500
1N2057	250 (100°C)	200	55	4500
1N2058	250 (100°C)	250	55	4500
1N2059	250 (100°C)	300	55	4500
1N2060	250 (100°C)	350	55	4500
1N2061	250 (100°C)	400	55	4500
1N2062	250 (100°C)	450	55	4500
1N2063	250 (100°C)	500	55	4500
1N2064	250 (100°C)	600	55	4500

Type No.	I_O (150°C Case) Amps	V_{RM} (wkg) Volts	I_R Ma.	I_{FM} (Surge) Amps
CS131Z/ZR	275 (120°C)	50	16.0	4000
CS131A/AR	275 (120°C)	100	16.0	4000
CS131AZ/AZR	275 (120°C)	150	16.0	4000
CS131B/BR	275 (120°C)	200	16.0	4000
CS131C/CR	275 (120°C)	300	16.0	4000
CS131D/DR	275 (120°C)	400	16.0	4000
CS131E/ER	275 (120°C)	500	15.0	4000
CS131F/FR	275 (120°C)	600	12.5	4000

CONTROLLED AVALANCHE

CH-1511/R	420	1000	10	6000
CH-1512/R	375	1200	10	5300
CH-1513/R	340	1400	10	4500
CH-1514/R	340	1600	10	4500
CH-1515/R	320	1800	10	3500
CH-1516/R	320	2000	10	3500
CH-1517/R	300	2400	10	3500
CH-1518/R	300	3000	10	3500

NOTES:

1. All diodes are available in reverse polarity.
2. Unless otherwise specified current ratings are at 150°C. case with the exception of 1511, 1611 and 1621 series. Refer to data sheets for ratings on these types.

I_{FM} (Surge) Peak one-cycle surge current, under same conditions as I_O rating.

I_O Max. rectified avg. d.c. output current, resistive or inductive load, 60 cps sine wave input.

UNITRODE

ZENER DIODES

Industrial			Military		
Package	Body A	Body B	Body A	Body B	Body C
Voltage 10% Tolerance	1 Watt	5 Watt	3 Watt	5 Watt	10 Watt 6 Watt (in lead mount version)
6.8	UZ8806	UZ4806	UZ806	UZ5806	UZ7806
7.5	UZ8807	UZ4807	UZ807	UZ5807	UZ7807
8.2	UZ8808	UZ4808	UZ808	UZ5808	UZ7808
9.1	UZ8809	UZ4809	UZ809	UZ5809	UZ7809
10	UZ8810	UZ4810	UZ810	UZ5810	UZ7810
12	UZ8812	UZ4812	UZ812	UZ5812	UZ7812
13	UZ8813	UZ4813	UZ813	UZ5813	UZ7813
14	UZ8814		UZ814	UZ5814	UZ7814
15	UZ8815	UZ4815	UZ815	UZ5815	UZ7815
16	UZ8816	UZ4816	UZ816	UZ5816	UZ7816
18	UZ8818	UZ4818	UZ818	UZ5818	UZ7818
20	UZ8820	UZ4820	UZ820	UZ5820	UZ7820
22	UZ8822	UZ4822	UZ822	UZ5822	UZ7822
24	UZ8824	UZ4824	UZ824	UZ5824	UZ7824
27	UZ8827	UZ4827	UZ827	UZ5827	UZ7827
30	UZ8830	UZ4830	UZ830	UZ5830	UZ7830
33	UZ8833	UZ4833	UZ833	UZ5833	UZ7833
36	UZ8836	UZ4836	UZ836	UZ5836	UZ7836
40	UZ8840	UZ4839*	UZ840	UZ5840	UZ7840
45	UZ8845	UZ4843*	UZ845	UZ5845	UZ7845
47		UZ4847			
50	UZ8850	UZ4851*	UZ850	UZ5850	UZ7850
56	UZ8856	UZ4856	UZ856	UZ5856	UZ7856
60	UZ8860	UZ4862*	UZ860	UZ5860	UZ7860
70	UZ8870	UZ4868*	UZ870	UZ5870	UZ7870
75	UZ8875	UZ4875	UZ875	UZ5875	UZ7875
80	UZ8880	UZ4882*	UZ880	UZ5880	UZ7880
90	UZ8890	UZ4891*	UZ890	UZ5890	UZ7890
100	UZ8210	UZ4210	UZ210	UZ5210	UZ7210
110	UZ8211	UZ4211	UZ211	UZ5211	
120	UZ8212	UZ4212	UZ212	UZ5212	
130	UZ8213	UZ4213	UZ213	UZ5213	
140	UZ8214		UZ214	UZ5214	
150	UZ8215	UZ4215	UZ215	UZ5215	
160	UZ8216	UZ4216	UZ216	UZ5216	
170	UZ8217		UZ217	UZ5217	
180	UZ8218	UZ4218	UZ218	UZ5218	
190	UZ8219		UZ219	UZ5219	
200	UZ8220		UZ220	UZ5220	
220		UZ4220	UZ222	UZ5222	
240			UZ224	UZ5224	
260			UZ226	UZ5226	
280			UZ228	UZ5228	
300			UZ230	UZ5230	
320			UZ232	UZ5232	
340			UZ234	UZ5234	
360			UZ236	UZ5236	
380			UZ238	UZ5238	
400			UZ240	UZ5240	

Specify 20% voltage tolerance by changing third digit from right up one digit. (UZ809 becomes UZ909).
Specify 5% voltage tolerance by changing third digit from right down one digit. (UZ2820 becomes UZ2720).

Polarity is cathode to stud. For reverse polarity use suffix "R" with part numbers. e.g. UZ7818R

*Voltage ratings for these Models are 39, 43, 51, 62, 68, 82, and 91 respectively.

Military Approved Zener Diodes

JAN & JANTX Part No. 1.5 Watt	JAN & JANTX Part No. 5 Watt	V nom at 1Z 1250 mV
1N4461*	1N4954*	6.8V
1N4462*	1N4955*	2.5
1N4463*	1N4956*	8.2
1N4464*	1N4957*	9.1
1N4465*	1N4958*	10
1N4466*	1N4959*	11
1N4467*	1N4960*	12
1N4468*	1N4961*	13
1N4469*	1N4962*	15
1N4470*	1N4963*	16
1N4471*	1N4964*	18
1N4472*	1N4965*	20
1N4473*	1N4966*	22
1N4474*	1N4967*	24
1N4475*	1N4968*	27
1N4476*	1N4969*	30
1N4477*	1N4970*	33
1N4478*	1N4971*	36
1N4479*	1N4972*	39
1N4480*	1N4973*	43
1N4481*	1N4974*	47
1N4482*	1N4975*	51
1N4483*	1N4976*	56
1N4484	1N4977*	62
1N4485	1N4978*	68
1N4486	1N4979*	75
1N4487	1N4980	82
1N4488	1N4981	91
1N4489	1N4982	100
	1N4983	110
	1N4984	120
	1N4985	130
	1N4986	150
	1N4987	160
	1N4988	180
	1N4989	200
	1N4990	220
	1N4991	240
	1N4992	270
	1N4993	300
	1N4994	330
	1N4995	360
	1N4996	390

*Available as JAN & JANTX

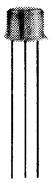
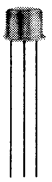
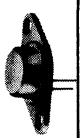
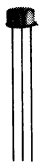
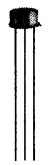
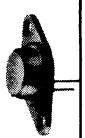
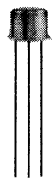
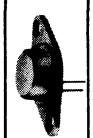
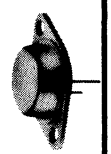
UNITRODE

INDUSTRIAL POWER SWITCHING TRANSISTORS

D.C. Collector Current	Collector Emitter Sustaining Voltage		Type		Maximum Collector Saturation Voltage	Minimum D.C. Current Gain	Typical Turn-on Time	Typical Turn-off Time	Typical Gain–Bandwidth Product
I_C	V_{CER}	V_{CEO}	Package/Power 100°C Case		$V_{CE(sat)}$	h_{FE}	t_{on}	t_{off}	f_T
A	V	V			V		ns	ns	MHz
0.5	200 250 300 350 400	150 200 250 300 300	TO-5/4W UPT011 UPT012 UPT013 UPT014 UPT015	TO-66/16W UPT021 UPT022 UPT023 UPT024 UPT025	1 @ 0.5A	10 @ 0.5A	50	400	40
1	60 80 100 120 150	40 60 80 100 120	TO-5/4W UPT111 UPT112 UPT113 UPT114 UPT115	TO-66/16W UPT121 UPT122 UPT123 UPT124 UPT125	1 @ 1A	20 @ 1A	100	250	50
2	60 80 100 120 150	40 60 80 100 120	TO-5/4W UPT211 UPT212 UPT213 UPT214 UPT215	TO-66/16W UPT221 UPT222 UPT223 UPT224 UPT225	1 @ 2A	20 @ 2A	130	300	70
	200 250 300 350 400	150 200 250 300 300	TO-5/10W UPT311 UPT312 UPT313 UPT314 UPT315	TO-66/16W UPT321 UPT322 UPT323 UPT324 UPT325	1 @ 2A	10 @ 2A	200	800	40
3	200 250 300 350 400	150 200 250 300 300	TO-3/50W UPT531 UPT532 UPT533 UPT534 UPT535	TO-66/25W UPT521 UPT522 UPT523 UPT524 UPT525	1 @ 3A	10 @ 3A	200	900	30
5	60 80 100 120 150	40 60 80 100 100	TO-5/5W UPT611 UPT612 UPT613 UPT614 UPT615	TO-66/25W UPT621 UPT622 UPT623 UPT624 UPT625	1.0 @ 5A 1.0 @ 5A 1.0 @ 5A 1.5 @ 5A 1.5 @ 5A	15 @ 5A	250	550	40
	200 250 300 350 400	150 200 250 300 300	TO-3/50W UPT731 UPT732 UPT733 UPT734 UPT735	TO-66/25W UPT721 UPT722 UPT723 UPT724 UPT725	1 @ 5A	10 @ 5A	250	800	30
10	60 80 100 120 150	40 60 80 100 100	TO-3/50W UPT831 UPT832 UPT833 UPT834 UPT835	TO-66/25W UPT821 UPT822 UPT823 UPT824 UPT825	1.0 @ 10A 1.0 @ 10A 1.0 @ 10A 1.5 @ 10A 1.5 @ 10A	20 @ 10A	250	550	60
	200 250 300 350 400	150 200 250 300 300	TO-3/70W UPT931 UPT932 UPT933 UPT934 UPT935		1.5 @ 10A	10 @ 10A	500	1200	30
15	60 80 100 120 150	40 60 80 100 100	TO-3/60W UPT1031 UPT1032 UPT1033 UPT1034 UPT1035	TO-66/30W UPT1021 UPT1022 UPT1023 UPT1024 UPT1025	1.5 @ 15A 1.5 @ 15A 1.5 @ 15A 2.0 @ 15A 2.0 @ 15A	15 @ 15A	450	350	50
20	60 80 100 120 150	40 60 80 100 100	TO-3/70W UPT1131 UPT1132 UPT1133 UPT1134 UPT1135		1.5 @ 20A	15 @ 20A	300	600	60

UNITRODE

POWER TRANSISTORS

Package	 TO-5	 TO-5	 TO-66	 Low Profile TO-5	 Low Profile TO-5	 TO-66	TO-59 TO-111*	 TO-5	 TO-66	TO-59 TO-111*†	TO-61††	TO-63	 TO-3
V_{CEO} (sust)	2A 5W	2A 15W	2A 20W	5A 5W	5A 15W	5A 20W	5A 30W	5A 15W	5A 30W	20A 30W	20A 50W	30A 100W	30A 150W
40				SSP2853 [2] SSP2854 SSP2855 SSP2856	2N2853 2N2854 2N2855 2N2856		2N3852 2N3853 SSP3852* SSP3853*						
50						2N3878							
60						SSP3050						SSP3303	SSP3301
70								2N4150 [1]					
75						2N3879							
80				SSP2848 [2] SSP2850 SSP2851 SSP2852	2N5487 [2] 2N5850 2N5851 2N5852	SSP3051	2N3850 2N3851 SSP3850* SSP3851*	2N5552 [1]		2N5658 2N5659*†	SSP3200 SSP3201††	SSP3302	SSP3300
100				SSP2849 [2]	2N5488 [2]			2N6232					
120	2N4863† SSP3020†												
150													
200		2N5662 [1]	2N5660					2N5666 [1]	2N5664				
300		2N5663 [1]	2N5661					2N5667 [1]	2N5665				

† Also available in:
TO-5 Low Profile
TO-5 Low Profile 7/16 Stud
TO-5 7/16 Stud

[1] Also available in:
TO-5 7/16 Stud

[2] Also available in:
TO-5 Low Profile 7/16 Stud
TO-5
TO-5 7/16 Stud

MILITARY APPROVED POWER TRANSISTORS

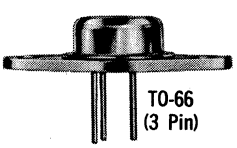
JAN & JANTX 2N2151
JAN & JANTX 2N3996-9
JAN & JANTX 2N4150
JAN & JANTX 2N5660-3
JAN & JANTX 2N5664-7

UNITRODE

POWER DARLINGTON TRANSISTORS

	Collector Current DC	Collector Current Peak	Type	Package	Power Dissipation 100°C Case	Collector Emitter Voltage	Minimum DC Current Gain	Maximum Collector Saturation Voltage	Typical Turn-on Time	Typical Turn-off Time	Typical Gain—Bandwidth Product
	I_C	I_C			P_D	V_{CER}	h_{FE}	$V_{CE(sat)}$	t_{on}	t_{off}	f_T
	A	A			W	V		V	ns	ns	MHz
NPN	2	5	U2T301 U2T401 U2T305 U2T405	TO-33* TO-66** TO-33 TO-66	4 16 4 16	60 150	1000	1.5 2.5	300 400	1000	80 70
NPN	5	10	U2T101 U2T201 U2T105 U2T205	TO-33 TO-66 TO-33 TO-66	5 25 5 25	80 150	2000 1000	1.5 2.5	400 500	1000	100 80
NPN	10	20	U2T501 U2T601 U2T505 U2T605	TO-66 TO-3† TO-66 TO-3	30 50 30 50	80 150	2000 1000	1.5 2.5	400 500	1000	100 80
PNP	2	5	U2T351 U2T451 U2T355 U2T455	TO-33 TO-66 TO-33 TO-66	4 16 4 16	60 120	1000	2.0 2.5	250 300	900	70 60
PNP	5	10	U2T151 U2T251 U2T155 U2T255	TO-33 TO-66 TO-33 TO-66	5 25 5 25	80 120	2000 1000	2.5 3.0	300 400	900	80 70

*4 Leaded TO-5
**3 Pin TO-66
†3 Pin TO-3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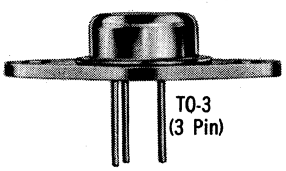
(3 Pin)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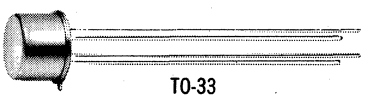
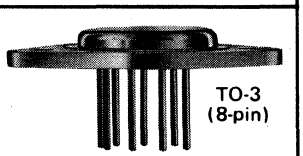
(3 Pin)


TO-33

DUAL DARLINGTON TRANSISTORS

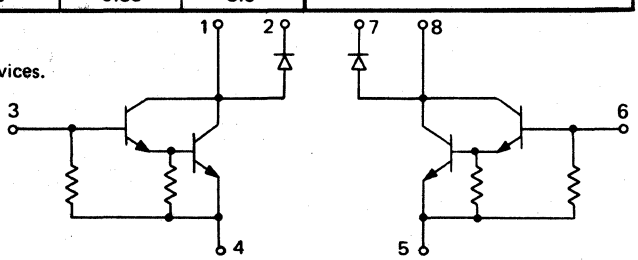
5 Amp D.C., 10 Amp Peak NPN

Type	Power Rating per Darlington 25°C Case	Minimum Operating Voltage	Minimum D.C. Current Gain 5A	Maximum Saturation Voltage 5A	Maximum Turn-on Time 5A	Maximum Turn-off Time 5A	Package
	P_D	V_{CEO}	h_{FE}	$V_{CE(sat)}$	t_{on}	t_{off}	
	W	V		V	μs	μs	
PIC500	30	100	2000	1.5	0.55	2.0	
PIC501‡	20	100	1000	2.0	0.65	3.6	
PIC502‡‡	20	80	750	2.0	0.65	3.6	


TO-3
(8-pin)

‡ Replaces DPS 1000 ‡‡ Replaces DPS2000, HC3000

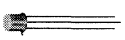
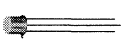
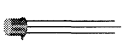
Consult factory for higher current ratings and for complementary devices.



UNITRODE

The programmable Unijunction Transistor is today's preferred device for low cost timing circuits, oscillators, sensing circuits, and a wide range of other applications where a variable voltage level threshold is desired. Functionally equivalent to standard Unijunction Transistors, Unitrode PUTs offer the superior advantage of versatile programming. External resistors can be added to meet designers' needs in programming I_P, I_V, R_{BB}, and Eta. All units are fully planar passivated and are constructed to the same high quality standards expected from all Unitrode semiconductors.

PROGRAMMABLE UNIJUNCTION TRANSISTORS (PUTs)

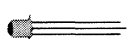
Type	V_{AK} Anode to Cathode Voltage min. (Volts)	I_P Peak Point Current max. (μA)	I_V Valley Point Current min. (μA)	V_O Pulse Output Voltage min. (Volts)	PACKAGE
¢-Line Industrial Plastic Types					
P13T1 P13T2	40 40	2 0.15	70 25	9	TO-92
2N6027 2N6028	40	2 0.15	1.5mA* 1.0mA*	6	TO-98
¢-Line Industrial Metal Can Types					
U13T1 U13T2 U13T3 U13T4	40 40 100 100	2 0.15 2 0.15	70 25 70 25	6	 TO-18
Premium Industrial Types					
2N6116 2N6117 2N6118 2N6119 2N6120	40	2 0.3 0.15 2 0.15	70 50 50 1.5mA* 1.0mA*	6 6 6 9 9	 TO-18
Military Types					
2N6137 2N6138	40 100	10 (1) 10 (1)	40 (2) 40 (2)	9	 TO-18

NOTES: (1) T=55°C (2) T=+125°C *R_G = 200Ω

LIGHT ACTIVATED SCRs

These light activated SCRs can often perform the dual role of light sensing and load actuating. Simple bias adjustment adapts for a wide variety of light sources, from ultrasensitive to well above any undesired ambient illumination. They are ideal for use in isolation switches, punched paper tape and card readers, meter position sensing, intrusion alarms, slave flashes, and a wide variety of other light sensing applications.

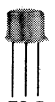
LIGHT ACTIVATED SCRs

Type	V_{FX} V_{RX} min Volts	Light trigger intensity min foot candles	Light trigger intensity max foot candles	I_{HX} max mA R_{GK} = 4.7K	Package
PR30 PR60 PR100 PR200	30 60 100 200	2	10	1	 ROUND LENS TO-18
PR30A PR60A PR100A PR200A	30 60 100 200	4	10	1	
PF30 PF60 PF100 PF200	30 60 100 200	10	50	1	FLAT LENS TO-18
PF30A PF60A PF100A PF200A	30 60 100 200	20	50	1	

UNITRODE

THYRISTORS, SILICON CONTROLLED RECTIFIERS (SCRs)

¢-line Industrial

Package	Standard Grade			High Speed		Premium Grade	
	TO-18	TO-92	 TO-5	TO-18	TO-59	TO-18	TO-5
V_{FX} V_{RX} min Volts	0.5A @ 100°C case	0.8A @ 25°C case	1.6A @ 70°C case	0.5A @ 100°C case	5.0A @ 100°C case	0.5A @ 100°C case	1.6A @ 85°C case
30	ID100	IP100 2N5060	ID600*			BA150 CB200	CD200
50			ID200 ID601*				
60	ID101	IP101 2N5061		GA300 GA300A	GB300 GB300A	AA100 AA107 AA114 BA151 CB201	AD100 AD107 AD114 CD201
100	ID102	IP102 2N5062	ID201 ID602*	GA301 GA301A	GB301 GB301A	AA101 AA108 AA115 BA152 CB202	AD101 AD108 AD115 CD202
150	ID103	IP103 2N5063	ID202 ID603*				
200	ID104	IP104 2N5064	ID203 ID604*			AA102 AA109 AA116 CB203	AD102 AD109 AD116 CD203
300			ID300 ID605*			AA103 AA110 AA117	AD103 AD110 AD117
400			ID301 ID606*			AA104 AA111 AA118	AD104 AD111 AD118

*Electrically equivalent hermetic replacement for the GE C106 with the same lead sequence.

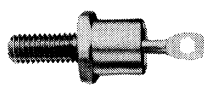
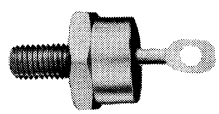
Package	Military Aerospace				Military High Speed			
	TO-18	TO-46	TO-5	TO-59	TO-18	TO-18	TO-46	TO-59
V_{FX} V_{RX} min Volts	0.5A @ 100°C case	0.5A @ 100°C case	1.6A @ 85°C case	5.0A @ 100°C case	0.4A @ 100°C case	0.5A @ 100°C case	0.5A @ 100°C case	5.0A @ 100°C case
30	2N3027 2N3030	3027-1 3030-1				2N3027 2N3030	3027-1 3030-1	
60	2N5719 2N3028 2N3031	3028-1 3031-1	2N5724	CM100	GA200 GA200A	2N3028 2N3031	3028-1 3031-1	GB200 GB200A
100	2N5720 2N3029 2N3032	3029-1 3032-1	2N5725	CM101	GA201 GA201A	2N3029 2N3032	3029-1 3032-1	GB201 GB201A
200	2N5721		2N5726	CM102				
300	2N5722		2N5727	CM103				
400	2N5723		2N5728	CM104				

MILITARY APPROVED SCRs

JAN 2N1870A JAN 2N1871A JAN 2N1872A JAN 2N1874A	JAN & JANTX 2N2323 JAN & JANTX 2N2323A JAN & JANTX 2N2324 JAN & JANTX 2324A	JAN & JANTX 2N2326 JAN & JANTX 2N2326A JAN & JANTX 2N2328 JAN & JANTX 2N2328A	JAN & JANTX 2N2329 JAN & JANTX 2N3027 JAN & JANTX 2N3028 JAN & JANTX 2N3029	JAN & JANTX 2N3030 JAN & JANTX 2N3031 JAN & JANTX 2N3032

UNITRODE

HIGH EFFICIENCY ESP RECTIFIERS

Type	Peak Inverse Voltage Per Leg	Maximum Average D.C. Output Current	Non-Repetitive Sinusoidal Surge (8.3 mS)	Maximum Forward Voltage Drop Per Leg	Maximum Leakage Current Per Leg @ PIV		Maximum Reverse Recovery Time	Package
					I_R @ 25°C	I_R @ 100°C		
	PIV V	I_O A	I_F A	V_F V @ mA	μA	μA	t_{rr} ns	
1N5802 1N5803 1N5804 1N5805 1N5806	50 75 100 125 150	2.5	35	0.875 @ 1	1	50	25	A
1N5807 1N5808 1N5809 1N5810 1N5811	50 75 100 125 150	6	125	0.875 @ 4	5	150	30	B
1N5812 1N5813 1N5814 1N5815 1N5816	50 75 100 125 150	20	250	0.900 @ 10	10	500	35	 DO-4
UES501 UES502 UES503 UES504 UES505	50 75 100 125 150	50	600	0.95 @ 50	25	1.5 mA	50	 DO-5

STANDARD RECOVERY RECTIFIERS

	General Purpose	2 Amp Series				4 Amp Series		12 Amp Series		
Package	Body A	Body A				Body B		C (Stud)		
Max. Av. D.C. output current 25°C	3/4 A	1.0 A	1.25 A	1.5 A	2.0 A	2.0 A	4.0 A	7.5 A 100°C	9.0 A 100°C	12.0 A 100°C
50	UT111					UT2005	UT4005	UT5105	UT6105	UT8105
100	UT112	UT236	UT249	UT251	UT261	UT2010	UT4010	UT5110	UT6110	UT8110
200	UT113	UT234	UT242	UT252	UT262	UT2020	UT4020	UT5120	UT6120	UT8120
225	*UT211									
300	UT114 *UT212									
400	UT115 *UT213	UT235	UT244	UT254	UT264	UT2040	UT4040	UT5140	UT6140	UT8140
500	UT117 *UT214	UT237	UT245	UT255	UT265					
600	UT118 *UT215	UT238	UT247	UT257	UT267	UT2060	UT4060	UT5160	UT6160	UT8160
800	UT119	UT361	UT362	UT258	UT268					
1000	UT120	UT347	UT363	UT364						

PIV

*Low Leakage Types

UNITRODE

HIGH SPEED RECTIFIERS — 9 Amp Series

Type‡	Peak Inverse Voltage Per Leg	Maximum Average D.C. Output Current† 100°C Case Temp.	Non-Repetitive Sinusoidal Surge (8.3 mS)	Minimum Forward Current at 1.1V 25°C	Maximum Leakage Current Per Leg @ PIV		Maximum Reverse Recovery TimeS	Package
					I_R @ 25°C	I_R @ 100°C		
	PIV V	I_o A	I_F A	A	μA	μA	t_{rr} ns	Body
UTR6405	50	9.0	150	6.0	10	300	300	C (Stud) ††
UTR6410	100						300	
UTR6420	200						400	
UTR6440	400						500	
UTR5405	50	7.5	135	5.0	10	300	300	
UTR5410	100						300	
UTR5420	200						400	
UTR5440	400						500	
UTR4405	50	6.0	120	4.0	10	300	300	
UTR4410	100						300	
UTR4420	200						400	
UTR4440	400						500	

‡Polarity is cathode to stud. For reverse polarity, use suffix "R" with part numbers, e.g. UTR 6405R.

†Rating is based on E.I.A. Standards RS.248 and RS.289 covering ratings for hex base silicon rectifiers.

§Recovery is measured from 1A to 1A, recovery to ½A. In the 1A to 30V circuit of MIL-STD-750 Method 4031, recovery times are approximately 40% of those shown in the table above.

††Also available with insulated stud at the same ratings.

HIGH SPEED RECTIFIERS — 4 Amp Series

Type	Peak Inverse Voltage Per Leg	Maximum Average D.C. Output Current 25°C Temp.	Non-Repetitive Sinusoidal Surge (8.3 mS)	Minimum Forward Current at 1.1V 25°C **	Maximum Leakage Current Per Leg @ PIV		Maximum Reverse Recovery Time *	Package
					I_R @ 25°C	I_R @ 100°C		
UTX4105	50	4.0	80	3.0	5	75	100	Body B
UTX4110	100							
UTX4115	150							
UTX4120	200							
UTX3105	50	3.0	60	2.0	5	75	100	
UTX3110	100							
UTX3115	150							
UTX3120	200							

*Measured in a reverse recovery circuit switching from 1A forward current to 1A reverse current recovery to ½A.

**Forward voltage drop is measured at least 1 sec after application of current.

MILITARY APPROVED RECTIFIERS

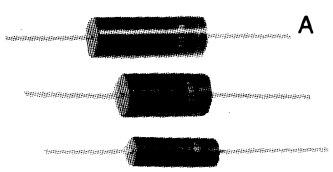
General Purpose — 1 Amp Types JAN & JANTX 1N4245, 46, 47	**Fast Recovery — 1 Amp Types** JAN & JANTX 1N4942, 44, 46
General Purpose — 2 Amp Types JAN & JANTX 1N3611, 12, 13, 14	**Fast Recovery — 3 Amp Types** JAN & JANTX 1N5186, 87, 88, 90
General Purpose — 3 Amp Types JAN & JANTX 1N5550, 1, 2, 3	

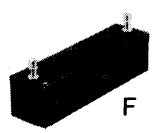
UNITRODE

HIGH VOLTAGE STACKS

Output Current Amperes	VOLTAGE																			
	1200	1500	1800	2000	2500	3000	3500	4000	4500	5000	6000	7000	7500	8000	10,000	12,000	15,000	18,000	20,000	25,000
.25	—	—	—	—	—	—	—	—	—	USR50A I	US60A I USR60A I	US70A I USR70A I	—	US80A I USR80A I	US100A I USR100A I	US120A I USR120A I	US150A I USR150A I	US180A I USR180A I	688-20 F US200A I	688-25 F
.25-.5	—	—	—	—	USR25	USR30 A	US35 A USR35 A	US40 A USR40A I	US45A I USR45A I	US50A I	—	—	UFS7.5-C USS7.5-C UFB7.5-C	—	USB10-C UFS10-C USS10-C	688-12 F	USS15-C UDC15-J 688-15-F	688-18 F	—	—
.5-.75	—	—	US18 A USR18 A	US20 A USR20 A	US25 A	US30 A	—	—	—	USB5-C UFS5-C USS5-C UFB5-C	—	—	USB7.5 C	—	688-10 F UDC10 J	—	UDA15 J	—	—	—
.75 1.0	—	US15 A USR15 A	—	—	UFB2.5 C	—	—	—	—	—	—	—	UDC7.5 J UDD7.5 J	—	UDA10 J	—	—	—	—	—
1.0-1.5	US12 A USR12 A	—	—	—	USB2.5 C	—	—	—	—	UDC5 J UDD5 J	—	—	UDA7.5 J UDB7.5 J	—	—	—	—	—	—	—
1.5-2.0	—	—	—	—	—	—	—	—	—	UDA5 J UDB5 J	—	—	—	—	UGD10 J	—	—	—	—	—
2.0-2.5	—	—	—	—	UDD2.5 J	—	—	—	—	—	—	—	UGD7.5 J UGF7.5 J	—	UGB10 J	—	—	—	—	—
2.5-3.0	—	—	—	—	UDB2.5 J	—	—	—	—	—	—	—	UGB7.5 J	—	—	—	—	—	—	—
3.0-4.0	—	—	—	—	—	—	—	—	—	UGD5-J UGF5-J UDF5-J	—	—	UGE7.5 J	—	—	—	—	—	—	—
4.0 5.0	—	—	—	—	UDF2.5 J	—	—	—	—	UGB5-J UDE5-J UGE5-7	—	—	—	—	—	—	—	—	—	—
5.0-6.0	—	—	—	—	UDE2.5 J UGF2.5 J	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.0 7.0	—	—	—	—	UGE2.5 J	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

NOTE: READ type numbers and package code letters under appropriate output current. **SEE** package illustrations below at proper code letter.





UNITRODE

SINGLE PHASE FULL WAVE BRIDGES

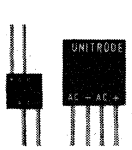
Output Current Amperes	VOLTAGE															
	100	200	300	400	500	600	1200	1800	2400	2500	3000	3600	4000	4200	4800	5000	7000
.250	—	—	—	—	—	—	—	—	—	—	676-30 B	673-9 676-36 B	—	673-10 676-42 B	673-11 676-48 B	673-12 686-5 676-50 B	—
.25-.5	—	—	—	—	—	—	673-12 B	673-75 676-18 B	673-8 676-24 B	—	673-85 B	—	—	—	—	686-5 F	686-7 F
.5-.75	—	—	—	—	—	—	673-7 B	—	—	—	—	—	686-4 F	—	—	—	—
.75-1.0	676-1 677-2 B	676-2 677-4 B	676-3 B	676-4 B	676-5 B	676-6 B	—	—	—	686-2.5 F	—	—	—	—	—	—	—
1.0-1.5	673-1 B	673-2 B	673-3 B	673-4 B	673-5 B	673-6 B	—	—	—	—	—	—	—	—	—	—	—
1.5-2.5	697-1 698-1 B	697-2 698-2 B	697-3 698-3 B	697-4 698-4 B	697-5 698-5 B	697-6 698-6 B	—	—	—	—	—	—	—	—	—	—	—
2.5-5.0	694-1 H	694-2 H	694-3 H	694-4 H	694-5 H	694-6 H	—	—	—	—	—	—	—	—	—	—	—
5.0-7.5	693-1 H	693-2 H	693-3 H	693-4 H	693-5 H	693-6 H	—	—	—	—	—	—	—	—	—	—	—
7.5-10	680-1 684-1 E	680-2 684-2 E	680-3 684-3 E	680-4 684-4 E	680-5 684-5 E	680-6 684-6 E	—	—	—	—	—	—	—	—	—	—	—
10-25	679-1 683-1 E	679-2 683-2 E	679-3 683-3 E	679-4 683-4 E	679-5 683-5 E	679-6 683-6 E	—	—	—	—	—	—	—	—	—	—	—

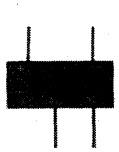
NOTE: READ type numbers and package code letters under appropriate output current. **SEE** package illustrations below at proper code letter.

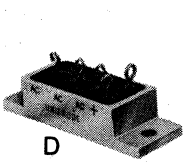
THREE PHASE FULL WAVE BRIDGES

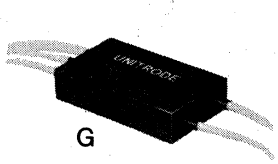
Output Current Amperes	VOLTAGE														
	100	200	300	400	500	600	2500	3000	4000	5000	7000	8000	10,000	12,000	15,000
.5	—	—	—	—	—	—	—	—	—	—	685-7 F	690-8 G	690-10 G	690-12 G	690-15 G
.5-1.0	—	—	—	—	—	—	685-2.5 F	685-3 F	685-4 F	685-5 F	—	—	—	—	—
1.0-2.5	700-1 701-1 K	700-2 701-2 K	700-3 701-3 K	700-4 701-4 K	700-5 701-5 K	700-6 701-6 K	—	—	—	—	—	—	—	—	—
2.5-3.5	692-1 H	692-2 H	692-3 H	692-4 H	692-5 H	692-6 H	—	—	—	—	—	—	—	—	—
3.5-4.5	691-1 H	691-2 H	691-3 H	691-4 H	691-5 H	691-6 H	—	—	—	—	—	—	—	—	—
4.5-15	696-1 D	696-2 D	696-3 D	696-4 D	696-5 D	696-6 D	—	—	—	—	—	—	—	—	—
15-20	682-1 D	682-2 D	682-3 D	682-4 D	682-5 D	682-6 D	—	—	—	—	—	—	—	—	—
20-25	678-1 D	678-2 D	678-3 D	678-4 D	678-5 D	678-6 D	—	—	—	—	—	—	—	—	—

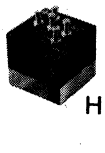
NOTE: READ type numbers and package code letters under appropriate output current. **SEE** package illustrations below at proper code letter.

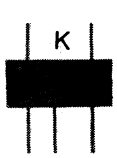












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1973-74

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EEM contains four complete directories which provide the most up-to-date information available. These directories are listed and described at the right. They appear in all three volumes, with the exception of the Trade Mark Directory which appears only in Volume 1. Directory references to Volume 4 indicate the 1973 edition, which you received in January. That copy of Volume 4 should be retained to complete the 4-volume set.

Add Volume 4/1973 to your copies of Volumes 1, 2 and 3 to make a complete set of **EEM** for 1973-74.

UNITED TECHNICAL PUBLICATIONS

Included in this volume are:

The Product Index and Directory

The Product Index and Directory (green section, page 9) lists more than 6,000 types of electronic products alphabetically, by product. Under each product heading is a complete, alphabetical listing of manufacturers who make that product. **Bold face** listings indicate which manufacturers have provided catalog data on that product in the white pages.

The Manufacturers and Sales Office Directory

The Manufacturers and Sales Office Directory (starts yellow section of each volume) lists more than 3,000 manufacturers of electronic components, materials, instruments, assemblies, systems, and key services. Provided are complete addresses, phone numbers, sales managers' names, names of application engineers, TWX numbers where applicable, selected distributors. **Bold face** listings indicate that manufacturers have provided catalog data in the white pages and that sales offices are listed.

The Distributor Directory

The Distributor Directory (yellow section, page 1594, with black edge marking) lists more than 1,000 electronic distributors and branch locations, alphabetically by distributor's name, geographically by state and city.

Need catalog information?

For complete catalog information on any product, refer to the Product Index and Directory (green section, page 9, all volumes) which provides a complete listing of all the manufacturers who supply a particular product. Those manufacturers listed in bold face with page and volume number references have provided catalog data on this product in the catalog section (white pages) where you can find the information you need. References to Volume 4 indicate the Volume 4 you received in January and which should be retained to complete your 4-volume set of EEM.

Need additional information in a hurry?

Two special telephone services are being maintained for EEM users to provide extra information you need. If you need to determine a local source of supply, just **D.I.A.L. EEM.** This toll-free service (**D**istributor **I**nformation **A**nd **L**istings), provides you with the name of a sales office or distributor in your area who can provide a needed product.
For up-to-the-minute listings of manufacturers who provide certain IC functions, **call the IC UPDATE HOTLINE.** Listings of IC functions are updated daily by manufacturers throughout the country. For information in a hurry, **just D.I.A.L. EEM** — call toll-free 800-645-9200 (in N. Y. State call collect (516) 294-0990). Or **call The IC UPDATE HOTLINE,** Dial toll-free 800-645-9201.

Need additional assistance?

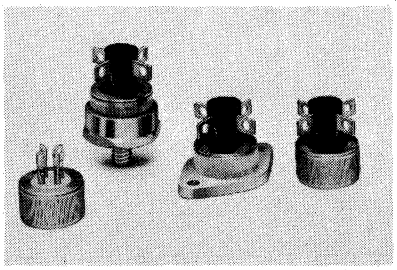
Contact the EEM editorial staff, at United Technical Publications, Inc., 645 Stewart Avenue, Garden City, N. Y. 11530, or phone (516) 248-9700.

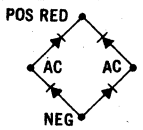
VARO SEMICONDUCTOR, INC.

VARO

IBR® SILICON INTEGRATED BRIDGE RECTIFIERS

CONTROLLED AVALANCHE TYPES WITH 250V, 450V, & 650V MIN AVALANCHE VOLTAGE
FAST RECOVERY TYPES WITH 200 NANOSECONDS RECOVERY TIME





ELECTRICALLY INSULATED CASE/FULL RATED DC OUTPUT TO 100°C CASE TEMPERATURE

VARO Integrated Bridge Rectifiers offer single-phase full-wave rectification in rigidly constructed, welded packages.

The specified minimum and maximum avalanche characteristics of controlled avalanche types permit selection of decreased PRV safety factors in design considerations without greatly reduced transient voltage vulnerability. The avalanche characteristics insure that the avalanche voltages in the IBR® occur below the point that would degrade or destroy the junction perimeter under transient overvoltage conditions.

The 200 nanoseconds recovery time permits operation of fast recovery types in such high-frequency applications as ultrasonic systems, choppers, inverters, power supplies and low RF interference applications.

Proper heat sinking allows great flexibility in DC output current range. This feature, coupled with the electrically insulated case (insulation strength of 2000 volts minimum) allows the IBR® to be used in many applications where space, current, and cost requirements have not allowed the application of semiconductors.

MAXIMUM RATINGS (60 HZ RESISTIVE AND INDUCTIVE LOAD)

Part No.	Peak Inverse Voltage DC Blocking Voltage V_R	Operating and Storage Temperature Range	Average DC Output at 100°C Case Temp. I_O (1)	Peak 1 Cycle Forward Surge Current I_{FSM}	Avalanche Power Dissipation (100 μsec Sq. Wave)
	Volts	°C	Amps	Amps	Watts
10 AMP CONTROLLED AVALANCHE FULL WAVE BRIDGE					
1N4436	200	−65 to +160	10	100	600
1N4437	400	−65 to +160	10	100	600
1N4438	600	−65 to +160	10	100	600
10 AMP FAST RECOVERY FULL WAVE BRIDGE (3)					
VR100X	100	−65 to +150	10	75	NA
VR200X	200	−65 to +150	10	75	NA
VR400X	400	−65 to +150	10	75	NA
25 AMP CONTROLLED AVALANCHE FULL WAVE BRIDGE					
VT200	200	−65 to +180	25	250	1500
VT400	400	−65 to +180	25	250	1500
VT600	600	−65 to +180	25	250	1500
25 AMP FAST RECOVERY FULL WAVE BRIDGE (3)					
VY100X	100	−65 to +150	25	150	NA
VY200X	200	−65 to +150	25	150	NA
VY400X	400	−65 to +150	25	150	NA

ELECTRICAL CHARACTERISTICS AT Tc = 25°C (UNLESS OTHERWISE SPECIFIED)

Part No.	Avalanche Voltage V_{BR} Min.	Avalanche Voltage V_{BR} Max.	Reverse Recovery Time t_{rr} (2)	Maximum DC Reverse Current I_{RM} @ PIV and indicated Tc	Maximum Forward Voltage Drop @ I_O (Instantaneous) V_{FM}	Maximum Thermal Resistance Junction to Case $R\theta_{JC}$	Write for Data Sheet No.	PRICING*	
	Volts	Volts	Nanosecs	Milliamps/Leg	Volts/Leg	°C/Watt		1-99	100-999
10 AMP CONTROLLED AVALANCHE FULL WAVE BRIDGE									
1N4436	250	500	NA	0.2 at 160°C	1.3	1.5	DLS022	$4.15	$3.05
1N4437	450	700	NA	0.2 at 160°C	1.3	1.5	DLS022	5.45	4.00
1N4438	650	900	NA	0.2 at 160°C	1.3	1.5	DLS022	7.45	5.45
10 AMP FAST RECOVERY FULL WAVE BRIDGE (3)									
VR100X	NA	NA	200	5 at 150°C	1.5	1.5	DLS024	6.30	5.05
VR200X	NA	NA	200	5 at 150°C	1.5	1.5	DLS024	7.45	5.95
VR400X	NA	NA	200	5 at 150°C	1.5	1.5	DLS024	10.90	8.00
25 AMP CONTROLLED AVALANCHE FULL WAVE BRIDGE									
VT200	250	700	NA	5 at 180°C	1.5	1.0	DLS025	5.35	3.95
VT400	450	900	NA	5 at 180°C	1.5	1.0	DLS025	7.00	5.30
VT600	650	1100	NA	5 at 180°C	1.5	1.0	DLS025	9.85	7.10
25 AMP FAST RECOVERY FULL WAVE BRIDGE (3)									
VY100X	NA	NA	200	5 at 150°C	1.8	1.0	DLS032	8.16	6.54
VY200X	NA	NA	200	5 at 150°C	1.8	1.0	DLS032	9.60	7.70
VY400X	NA	NA	200	5 at 150°C	1.8	1.0	DLS032	14.00	10.60

NOTES: (1) Case temperature is measured on the bottom of the case within 0.125 inches of center. *Also see mounting Adapter Price Adders.
(2) At I_F = 1 Amp, I_R = 2 Amps max. Recovery to I_R = .5 Amp.
(3) For V_{RM} (Non-Repetitive) add 20% to device V_R.

VARO SEMICONDUCTOR, INC. INC. P. O. BOX 676, 1000 NORTH SHILOH, GARLAND, TEXAS 75040, (214) 272-4551, TWX 910-860-5178

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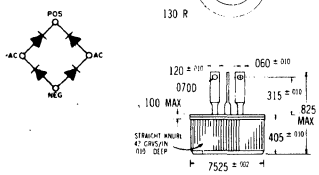
IBR®

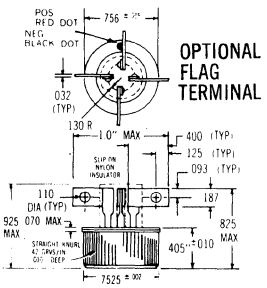
SILICON INTEGRATED BRIDGE RECTIFIERS

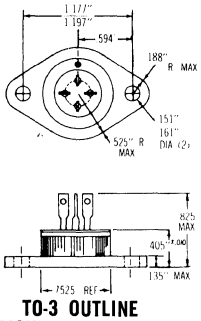
CONTROLLED AVALANCHE TYPES WITH 250V, 450V, & 650V MIN AVALANCHE VOLTAGE
FAST RECOVERY TYPES WITH 200 NANOSECONDS RECOVERY TIME

TYPICAL CASE STYLES

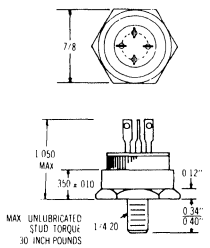


PRESS MOUNTING (Standard)





TO-3 OUTLINE MOUNTING FLANGE (Optional)



SINGLE STUD (Optional)

TO ORDER OPTIONAL TERMINALS OR MOUNTS:

FLAG TERMINALS: ADD "/F" TO PART NO. (STANDARD ON 25 AMP DEVICES)
TO-3 MOUNT: ADD "/T" TO PART NO.
SINGLE STUD MOUNT: ADD "/S" TO PART NO.

MOUNTING ADAPTOR PRICE ADDERS (Factory Installed)

TYPE	1-99	100-999
TO-3	0.25	0.20
STUD	0.40	0.30

Flag terminals standard on 25 Amp devices; optional at no extra charge on 10 Amp devices. Specify by adding "/F" to part number.

OTHER CIRCUITS AVAILABLE IN ABOVE CASE STYLES

Fig.	Type
A	Center Tap Common Cathode
B	Center Tap Common Anode
C	Three Phase Common Cathode
D	Three Phase Common Anode
E	Doubler
F	Tripler
G	Quadrupler
H	Three Phase, Full Wave Bridge*

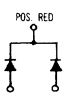


Fig. A

Fig. B

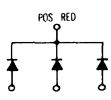


Fig. C

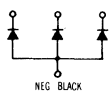


Fig. D

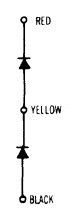


Fig. E

Fig. F

Fig. G

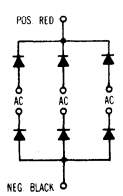
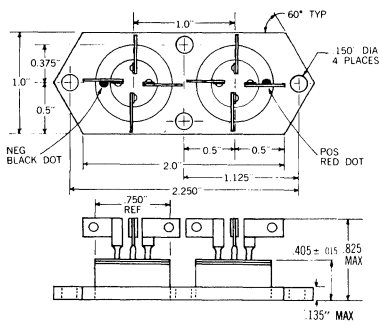


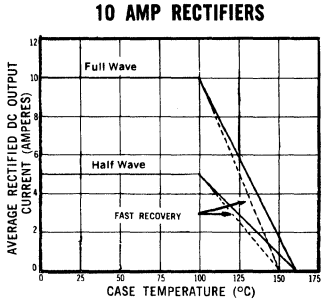
Fig. H



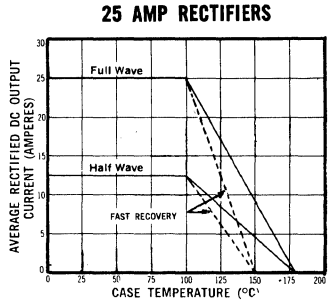
*** CASE STYLE FOR THREE PHASE, FULL WAVE BRIDGE**

DERATING CURVES/MAXIMUM ALLOWABLE DC OUTPUT CURRENT

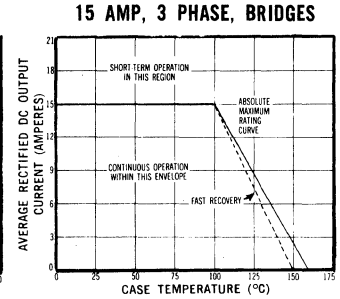
10 AMP RECTIFIERS



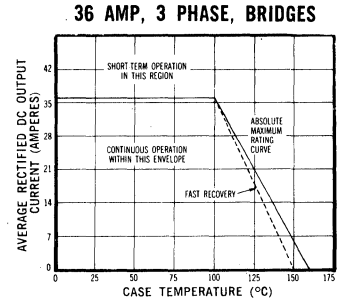
25 AMP RECTIFIERS



15 AMP, 3 PHASE, BRIDGES



36 AMP, 3 PHASE, BRIDGES



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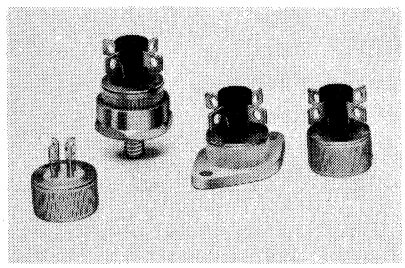
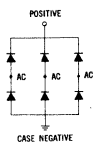
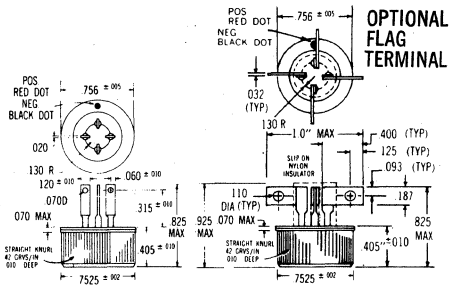
SILICON INTEGRATED BRIDGE RECTIFIERS

15 AMP & 36 AMP — 3 PHASE FULL WAVE
CONTROLLED AVALANCHE TYPES WITH 250V, 450V, & 650V MIN AVALANCHE VOLTAGE
FAST RECOVERY TYPES WITH 200 NANOSECONDS RECOVERY TIME

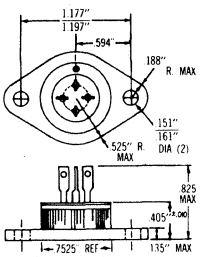
DC NEGATIVE TO CASE/FULL RATED DC OUTPUT TO 100°C CASE TEMPERATURE



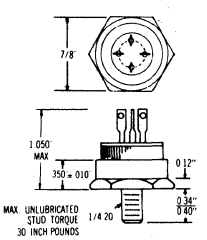




PRESS MOUNTING (Standard)



TO-3 OUTLINE MOUNTING FLANGE (Optional)



SINGLE STUD (Optional)

TO ORDER OPTIONAL TERMINALS OR MOUNTS:
FLAG TERMINALS: ADD "/F" TO PART NO. (STANDARD ON 36 AMP DEVICES)
TO-3 MOUNT: ADD "/T" TO PART NO.
SINGLE STUD MOUNT: ADD "/S" TO PART NO.

MAXIMUM RATINGS (60 Hz RESISTIVE AND INDUCTIVE LOAD)

Part No.	Peak Inverse Voltage DC Blocking Voltage V_R	Operating and Storage Temperature Range	Average DC Output at 100°C Case Temp. I_O[1]	Peak 1 Cycle Forward Surge Current I_{FSM}	Avalanche Power Dissipation (100 μsec Sq. Wave)
	Volts	°C	Amps	Amps	Watts
15 AMP CONTROLLED AVALANCHE THREE PHASE FULL WAVE BRIDGE					
R602	200	−65 to +160	15	100	600
R604	400	−65 to +160	15	100	600
R606	600	−65 to +160	15	100	600
15 AMP FAST RECOVERY THREE PHASE FULL WAVE BRIDGE[3]					
R611X	100	−65 to +150	15	75	NA
R612X	200	−65 to +150	15	75	NA
R614X	400	−65 to +150	15	75	NA
36 AMP CONTROLLED AVALANCHE THREE PHASE FULL WAVE BRIDGE					
R622	200	−65 to +160	36	250	1500
R624	400	−65 to +160	36	250	1500
R626	600	−65 to +160	36	250	1500
36 AMP FAST RECOVERY THREE PHASE FULL WAVE BRIDGE[3]					
R631X	100	−65 to +150	36	150	NA
R632X	200	−65 to +150	36	150	NA
R634X	400	−65 to +150	36	150	NA

ELECTRICAL CHARACTERISTICS AT Tc = 25°C (UNLESS OTHERWISE SPECIFIED)

Part No.	Avalanche Voltage V_{BR} Min.	Avalanche Voltage V_{BR} Max.	Reverse Recovery Time t_{rr}[2]	Maximum DC Reverse Current I_{RM} @ PIV and Indicated Tc	Maximum Forward Voltage Drop @ I_O (Instantaneous) V_{FM}	Maximum Thermal Resistance Junction to Case $R_{\theta JC}$	Write for Data Sheet No.	PRICING*	
	Volts	Volts	Nanosecs	Milliamps/Leg	Volts/Leg	°C/Watt		1-99	100-999
15 AMP CONTROLLED AVALANCHE THREE PHASE FULL WAVE BRIDGE									
R602	250	500	NA	0.2 at 160°C	1.3	1.0	DLS035	$5.15	$3.95
R604	450	700	NA	0.2 at 160°C	1.3	1.0	DLS035	6.60	5.10
R606	650	900	NA	0.2 at 160°C	1.3	1.0	DLS035	9.20	7.15
15 AMP FAST RECOVERY THREE PHASE FULL WAVE BRIDGE									
R611X	NA	NA	200	5 at 150°C	1.5	1.0	DLS035	7.70	5.92
R612X	NA	NA	200	5 at 150°C	1.5	1.0	DLS035	9.30	7.12
R614X	NA	NA	200	5 at 150°C	1.5	1.0	DLS035	11.85	9.18
36 AMP CONTROLLED AVALANCHE THREE PHASE FULL WAVE BRIDGE									
R622	250	700	NA	5 at 180°C	1.5	.75	DLS036	6.50	4.90
R624	450	900	NA	5 at 180°C	1.5	.75	DLS036	8.40	6.35
R626	650	1100	NA	5 at 180°C	1.5	.75	DLS036	11.80	8.85
36 AMP FAST RECOVERY THREE PHASE FULL WAVE BRIDGE									
R631X	NA	NA	200	5 at 150°C	1.8	.75	DLS036	9.75	7.35
R632X	NA	NA	200	5 at 150°C	1.8	.75	DLS036	11.65	8.80
R634X	NA	NA	200	5 at 150°C	1.8	.75	DLS036	15.10	11.45

NOTES: [1] Case temperature (T_C) is measured on the bottom of the case within 0.125 inches of center. *Also see mounting Adapter Price Adders.
[2] At I_F = 1 Amp, I_R = 2 Amps max. Recovery to I_R = .5 Amp.
[3] For V_{RM} (Non-Repetitive) add 20% to device V_R.

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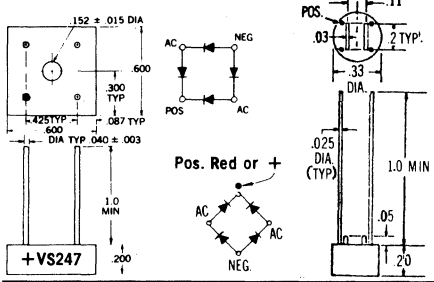
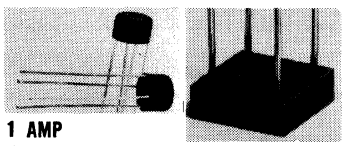
VARO SEMICONDUCTOR, INC.

VARO

EBR EPOXY BRIDGE RECTIFIERS 1 AMP, 2 AMP, 6 AMP





1 AMP

VE 27-47-67: CONTROLLED AVALANCHE EBR
VE 18-28-48-68: NON-CONTROLLED AVALANCHE EBR
VE 18X-28X-48X: FAST RECOVERY TIME EBR

2 AMP

VS 247-447-647: CONTROLLED AVALANCHE EBR
VS 148-248-448-648: NON-CONTROLLED AVALANCHE EBR
VS 148X-248X-448X: FAST RECOVERY TIME EBR

6 AMP

VH 247-447-647: CONTROLLED AVALANCHE EBR
VH 148-248-448-648: NON-CONTROLLED AVALANCHE EBR

Controlled Avalanche Series with 250 V, 450 V and 650 V Minimum Avalanche Ratings.

Non-controlled Avalanche Series with 100 V, 200 V, 400 V and 600 V PRV Ratings.

Fast Recovery Series with 200 nanosec. Reverse Recovery Time in 100 V, 200 V and 400 V PRV Ratings.

2000 V Minimum Circuit to Case Insulation. (2 Amp. & 6 Amp Only).

MAXIMUM RATINGS

Part No.	Peak Inverse Voltage DC Blocking Voltage V_{BR} Volts	Working Voltage $V_{R(RMS)}$ Volts	Average DC Output Current I_O at Indicated T_A Amps	Peak 1 Cycle Forward Surge Current I_{FSM} Amps	Avalanche Power Dissipation (100 μsec Sq. Wave) Watts
1 AMP CONTROLLED AVALANCHE					
VE27	200	140	1 at 65°C	25	200
VE47	400	280	1 at 65°C	25	200
VE67	600	420	1 at 65°C	25	200
1 AMP NON-CONTROLLED AVALANCHE					
W110	25	17	1 at 65°C	25	NA
W111	50	35	1 at 65°C	25	NA
VE18	100	70	1 at 65°C	25	NA
VE28	200	140	1 at 65°C	25	NA
VE48	400	280	1 at 65°C	25	NA
VE68	600	420	1 at 65°C	25	NA
1 AMP FAST RECOVERY					
VE18X	100	70	1 at 40°C	25	NA
VE28X	200	140	1 at 40°C	25	NA
VE48X	400	280	1 at 40°C	25	NA
2 AMP CONTROLLED AVALANCHE					
VS247	200	140	2 at 60°C	50	300
VS447	400	280	2 at 60°C	50	300
VS647	600	420	2 at 60°C	50	300
2 AMP NON-CONTROLLED AVALANCHE					
VS148	100	70	2 at 60°C	50	NA
VS248	200	140	2 at 60°C	50	NA
VS448	400	280	2 at 60°C	50	NA
VS648	600	420	2 at 60°C	50	NA
2 AMP FAST RECOVERY					
VS148X	100	70	2 at 45°C	35	NA
VS248X	200	140	2 at 45°C	35	NA
VS448X	400	280	2 at 45°C	35	NA
6 AMP[2] CONTROLLED AVALANCHE					
VH247	200	140	6 at T_{HS} = 80°C	100	400
VH447	400	280	6 at T_{HS} = 80°C	100	400
VH647	600	420	6 at T_{HS} = 80°C	100	400
6 AMP[2] NON-CONTROLLED AVALANCHE					
VH148	100	70	6 at T_{HS} = 80°C	100	NA
VH248	200	140	6 at T_{HS} = 80°C	100	NA
VH448	400	280	6 at T_{HS} = 80°C	100	NA
VH648	600	420	6 at T_{HS} = 80°C	100	NA

ELECTRICAL CHARACTERISTICS T_A = 25°C (UNLESS OTHERWISE SPECIFIED)

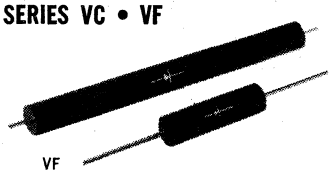
Part No.	Avalanche Voltage V_{BR} Min. Volts	Avalanche Voltage V_{BR} Max. Volts	Reverse Recovery Time t_{rr}[1] Nanosecs	Maximum Reverse Current At Rated V_R T_A = 150°C Milliamps/Leg	Maximum Reverse Current At Rated V_R T_A = 40°C Microamps/Leg	Maximum Forward Voltage Drop @ I_O Volts/Leg	Operating and Storage Temperature Range °C	Write for Data Sheet No.	PRICING 1-99	PRICING 100-999
1 AMP CONTROLLED AVALANCHE										
VE27	250	700	NA	0.1	5	1.2	−50 to +150	DLS028	$1.20	$1.10
VE47	450	900	NA	0.1	5	1.2	−50 to +150	DLS028	1.30	1.20
VE67	650	1100	NA	0.1	5	1.2	−50 to +150	DLS028	1.59	1.45
1 AMP NON-CONTROLLED AVALANCHE										
W110	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	.90	.81
W111	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	.95	.85
VE18	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	1.00	.90
VE28	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	1.10	1.00
VE48	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	1.20	1.10
VE68	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS028	1.49	1.35
1 AMP FAST RECOVERY										
VE18X	NA	NA	200	NA	10	1.5	−50 to +125	DLS028	1.49	1.35
VE28X	NA	NA	200	NA	10	1.5	−50 to +125	DLS028	1.65	1.50
VE48X	NA	NA	200	NA	10	1.5	−50 to +125	DLS028	1.80	1.65
2 AMP CONTROLLED AVALANCHE										
VS247	250	700	NA	0.1	5	1.2	−50 to +150	DLS021	1.20	1.10
VS447	450	900	NA	0.1	5	1.2	−50 to +150	DLS021	1.30	1.20
VS647	650	1100	NA	0.1	5	1.2	−50 to +150	DLS021	1.60	1.50
2 AMP NON-CONTROLLED AVALANCHE										
VS148	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS021	1.00	.90
VS248	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS021	1.10	1.00
VS448	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS021	1.20	1.10
VS648	NA	NA	NA	0.1	5	1.2	−50 to +150	DLS021	1.50	1.40
2 AMP FAST RECOVERY										
VS148X	NA	NA	200	NA	10	1.5	−50 to +135	DLS021	1.65	1.50
VS248X	NA	NA	200	NA	10	1.5	−50 to +135	DLS021	1.81	1.65
VS448X	NA	NA	200	NA	10	1.5	−50 to +135	DLS021	1.98	1.81
6 AMP[1] CONTROLLED AVALANCHE										
VH247	250	700	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.25	1.85
VH447	450	900	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.59	2.13
VH647	650	1100	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.98	2.45
6 AMP[2] NON-CONTROLLED AVALANCHE										
VH148	NA	NA	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	1.93	1.58
VH248	NA	NA	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.15	1.75
VH448	NA	NA	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.49	2.03
VH648	NA	NA	NA	0.1	5	1.2 at 2 Amps	−50 to +150	DLS029	2.88	2.35

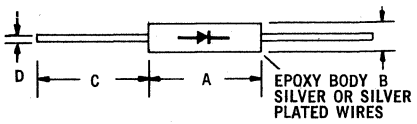
NOTES: [1] At I_F = 1 Amp, I_R = 2 Amps max. Recovery to I_R =.
[2] Mounted to heat sink as shown in Figure 1.

VARO SEMICONDUCTOR, INC.

HIGH VOLTAGE DIFFUSED SILICON POWER RECTIFIERS

SERIES VC • VF

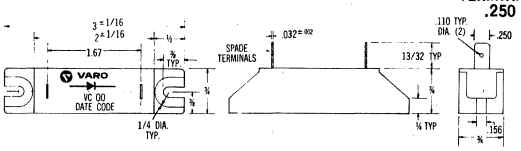




Case Style	A Pkg. Length	B Dia.	C Min. Wire Length	D Nominal Wire Dia.
VF (A)	1.000	.250	1.500	.032
(B)*	2.000	.300	1.500	.032
(C)*	3.000	.300	1.500	.032

*Ferrule End Caps Available.

SPADE TERMINALS .250



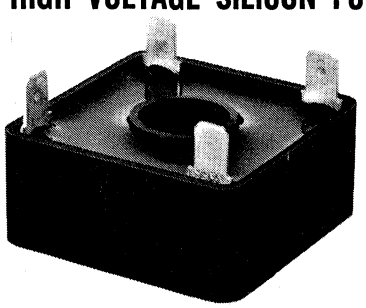
VC

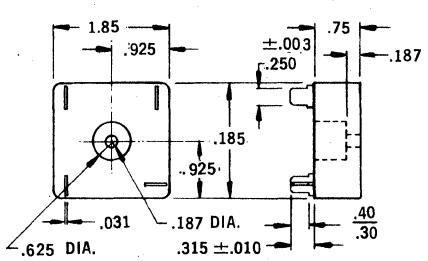
SERIES VC

Part No.	Peak Inverse Voltage PIV (Volts)	Avg. Fwd. Current Io @ 40°C (Amps)	Max. Fwd. Voltage Drop @ 25°C & Io V_{FM} (Volts)	PRICING 1-99	100-999
VC20	2,000	2	4	$5.20	$4.00
VC30	3,000	2	4	5.52	4.25
VC40	4,000	2	4	5.85	4.50
VC50	5,000	1.5	6	6.18	4.75
VC60	6,000	1.5	6	6.50	5.00
VC70	7,000	1.5	8	6.82	5.25
VC80	8,000	1	8	7.15	5.50
VC20X	2,000	2	4.8	5.98	4.60
VC30X	3,000	2	7.2	6.34	4.88
VC40X	4,000	2	9.6	6.72	5.17
VC50X	5,000	1.5	12.0	7.10	5.45
VC60X	6,000	1.5	14.4	7.47	5.75
VC70X	7,000	1.5	14.4	7.85	6.03
VC80X	8,000	1	16.8	8.22	6.32

NOTES:
1. Suffix (X) denotes Fast Recovery Series.
2. Maximum lead and terminal temperature for soldering, ⅜ inch from case, 5 seconds at 250°C.
3. If operated over 10,000 V/inch in length, devices should be immersed in oil or re-encapsulated.

HIGH VOLTAGE SILICON FULL WAVE BRIDGES





Terminals are standard .250 spade

SPECIFICATIONS

I_{FSM} Peak Surge Current, ½ Cycle @ 60 Hz	20 Amps
Storage Temperature Range	−30°C to 150°C
Operating Temperature Range	−30°C to 100°C

Part No.	PRV (KV)	Avg. Fwd. Current, Io @ T_A = 50°C (mA)	PRICING 1-99	100-999
H439	2	1500	$7.62	$6.35
H440	4	650	8.28	6.90
H441	6	650	8.98	7.48
H442	8	500	9.43	7.86
H443	10	500	9.79	8.16

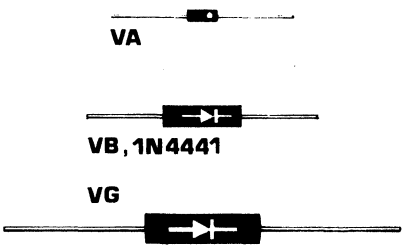
SERIES VF

Part No.	Peak Inverse Voltage PIV (KV)	Max. Fwd. Voltage Drop @ 25°C and Io V_{FM} (Volts)	Case Style	Avg. Fwd. Current Io @ 40°C (mA)	PRICING 1-99	100-999
VF5-5	5	12	A	5	$1.60	$1.08
VF5-7	7	12	A	5	1.71	1.15
VF5-10	10	18	A	5	1.96	1.32
VF5-12	12	18	A	5	2.22	1.49
VF5-15	15	35	B	5	2.30	1.55
VF5-20	20	35	B	5	2.97	2.00
VF5-25	25	35	B	5	3.72	2.50
VF5-30	30	50	C	5	4.46	3.00
VF5-40	40	50	C	5	5.95	4.00
VF5-5X	5	15	A	5	1.77	1.19
VF5-7X	7	15	A	5	1.89	1.27
VF5-10X	10	30	A	5	2.16	1.45
VF5-12X	12	30	A	5	2.44	1.64
VF5-15X	15	60	B	5	2.54	1.71
VF5-20X	20	60	B	5	3.27	2.20
VF5-25X	25	60	B	5	4.09	2.75
VF5-30X	30	90	C	5	4.91	3.30
VF5-40X	40	90	C	5	6.54	4.40
VF10-5	5	12	A	10	1.77	1.50
VF10-7	7	12	A	10	1.89	1.60
VF10-10	10	18	A	10	2.16	1.83
VF10-12	12	18	A	10	2.44	2.07
VF10-15	15	35	B	10	2.54	2.15
VF10-20	20	35	B	10	3.27	2.77
VF10-25	25	35	B	10	4.09	3.47
VF10-30	30	50	C	10	4.91	4.16
VF10-40	40	50	C	10	6.54	5.54
VF10-5X	5	15	A	10	1.95	1.65
VF10-7X	7	15	A	10	2.08	1.76
VF10-10X	10	30	A	10	2.38	2.02
VF10-12X	12	30	A	10	2.68	2.27
VF10-15X	15	60	B	10	2.80	2.37
VF10-20X	20	60	B	10	3.60	3.05
VF10-25X	25	60	B	10	4.51	3.82
VF10-30X	30	90	C	10	5.39	4.57
VF10-40X	40	90	C	10	7.20	6.10
VF25-5	5	12	A	25	1.95	1.65
VF25-7	7	12	A	25	2.08	1.76
VF25-10	10	18	A	25	2.38	2.02
VF25-12	12	18	A	25	2.68	2.27
VF25-15	15	35	B	25	2.80	2.37
VF25-20	20	35	B	25	3.60	3.05
VF25-25	25	35	B	25	4.51	3.82
VF25-30	30	50	C	25	5.39	4.57
VF25-40	40	50	C	25	7.20	6.10
VF25-5X	5	15	A	25	2.14	1.81
VF25-7X	7	15	A	25	2.29	1.94
VF25-10X	10	30	A	25	2.62	2.22
VF25-12X	12	30	A	25	2.94	2.49
VF25-15X	15	60	B	25	3.08	2.61
VF25-20X	20	60	B	25	3.95	3.35
VF25-25X	25	60	B	25	4.96	4.20
VF25-30X	30	90	C	25	5.94	5.03
VF25-40X	40	90	C	25	7.91	6.70

VARO SEMICONDUCTOR, INC.

HIGH VOLTAGE DIFFUSED SILICON POWER RECTIFIERS

SERIES VA • VB • IN4441 • VG

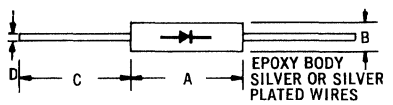


Varo high voltage and high voltage fast recovery time diffused silicon rectifiers are designed for industrial and commercial applications that require high reliability at an economical cost.

These rectifiers offer high voltage ranges in minimum-sized, epoxy-encapsulated packages with low leakage current. All ratings are obtained without the use of special heat sinks or mounting techniques (except VC Series).

They are designed to withstand 500 G's shock and vibration of 100 Hz with a peak acceleration of 10 G's.

Applications: television receivers, electrostatic power supplies, electrostatic copiers, electrostatic air filters and precipitators, cathode ray tube power supplies, transmitters, and microwave ovens.



Case Style	A Pkg. Length	B Dia.	C Min. Wire Length	D Nominal Wire Dia.
VA	.150	.060	.400	.010
VB	.400	.100	.400	.020
VG	.600	.160	.750	.020

*Ferrule End Caps Available.

Electrical Characteristics (@ T_A = 25°C Unless Otherwise Specified)	Series VA & VB and 1N4441	Series VF	Series VG	Series VC & VCX*
Max. DC Reverse Current @ PIV and 25°C, I_{RM}	.05μA / .03μA*	1μA	1μA	1μA / 2μA*
Max. DC Reverse Current @ PIV and 100°C/85°C*, I_{RM}	5.0μA / 60μA*	40μA / 60μA*	40μA / 60μA*	10μA / 20μA*
Max. Reverse Recovery Time, t_{rr}, Recovery to 1.0 mA	250 nanosec* (I_F = 2mA & I_R = 4mA)	250 nanosec* (I_F = 2 mA & I_R = 4 mA)	250 nanosec* (I_F = 2 mA & I_R = 4 mA)	300 nanosec* (I_F = 1A & I_R = 2A
Ambient Operating Temperature Range, T_A	+150°C / +85°C*	−55°C to +150°C / +85°C*	−55°C to +150°C / +85°C*	−50°C to +125°C
Max. One-Half Cycle Surge Current, I_{FSM} @ 60 Hz	3 Amps	3 Amps	3 Amps	50 Amps / 35 Amps*

*Fast Recovery Series.

SERIES VA • VB • IN4441

Part No.	Peak Inverse Voltage PIV (Volts)	Avg. Fwd. Current I_O @ 40°C (mA)	Max. Fwd. Voltage Drop @ 25°C & I_O V_{FM} (Volts)	PRICING 1-99	PRICING 100-999
VA10	1,000	50	4	$1.36	$1.02
VA15	1,500	50	4	1.44	1.08
VA20	2,000	50	4	1.55	1.16
VA25	2,500	50	4	1.66	1.25
VA30	3,000	25	6	1.93	1.45
VA35	3,500	25	6	2.70	2.02
VA10X	1,000	40	6	1.80	1.35
VA15X	1,500	40	6	1.93	1.45
VA20X	2,000	40	6	2.07	1.55
VA25X	2,500	20	8	2.20	1.65
VA30X	3,000	20	8	2.85	2.13
VB10	1,000	100	5	1.41	1.07
VB15	1,500	100	5	1.51	1.15
VB20	2,000	100	5	1.59	1.20
VB25	2,500	100	5	1.72	1.30
VB30	3,000	50	10	1.88	1.42
VB40	4,000	50	10	2.05	1.56
VB50	5,000	50	10	2.40	1.82
VB60	6,000	50	10	2.62	1.99
VB10X	1,000	50	6	1.88	1.43
VB15X	1,500	50	6	2.01	1.53
VB20X	2,000	50	6	2.12	1.60
VB25X	2,500	25	12	2.30	1.73
VB30X	3,000	25	12	2.50	1.90
VB40X	4,000	25	12	2.74	2.08
VB50X	5,000	25	12	3.20	2.42
1N4441	1,500	25	4	2.01	1.53

SERIES VG

Part No.	Peak Inverse Voltage PIV (Volts)	Avg. Fwd. Current I_O @ 40°C (mA)	Max. Fwd. Voltage Drop @ 25°C & I_O V_{FM} (Volts)	PRICING 1-99	PRICING 100-999
VG1	1,000	100	5	$ .80	$ .65
VG2	2,000	100	5	.85	.68
VG3	3,000	50	10	.97	.77
VG4	4,000	50	10	1.04	.83
VG5	5,000	50	12	1.22	.97
VG7	7,000	25	14	1.30	1.03
VG10	10,000	25	20	1.49	1.18
VG12	12,000	10	24	1.58	1.25
VG15	15,000	10	30	1.76	1.40
VG20	20,000	10	40	2.08	1.65
VG1X	1,000	50	6	.85	.68
VG2X	2,000	50	6	.89	.71
VG3X	3,000	25	12	.99	.79
VG4X	4,000	25	12	1.14	.91
VG5X	5,000	25	14	1.35	1.07
VG7X	7,000	10	16	1.42	1.13
VG10X	10,000	10	24	1.64	1.30
VG12X	12,000	5	30	1.74	1.38
VG15X	15,000	5	36	1.94	1.54
VG20X	20,000	5	50	2.29	1.82

NOTES:

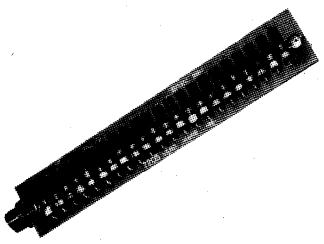
1. Suffix (X) denotes Fast Recovery Series.
2. Maximum lead and terminal temperature for soldering, ⅜ inch from case, 5 seconds at 250°C.
3. If operated over 10,000 V/inch in length, devices should be immersed in oil or re-encapsulated.

VARO SEMICONDUCTOR, INC. INC. P. O. BOX 676, 1000 NORTH SHILOH, GARLAND, TEXAS 75040, (214) 272-4551, TWX 910-860-5178

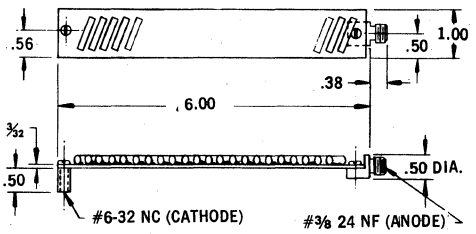
VARO SEMICONDUCTOR, INC.

VARO

HIGH VOLTAGE RECTIFIERS FOR X-RAY APPARATUS



The required peak reverse voltage determines the number of individual diode packages used in series for the completed, unencapsulated rectifier. Each diode package contains a stack of controlled avalanche chips. In order to achieve the rated voltage and current, the diodes should be submerged in Shell Diala Oil AX electrical Insulating oil or equivalent.



SPECIFICATIONS

I_F Average in 55°C Oil*	220 mA Max.
I_F Peak 10 Cycles @ 60 Hz Rate	6 A Max.
Max. ½ Cycle Surge Current @ 60 Hz, Non-Rep, I_{FSM}	20 A Max.
Max. DC Reverse Current @ PRV Test, I_{RM}	1 μA Max.
Operating and Storage Temperature Range	−55°C to +125°C

*Derate linearity from 55°C to zero current @ 125°C.

Part No.	PRV (kV) Operating	PRV (kV) Test	V_{FM} (Max.) I_F = 50 mA	No. of Individual Diode Packages	PRICING 1-99	PRICING 100-249
H466	100	125	160	16	$39.00	$28.50
H467	125	150	190	19	42.00	32.50
H468	150	175	220	22	45.00	40.00

All specifications at T_C = 25°C unless noted.

HIGH VOLTAGE MULTIPLIERS

APPLICATIONS: CRT terminal display systems, electrostatic power supplies, television receivers, monitors and other high voltage applications.

RATINGS

	Doubler (T_A = 60°C)	Tripler (T_A = 75°C)	Quad (T_A = 65°C)
DC Forward Current Output	0.25 mA	0.25 mA	0.25 mA
DC Forward Current at Focus Tap	1.5 mA	2.0 mA	2.25 mA
Input Voltage Under No Load	10KV MAX.	10KV MAX.	8KV MAX.

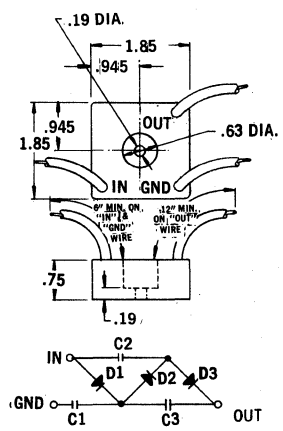
TYPICAL REGULATION AT TA = 25°C (TV TYPE GENERATOR) NOMINAL OUTPUT VOLTAGE WITH SPECIFIED PEAK-TO-PEAK MAINTAINED

	Pk to Pk	No Load	1 mA Load
Doubler — Varo P/N MH911*	10KV	19.0KV	18.0KV
Tripler — Varo P/N MH919*	8KV	24.0KV	22.0KV
Quad — Varo P/N MH353*	6KV	24.0KV	23.0KV

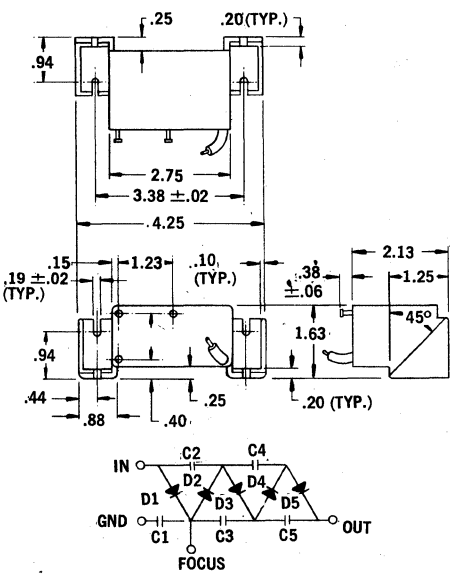
*Prices on request.

CASE STYLE AND CIRCUIT FOR:

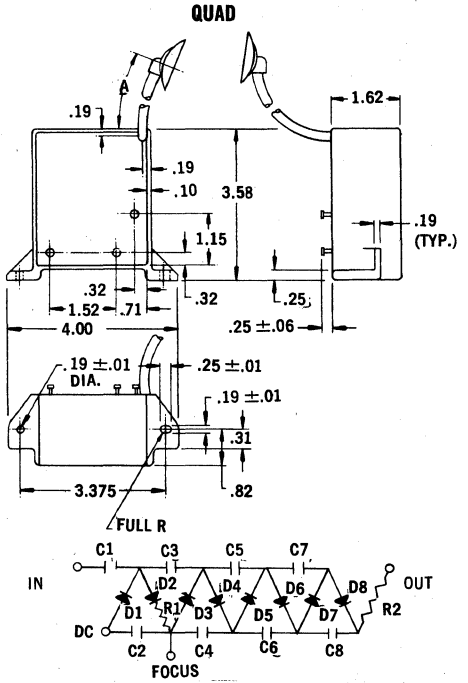
DOUBLER



TRIPLER



QUAD



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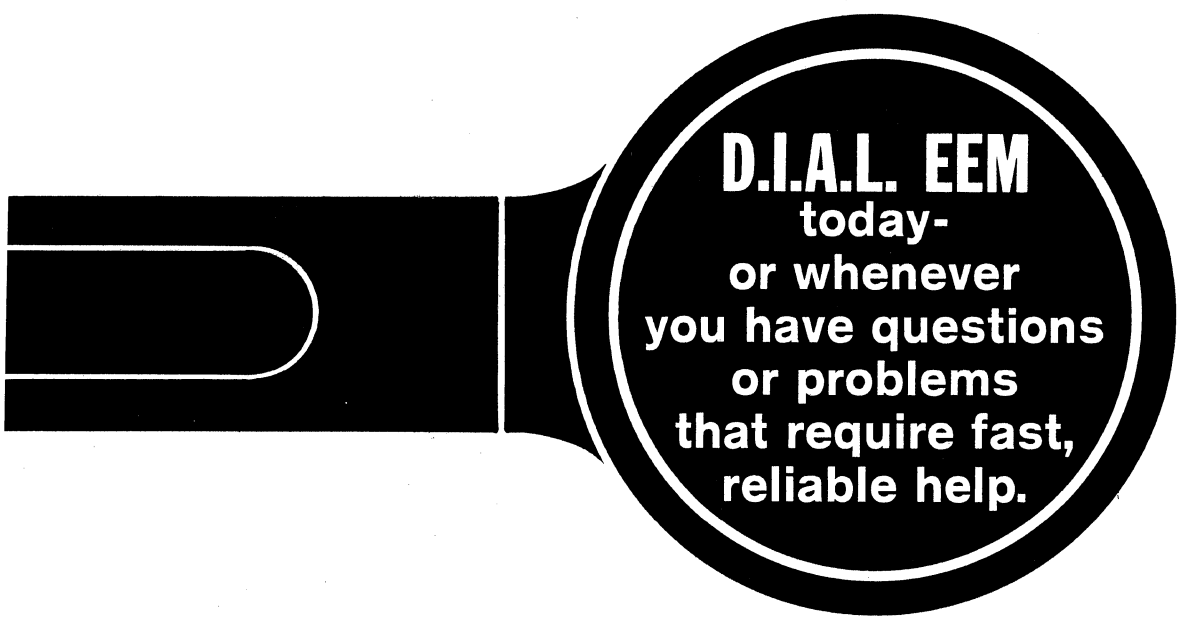

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rectifiers

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Westinghouse offers more than 1,000 silicon rectifiers to meet your application requirements. Standard types range from 1 to 2,000 amperes average, and from 50 to 4,000 volts. All standard rectifiers are available in both standard and reverse polarity. High power rectifiers are also available in the POW-R-DISC package.

Westinghouse preferred types shown in bold print offer economy and are readily available from your local distributor or directly from Westinghouse.
Choose from low cost, low power, lead mount rectifiers; hermetically sealed glass to metal case medium power rectifiers; and the exclusive Westinghouse Compression Bonded Encapsulation (CBE), ceramic seal high power rectifiers for the ultimate in reliability.
Specify a rectifier marked with this symbol — the rectifier with a Lifetime Guarantee — available only from Westinghouse.

LEAD MOUNT RECTIFIERS

Family Type	R040	R152	R140	R150	R240
Rating (Amps)	**1.0**	**1.0**	**1.5**	**1.5**	**3.0**
Package Outline	**DO-41**	**DO-15**	**DO-27**	**DO-15**	**A-36**
T Ambient	75°C	40°C	40°C	40°C	50°C
I_{FSM} (Amps)	30	35	50	50	200
T_{rr}	.....	200ns	.....	.....	.....
Old Type No.	.....	388	359	384	398
50 Volts	**1N4001**	**R1520010**	**1N4816**	**1N5391**	**1N5400**
100	**1N4002**	**R1520110**	**1N4817**	**1N5392**	**1N5401**
200	**1N4003**	**R1520210**	**1N4818**	**1N5393**	**1N5402**
300	.....	R1520310	1N4819	1N5394	1N5403
400	**1N4004**	**R1520410**	**1N4820**	**1N5395**	**1N5404**
500	.....	R1520510	1N4821	1N5396	1N5405
600	**1N4005**	**R1520610**	**1N4822**	**1N5397**	**1N5406**
700	.....	.....	1N5052	R1500715	R2400730
800	**1N4006**	.....	1N5053	1N5398	1N5407
1000	**1N4007**	.....	1N5054	1N5399	1N5408
Data Sheet	54-171: 5, 6	New Product Bulletin	54-161: 3, 4	54-171: 1, 2	54-171: 3, 4

MEDIUM CURRENT RECTIFIERS — 3-70 AMP Stud Mount Rectifier

***Reverse polarity units are available for all types listed below.**

Family Type	R310				R302	R310			R302	R310				R410
Rating (Amps)	**3**	**3.3**	**3**	**5**	**6**	**6**			**12**	**12**				**15**
Package Outline	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**	**DO-4**		**DO-5**
T Case	50°C	50°C	150°C	150°C	100°C	150°C	150°C	150°C	100°C	150°C	150°C	150°C		150°C
I_{FSM} (Amps)	25	25	40	150	75	150	150	160	150	240	240	250		250
T_{rr}	.....	.....	.....	.....	200ns	.....	.....	.....	200ns	.....	.....	5μs		.....
50 Volts	.....	.....	**1N1581**	1N1612	**1N3879**	**1N1341**	1N1341A	1N1341B	**1N3889**	**1N1199**	1N1199A	1N1199B		**1N3208**
100	.....	.....	**1N1582**	1N1613	**1N3880**	**1N1342**	1N1342A	1N1342B	**1N3890**	**1N1200**	1N1200A	1N1200B		**1N3209**
150	.....	.....	.....	.....	.....	1N1343	1N1343A	1N1343B	.....	1N1201	1N1201A	1N1201B		.....
200	1N1124	1N1124A	**1N1583**	1N1614	**1N3881**	**1N1344**	1N1344A	1N1344B	**1N3891**	**1N1202**	1N1202A	1N1202B		**1N3210**
300	1N1125	1N1125A	1N1584	.....	1N3882	1N1345	1N1345A	1N1345B	1N3892	1N1203	1N1203A	1N1203B		1N3211
400	1N1126	1N1126A	**1N1585**	1N1615	**1N3883**	**1N1346**	1N1346A	1N1346B	**1N3893**	**1N1204**	1N1204A	1N1204B		**1N3212**
500	1N1127	1N1127A	1N1586	.....	.....	1N1347	1N1347A	1N1347B	.....	1N1205	1N1205A	1N1205B		1N3213
600	1N1128	1N1128A	**1N1587**	1N1616	**R3020606**	**1N1348**	1N1348A	1N1348B	**R3020612**	**1N1206**	1N1206A	1N1206B		**1N3214**
700	.....	.....	.....	.....	.....	.....	1N3987	.....	.....	1N3670	1N3670A	.....		.....
800	.....	.....	.....	1N4458	.....	.....	1N3988	.....	.....	**1N3671**	1N3671A	.....		.....
900	.....	.....	.....	.....	.....	.....	1N3989	.....	.....	1N3672	1N3672A	.....		.....
1000	.....	.....	.....	1N4459	.....	.....	1N3990	.....	.....	**1N3673**	1N3673A	.....		.....
Data Sheet	Catalog 54-100													

Family Type	R310	R410	R402	R410					R402	R410			
Rating (Amps)	**16**	**18**	**20**	**20**			**22**	**25**	**30**	**35**	**40**	**60**	**70**
Package Outline	**DO-4**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**	**DO-5**
T Case	150°C	150°C	100°C	150°C	150°C	150°C	150°C	145°C	100°C	140°C	150°C	115°C	100°C
I_{FSM} (Amps)	300	220	225	300	300	350	500	400	300	500	800	700	750
T_{rr}	.....	.....	200ns	.....	.....	.....	.....	.....	200ns	.....	.....	.....	.....
50 Volts	**1N3615**	1N1191	**1N3899**	1N248A	1N248B	1N248C	**1N1191A**	1N2154	**1N3909**	**1N1183**	1N1183A	**1N2128**	**R4100070**
100	**1N3616**	1N1192	**1N3900**	1N249A	1N249B	1N249C	**1N1192A**	1N2155	**1N3910**	**1N1184**	1N1184A	**1N2129**	**R4100170**
150	1N3617	1N1193	.....	.....	.....	.....	1N1193A	.....	.....	1N1185	1N1185A	1N2130	.....
200	**1N3618**	1N1194	**1N3901**	1N250A	1N250B	1N250C	**1N1194A**	1N2156	**1N3911**	**1N1186**	1N1186A	**1N2131**	**1N4136**
300	1N3619	1N1195	1N3902	.....	.....	.....	1N1195A	1N2157	1N3912	1N1187	1N1187A	1N2133	.....
400	**1N3620**	1N1196	**1N3903**	.....	.....	.....	**1N1196A**	1N2158	**1N3913**	**1N1188**	1N1188A	**1N2135**	**1N4137**
500	1N3621	1N1197	.....	.....	.....	.....	1N1197A	1N2159	.....	1N1189	1N1189A	1N2137	.....
600	**1N3622**	1N1198	**R4020620**	.....	.....	.....	**1N1198A**	1N2160	**R4020630**	**1N1190**	1N1190A	**1N2138**	**1N4138**
700	.....	.....	.....	.....	.....	.....	.....	.....	.....	1N3765	.....	.....	.....
800	**1N3623**	.....	.....	.....	.....	.....	**R4100822**	.....	.....	**1N3766**	R4100840	.....	.....
900	.....	.....	.....	.....	.....	.....	.....	.....	.....	1N3767	.....	.....	.....
1000	**1N3624**	.....	.....	.....	.....	.....	**R4101022**	.....	.....	**1N3768**	R4101040	.....	.....
Data Sheet	Catalog 54-100												

Bold face numbers indicate preferred types.

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rectifiers

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HIGH CURRENT RECTIFIERS

Reverse polarity units are available for all stud types listed below.

Family Type	R500		R600							
Rating (Amps)	100	150	160	240	250	250	275	200	250	300
Package Outline ISURGE (Amps) Type	DO8 2300 JEDEC	DO8 3000 JEDEC	DO9 2000 JEDEC	DO9 3000 JEDEC	DO9 4500 JEDEC	DO9 4500 JEDEC	DO9 5000 JEDEC	DO9 5000 R600__20	DO9 5500 R600__25	DO9 6250 R600__30
50 Volts	.....	.....	1N3260	1N3161	.....	1N2054	1N4044	.....	.....	.....
100	1N3288A	1N4587	1N3261	1N3162	1N3735	1N2055	1N4045	R6000120	R6000125	R6000130
150	.....	.....	1N3262	1N3163	.....	1N2056	1N4046	.....	.....	.....
200	1N3289A•	1N4588	1N3263•	1N3164•	1N3736	1N2057	1N4047	R6000220	R6000225	R6000230
250	.....	.....	1N3264	1N3165	.....	1N2058	1N4048	.....	.....	.....
300	1N3290A	1N4589	1N3265	1N3166	1N3737	1N2059	1N4049	R6000320	R6000325	R6000330
350	.....	.....	1N3266	1N3167	.....	1N2060	.....	.....	.....	.....
400	1N3291A•	1N4590	1N3267•	1N3168•	1N3738	1N2061	1N4050	R6000420	R6000425	R6000430
500	1N3292B	1N4591	1N3268	1N3169	1N3739	1N2063	1N4051	R6000520	R6000525	R6000530
600	1N3293A•	1N4592	1N3269•	1N3170•	1N3740	1N2064	1N4052	R6000620	R6000625	R6000630
700	.....	.....	1N3270	1N3171	.....	1N2065	1N4053	R6000720	R6000725	R6000730
800	1N3294A•	1N4593	1N3271•	1N3172•	1N3741	1N2066	1N4054	R6000820	R6000825	R6000830
900	.....	.....	1N3272	1N3173	.....	1N2067	1N4055	R6000920	R6000925	R6000930
1000	1N3295A•	1N4594	1N3273•	1N3174•	1N3742	1N2068	1N4056	R6001020	R6001025	R6001030
1200	1N3296A	1N4595	1N3274	.....	1N3743	.....	.....	R6001220	R6001225	R6001230
1400	1N3297A	1N4596	1N3275	.....	1N3744	.....	.....	R6001420	R6001425	.....
1600	.....	.....	1N3276	.....	.....	.....	.....	R6001620	R6001625	.....
1800	.....	.....	.....	.....	.....	.....	.....	R6001820	R6001825	.....
2000	.....	.....	.....	.....	.....	.....	.....	R6002020	R6002025	.....
2200	.....	.....	.....	.....	.....	.....	.....	R6002220	.....	.....
2400	.....	.....	.....	.....	.....	.....	.....	R6002420	.....	.....
2600	.....	.....	.....	.....	.....	.....	.....	R6002620	.....	.....
2800	.....	.....	.....	.....	.....	.....	.....	R6002820	.....	.....
3000	.....	.....	.....	.....	.....	.....	.....	R6003020	.....	.....
Data Sheet	54-166: 1, 2	54-166: 3, 4	54-166: 11, 12	Contact Factory			54-166: 13, 14	54-166: 15-18		

Family Type	R620			R700			R720			R920		
Rating (Amps)	300	400	500	300	450	550	500	800	1000	1100	1600	2000
Package Outline ISURGE (Amps) Type	R62 5000 R620__30	R62 5500 R620__40	R62 6000 R620__50	R70 6000 R700__03	R70 8500 R700__04	R70 10000 R700__05	R72 6000 R720__05	R72 8500 R720__08	R72 10000 R720__10	R92 12000 R920__11	R92 16000 R920__16	R92 22000 R920__20
600 Volts	.....	R6200640	R6200650	.....	R7000604	R7000605	.....	R7200608	R7200610	.....	R9200616	R9200620
800	.....	R6200840	R6200850	.....	R7000804	R7000805	.....	R7200808	R7200810	.....	R9200816	R9200820
1000	.....	R6201040	R6201050	.....	R7001004	R7001005	.....	R7201008	R7201010	.....	R9201016	R9201020
1200	.....	R6201240	R6201250	.....	R7001204	R7001205	.....	R7201208	R7201210	.....	R9201216	R9201220
1400	.....	R6201440	.....	.....	R7001404	.....	.....	R7201408	.....	.....	R9201416	.....
1600	R6201630	R6201640	.....	R7001603	R7001604	.....	R7201605	R7201608	.....	R9201611	R9201616	.....
1800	R6201830	R6201840	.....	R7001803	R7001804	.....	R7201805	R7201808	.....	R9201811	R9201816	.....
2000	R6202030	R6202040	.....	R7002003	R7002004	.....	R7202005	R7202008	.....	R9202011	R9202016	.....
2200	R6202230	.....	.....	R7002203	.....	.....	R7202205	.....	.....	R9202211	.....	.....
2400	R6202430	.....	.....	R7002403	.....	.....	R7202405	.....	.....	R9202411	.....	.....
2600	R6202630	.....	.....	R7002603	.....	.....	R7202605	.....	.....	R9202611	.....	.....
2800	R6202830	.....	.....	R7002803	.....	.....	R7202805	.....	.....	R9202811	.....	.....
3000	R6203030	.....	.....	R7003003	.....	.....	R7203005	.....	.....	R9203011	.....	.....
3200	.....	.....	.....	R7003203	.....	.....	.....	.....	.....	.....	.....	.....
3400	.....	.....	.....	R7003403	.....	.....	.....	.....	.....	.....	.....	.....
3600	.....	.....	.....	R7003603	.....	.....	.....	.....	.....	.....	.....	.....
3800	.....	.....	.....	R7003803	.....	.....	.....	.....	.....	.....	.....	.....
4000	.....	.....	.....	R7004003	.....	.....	.....	.....	.....	.....	.....	.....
Data Sheet	54-168: 1-4			54-166: 21-24			54-168: 11-14			54-168: 21-24		

FAST RECOVERY RECTIFIERS — High Current

Current (Amps)		Package Outline	Type Number	Voltage VS. Recovery Time Capability Consult Factory for Faster Recovery Time and/or Higher Voltage							Data Sheet
RMS	AVE.			≤200V	≤400V	≤600V	≤800V	≤1000V	≤1200V	>1200V	
Size R5											
125	80	Stud DO-8	R502__08	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-170: 1-4
157	100	DO-8	R502__10	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-170: 1-4
Size R6											
315	200	Stud DO-9	R602__20	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-170: 11-14
400	250	DO-9	R602__25	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-170: 11-14
550	350	Disc R62	R622__35	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-172: 1-4
625	400	R62	R622__40	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥1.5μs	≥2.0μs	54-172: 1-4
Size R7											
470	300	Stud R70	R702__30	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥3.0μs	54-170: 21-24
625	400	R70	R702__40	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥3.0μs	54-170: 21-24
950	600	Disc R72	R722__60	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥3.0μs	54-172: 11-14
1250	800	R72	R722__80	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥2.0μs	≥3.0μs	54-172: 11-14

Bold face numbers indicate preferred types. • **Military types available.**

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Phase Control SCR's

16-1570 Amps. RMS/50-3000V

Full Capacity Series Features

- All Diffused Design
- Center Fired Gate
- Compression Bonded Encapsulation

which provides

- High Surge Current Capability
- Low Power Dissipation
- Low Thermal Resistance
- High dv/dt

All Medium and High Current Types are available in a POW-R-DISC Package.

POW-R-DISC thyristor package offers:

- Single or double-sided cooling
- Reversible mounting polarity
- Compact size and weight
- Long creepage and strike paths
- Hermetic seal

Most product families can be supplied in an integral heat sink or flat base package as well.

SCR's can be selected for higher junction temperature operation (i.e., $T_J = 150°C$) on special request.

High Frequency SCR's

63-700 Amps. RMS/50-1800V/60-25K Hz

These Full Capacity High Frequency SCR's feature di/namic gate construction which provides

- Low Dynamic Forward Voltage Drops
- High di/dt
- Low Gate Trigger Current

Special Devices

The RSR is designed for pulse modulator application where narrow current pulsewidths and high rates of current rise (di/dt) are required. This product is available for voltages from 600 to 1000 volts and di/dt in excess of 2000 A/μs.

All Full Capacity and JEDEC Products carry the Westinghouse Lifetime Guarantee.

PHASE CONTROL SCR's

Current (Amps) RMS	Current (Amps) AVE.	Voltage (Volts)	Package Outline	Type Number	Old Type Number	Features	Data Sheet
Low Current — Size T4							
			Stud				
16	10	25 to 500	TO-48	2N1842-2N1850	202	JEDEC $T_J = 100°C$	54-563: 1-2
16	10	25 to 500	TO-48	2N1842A-2N1850A	203	JEDEC $T_J = 125°C$	54-563: 1-2
25	16	25 to 600	TO-48	2N681-2N690	201	JEDEC	54-564: 1-2
35	22	50 to 600	TO-48	**T400__22**	.....	Standard Series	54-564: 3-4
Medium Current — Size T5							
			Stud				
63	40	50 to 1500	TO-94, TO-83	**T500__40**	251	Full Capacity Series	54-566: 1-4
110	70	25 to 800	TO-83	2N1792-2N1798	809	JEDEC	54-566: 5-6
110	70	25 to 800	TO-49	2N1909-2N1916	809	JEDEC	54-566: 5-6
110	70	100 to 1400	TO-94	2N4361-2N4368	254	JEDEC	54-566: 7-8
110	70	100 to 1400	TO-83	2N4371-2N4378	254	JEDEC	54-566: 7-8
125	80	50 to 1500	TO-94, TO-83	**T500__80**	250	Full Capacity Series	54-566: 1-4
			Disc				
200	125	50 to 1500	T62	**T520__13**	.....	Full Capacity Series	54-568: 1-2
High Current — Size T6							
			Stud				
200	125	100 to 1500	TO-93	**T600__13**	261	Full Capacity Series	54-566: 11-14
235	150	100 to 1500	TO-93	**T600__15**	.....	Full Capacity Series	54-566: 11-14
275	175	100 to 1500	TO-93	**T600__18**	260	Full Capacity Series	54-566: 11-14
275	175	50 to 1200	TO-93	2N3884-2N3895	220	JEDEC	54-566: 15-16
			Disc				
200	125	100 to 1500	T62	**T620__13**	263	Full Capacity Series	54-568: 11-14
315	200	100 to 1500	T62	**T620__20**	273	Full Capacity Series	54-568: 11-14
470	300	100 to 1500	T62	**T620__30**	272	Full Capacity Series	54-568: 11-14
			Integral Heat Sink				
470	300	100 to 1500	T66	**T660__30**	276	Full Capacity Series	54-574: 1-2
			Flat Base				
470	300	100 to 1500	T68	**T680__30**	2248	Full Capacity Series	54-578: 1-2

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PHASE CONTROL SCR's Continued

Current (Amps) RMS	Current (Amps) AVE.	Voltage (Volts)	Package Outline	Type Number	Old Type Number	Features	Data Sheet
High Current — Size T7							
			Stud				
400	250	100 to 1500	T70	**T700__25**	271	Full Capacity Series	54-566: 21-24
470	300	600 to 2000	T70	**T700__30**	270-Y30	Full Capacity Series	54-566: 21-24
550	350	100 to 1500	T70	**T700__35**	270	Full Capacity Series	54-566: 21-24
			Disc				
550	350	100 to 2000	T72	**T720__35**		Full Capacity Series	54-568: 21-24
700	450	600 to 2000	T72	**T720__45**	282-Y40	Full Capacity Series	54-568: 21-24
850	550	100 to 1500	T72	**T720__55**	282, 283	Full Capacity Series	54-568: 21-24
			Integral Heat Sink				
470	300	600 to 2000	T76	**T760__30**	286-Y30	Full Capacity Series	54-574: 11-12
			Flat Base				
625	400	100 to 1500	T78	**T780__40**	288	Full Capacity Series	54-578: 11-12
High Current — Size T9							
			Disc				
940	600	2000 to 3000	T92	**T920__06**	.....	Full Capacity Series	54-568: 31-38
1100	700	100 to 2000	T92	**T920__07**	.....	Full Capacity Series	54-568: 31-38
1255	800	100 to 2000	T92	**T920__08**	.....	Full Capacity Series	54-568: 31-38
1410	900	100 to 1200	T92	**T920__09**	.....	Full Capacity Series	54-568: 31-38
1570	1000	100 to 1200	T92	**T920__10**	.....	Full Capacity Series	54-568: 31-38

HIGH FREQUENCY SCR's — di/namic Gate Design

Current (Amps) RMS	Current (Amps) AVE.	Package Outline	Type Number	Voltage VS. Turn-Off Capability Consult Factory for Faster Turn-Off and/or Higher Voltage ≤200V	≤400V	≤600V	≤800V	≤1000V	≤1200V	>1200V	Data Sheet
Medium Current — Size T5											
		Stud									
63	40	TO-94, TO-83	**T507__40**	≥10μs	≥10μs	≥10μs	≥10μs	≥10μs	≥20μs	≥30μs	54-570: 1-4
110	70	TO-94, TO-83	**T507__70**	≥10μs	≥10μs	≥10μs	≥15μs	≥20μs	≥30μs	≥40μs	54-570: 1-4
125	80	TO-94, TO-83	**T507__80**	≥10μs	≥10μs	≥10μs	≥20μs	≥30μs	≥30μs	≥40μs	54-570: 1-4
		Disc									
95	60	T62	**T527__60**	≥10μs	≥10μs	≥10μs	≥10μs	≥10μs	≥20μs	≥30μs	54-572: 1-4
180	115	T62	**T527__12**	≥10μs	≥10μs	≥10μs	≥15μs	≥20μs	≥30μs	≥40μs	54-572: 1-4
200	125	T62	**T527__13**	≥10μs	≥10μs	≥10μs	≥20μs	≥30μs	≥30μs	≥40μs	54-572: 1-4
High Current — Size T6											
		Stud									
200	125	TO-93	**T607__13**	≥10μs	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥40μs	54-570: 11-14
235	150	TO-93	**T607__15**	≥15μs	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥50μs	54-570: 11-14
275	175	TO-93	**T607__18**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥40μs	≥60μs	54-570: 11-14
		Disc									
235	150	T62	**T627__15**	≥10μs	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥40μs	54-572: 11-14
315	200	T62	**T627__20**	≥15μs	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥50μs	54-572: 11-14
400	250	T62	**T627__25**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥40μs	≥60μs	54-572: 11-14
High Current — Size T7											
		Stud									
315	200	T70	**T707__20**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥30μs	≥40μs	54-570: 21-24
400	250	T70	**T707__25**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥30μs	≥50μs	54-570: 21-24
475	300	T70	**T707__30**	≥15μs	≥15μs	≥15μs	≥30μs	≥40μs	≥50μs	≥60μs	54-570: 21-24
		Disc									
400	250	T72	**T727__25**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥30μs	≥40μs	54-572: 21-24
550	350	T72	**T727__35**	≥15μs	≥15μs	≥15μs	≥20μs	≥30μs	≥30μs	≥50μs	54-572: 21-24
700	450	T72	**T727__45**	≥15μs	≥15μs	≥15μs	≥30μs	≥40μs	≥50μs	≥60μs	54-572: 21-24

SPECIAL DEVICES — Size T4

Current (Amps) RMS	Current (Amps) AVE.	Voltage (Volts)	Package Outline	Type Number	Old Type Number	Features	Data Sheet
35	22	600 to 1000	**Stud** DO-5	**T40R__22**	423	RSR/Reverse Blocking Diode Thyristor. Very High di/dt Pulse Modulator Applications.	Consult Factory

Bold face numbers indicate preferred types.

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GENERAL PURPOSE

Low Current/Medium Freq. — Medium Current/Medium Freq.

Family Type	D390		D480		D480		
Ic Rating	4 Amperes		15 Amperes		30 Amperes		
Package Outline	**TO-66**	**TO-66**	**TO-3**	**TO-3**	**TO-3**	**TO-3**	**TO-3**
Old Type No.	1571	1571	1561	1561	1561	1561	1561
h_{fe} min.	20 @ ½ Amp	25 @ ½ Amp	20 @ 3A	20 @ 4A	15 @ 8A	15 @ 10A	15 @ 15A
V_{ce} (sat) max.	1.0 V	1.0 V	1.1 V	1.1 V	1.4 V	2.0 V	2.0 V
f_T typical	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz	1.0 MHz
V_{ceo} (sus) 40	1571-0420	1571-0452	1561-0403	1561-0404	1561-0408	1561-0410	2N3771
60	1571-0620	2N3054	2N3232	2N3055	1561-0608	2N3772	1561-0615
80	1571-0820	1571-0825	1561-0803	1561-0804	1561-0808	1561-0810	1561-0815
100	1571-1020	1571-1025	2N3233	2N3236	1561-1008	1561-1010	1561-1015
120	1571-1220	1571-1225	2N4347	2N4348	1561-1208	1561-1210	1561-1215
140	2N3441	1571-1425	2N3442	1561-1404	2N3773	1561-1410	.....
Max. Ratings	V_{EB} = 7 V, I_B = 2A, T_J = −65°C to +200°C, P_T = 29 W @ T_C = 25°C, $R\theta_{JC}$ = 6°C/Watt		V_{EB} = 7 V, I_B = 7A, T_J = −65°C to 200°C	P_T = 115 W @ T_C = 25°C, $R\theta_{JC}$ = 1.5°C/W	V_{EB} = 7 V, I_B = 7A, T_J = −65°C to 200°C	P_T = 150W @ T_C = 25°C $R\theta_{JC}$ = 1.17°C/W	
Data Sheet	54-673: 11, 12		54-673: 15, 16	54-673: 1, 2, 13, 14	54-673: 33, 36	54-673: 29-32	54-673: 25-28

INDUSTRIAL & GENERAL PURPOSE — Low Current/Low Freq.

Family Type	A500		A510		A670	
Ic Rating	6 Amperes		7.5 Amperes		20 Amperes	
Package Outline	**MT-1**	**MT-1**	**MT-52**	**MT-52**	**MT-33**	**MT-33**
Old Type No.	151	152	153	154	163	164
h_{fe} min.	11 @ 1.5A	18 @ 1.5A	15 @ 1.5A	25 @ 1.5A	15 @ 5A	25 @ 5A
V_{ce} (sat) max.	1.3 V	1.25 V	1.3 V	1.25 V	1.1 V	1.0 V
f_T typical	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
V_{ceo} (sus) 40	151-04	152-04	153-04	154-04	163-04	164-04
50	151-05	152-05	153-05	154-05	163-05	164-05
60	151-06	152-06	153-06	154-06	163-06	164-06
70	151-07	152-07	153-07	154-07	163-07	164-07
80	151-08	152-08	153-08	153-08	163-08	164-08
90	151-09	152-09	153-09	154-09	163-09	164-09
100	151-10	152-10	153-10	154-10	163-10	164-10
120	151-12	152-12	153-12	154-12	163-12	164-12
140	151-14	152-14	153-14	154-14	163-14	164-14
160	151-16	152-16	153-16	154-16	163-16	164-16
180	151-18	152-18	153-18	154-18	163-18	164-18
200	151-20	152-20	153-20	154-20	163-20	164-20
220	151-22	152-22	153-22	154-22	163-22	164-22
Maximum Ratings	V_{EB} = 25 V, I_B = 3A $T_{J\&STG}$ = −65°C to +150°C P_T = 100 W @ 80°C $R\theta_{JC}$ = 0.7°C/Watt		V_{EB} = 25 V, I_B = 3A $T_{J\&STG}$ = −65°C to +175°C P_T = 200 W @ 25°C $R\theta_{JC}$ = 0.75°C/Watt		V_{EB} = 15 V, I_B = 7.5A $T_{J\&STG}$ = −65°C to +175°C P_T = 200 W @ 75°C $R\theta_{JC}$ = 0.5°C/Watt	
Data Sheet	54-672: 1, 2		54-672: 3, 4		54-672: 5, 6	

MILITARY — Low Current/Low Freq.

Family Type	A50H		A51H	A60G		A67G		A60H		
Ic Rating	7.5 Amperes		7.5 Amperes	10 Amperes (High Gain)		10 Amperes (High Gain)		20 Amperes		
Package Outline	**MT-1**	**MT-1**	**MT-52**	**MT-1**	**MT-1**	**MT-33**	**MT-33**	**MT-1A**	**MT-1A**	**MT-1A**
Old Type No.	107	108	113	118	118	120	120	109	109	109
h_{fe} min.	10 @ 2A	10 @ 5A	10 @ 5A	100 @ 10A	400 @ 10A	100 @ 10A	400 @ 10A	10 @ 10A	10 @ 15A	10 @ 20A
V_{ce} (sat) max.	1.5 V	2.5 V	1.0 V	3.5 V	3.5 V	3.5 V	3.5 V	1.5 V	1.5 V	1.5 V
f_T typical	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
V_{ceo} (sus) 30	2N1015	2N1016	.....	.....	.....	.....	.....	.....	.....	.....
50	2N1015A	2N1016A	2N3429	2N2226	2N2230	2N3470	2N3474	2N2739	2N2745	2N2751
100	2N1015B	2N1016B	2N3430	2N2227	2N2231	2N3471	2N3475	2N2740	2N2746	2N2752
150	2N1015C	2N1016C	2N3431	2N2228	2N2232	2N3472	2N3476	2N2741	2N2747	2N2753
200	2N1015D	2N1016D	2N3432	2N2229	2N2233	2N3473	2N3477	2N2742	2N2748	2N2754
Maximum Ratings	V_{EB} = 25 V, I_B = 5A $T_{J\&STG}$ = −65°C to +150°C P_T = 150 W @ 45°C $R\theta_{JC}$ = 0.7°C/Watt		V_{EB} = 25 V, I_B = 3A $T_{J\&STG}$ = −65°C to +175°C P_T = 150 W @ 60°C $R\theta_{JC}$ = 0.75°C/W	V_{EB} = 15 V, I_B = 1A $T_{J\&STG}$ = −65°C to +150°C P_T = 150 W @ 75°C $R\theta_{JC}$ = 0.5°C/W				V_{EB} = 15 V, I_B = 7.5A $T_{J\&STG}$ = −65°C to +175°C P_T = 200 W @ 75°C $R\theta_{JC}$ = 0.5°C/Watt		
Data Sheets	54-661: 1, 2		54-661: 3-6	54-663: 1-4				54-661: 9-12		

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MILITARY — Medium Current/Low Freq.

Family Type	A67H			
I_C Rating	30 Amperes			
Package Outline	MT-33	MT-33	MT-33	MT-33
Old Type No.	110	110	110	110
h_{fe} min.	10 @ 10A	10 @ 15A	10 @ 20A	10 @ 25A
V_{ceo} (sat) max.	1.5 V	1.5 V	1.5 V	1.5 V
f_T typical	0.5 MHz	0.5 MHz	0.5 MHz	0.5 MHz
V_{ceo} (sus) 50	2N2757	2N2763	2N2769	2N2775
100	2N2758	2N2764	2N2770	2N2776
150	2N2759	2N2765	2N2771	2N2777
200	2N2760	2N2766	2N2772	2N2778
250	2N2761	.....	.....	.....
Maximum Ratings	$T_{J\&STG}$ = −65°C to +175°C V_{EB} = 15 V, I_B = 7.5A P_T = 200 W @ 75°C $R\theta_{JC}$ = 0.5°C/Watt			
Data Sheet	54-662: 5-12			

MILITARY & INDUSTRIAL — Low Current/High Freq.

Family Type	E490			E58S		
I_C Rating	10 Amperes			20 Amperes		
Package Outline	TO-66	TO-66		TO-3A	TO-3A	
Old Type No.	1714	1714		1723	1723	
h_{fe} min.	20 @ 2A	20 @ 5A		20 @ 5A	20 @ 10A	
V_{ce} (sat) max.	0.60 V	0.75 V		1.0 V	1.25 V	
f_T typical	60 MHz	60 MHz		40 MHz	40 MHz	
V_{ceo} (sus) 40	1714-0402	1714-0405	.....	1723-0405	1723-0410	.....
60	1714-0602	1714-0605	.....	1723-0605	1723-0610	.....
80	1714-0802	1714-0805	.....	1723-0805	1723-0810	**2N5039**
100	1714-1002	1714-1005	**2N5202**	1723-1005	1723-1010	**2N5038**
120	1714-1202	1714-1205	**2N3879**	1723-1205	1723-1210	.....
140	1714-1402	1714-1405	.....	1723-1405	1723-1410	.....
160	1714-1602	.....	.....	1723-1605	.....	.....
Maximum Ratings	V_{EB} = 7 V, I_B = 2A $T_{J\&STG}$ = −65°C to +200°C P_T = 44 W @ T_C = 25°C $R\theta_{JC}$ = 4.0°C/Watt			V_{EB} = 7 V, I_B = 5A $T_{J\&STG}$ = −65°C to +200°C P_T = 150 W @ T_C = 25°C $R\theta_{JC}$ = 1.17°C/Watt		
Data Sheet	54-673: 17-20 54-661: 37, 38			54-673: 21-24 54-661: 9-12		

Medium Current/High Freq.

Family Type	E580			E58L		
I_C Rating	40 Amperes			40 Amperes		
Package Outline	TO-3A	TO-3A	TO-3A	TO-3A	TO-3A	TO-3A
Old Type No.	1743	1743	1743	1763	1763	1763
h_{fe} min.	20 @ 10A	20 @ 20A	20 @ 30A	20 @ 10A	20 @ 20A	20 @ 30A
V_{ce} (sat) max.	2.0 V	2.0 V	2.0 V	1.0 V	1.25 V	1.50 V
f_T typical	40 MHz	40 MHz	40 MHz	40 MHz	40 MHz	40 MHz
V_{ceo} (sus) 60	1743-0610	2N5932	1743-0630	1763-0610	1763-0620	1763-0630
80	2N5929	1743-0820	2N5935	1763-0810	1763-0820	1763-0830
100	1743-1010	2N5933	1743-1030	1763-1010	1763-1020	1763-1030
120	2N5930	1743-1220	2N5936	1763-1210	1763-1220	1763-1230
140	1743-1410	2N5934	.....	1763-1410	1763-1420	.....
160	2N5931	.....	.....	1763-1610	.....	.....
Maximum Ratings	V_{EB} = 7 V, I_B = 10A $T_{J\&STG}$ = −65°C to +200°C P_T = 100 W @ T_C = 100°C $R\theta_{JC}$ = 1.0°C/Watt			V_{EB} = 7 V, I_B = 10A $T_{J\&STG}$ = −65°C to +200°C P_T = 100 W @ T_C = 100°C $R\theta_{JC}$ = 1.0°C/Watt		
Data Sheet	54-651: 13-24			New Product Bulletin		

High Current/High Freq.

Family Type	E670	
I_C Rating	90 Amperes	
Package Outline	TO-114	TO-114
Old Type No.	1781	1781
h_{fe} min.	10 @ 40A	10 @ 60A
V_{ce} (sat) max.	1.5 V	1.5 V
f_T typical	30 MHz	30 MHz
V_{ceo} (sus) 40	1781-0440	1781-0460
60	1781-0640	1781-0660
80	1781-0840	1781-0860
100	1781-1040	1781-1060
120	1781-1240	1781-1260
Maximum Ratings	$T_{J\&STG}$ = −65°C to +200°C V_{EB} = 7 V, I_B = 15A P_T = 200 W @ T_C = 100°C $R\theta_{JC}$ = .45°C/Watt	
Data Sheet	TD54-653: 1-4	

MILITARY & INDUSTRIAL HIGH VOLTAGE Low and Medium Current/High Freq.

Family Type	E49V		E58V		
I_C Rating	10 Amperes		30 Amperes		
Package Outline	TO-66	TO-66	TO-3	TO-3	TO-3
Old Type No.	1814	1814	1843	1843	1843
h_{fe} min.	20 @ 1A	20 @ 2A	20 @ 5A	15 @ 10A	10 @ 20A
V_{ce} (sat) max.	0.60 V	0.60 V	1.0 V	1.25 V	1.75 V
f_T typical	50 MHz	50 MHz	25 MHz	25 MHz	25 MHz
V_{ceo} (sus) 200	1814-2001	1814-2002	1843-2005	1843-2010	1843-2020
225	1814-2201	1814-2202	1843-2205	1843-2210	1843-2220
250	1814-2501	1814-2502	1843-2505	1843-2510	1843-2520
275	1814-2701	1814-2702	1843-2705	1843-2710	1843-2720
300	1814-3001	1814-3002	1843-3005	1843-3010	.....
325	1814-3201	.....	1843-3205	.....	.....
Maximum Ratings	V_{EB} = 7 V, I_B = 2A $T_{J\&STG}$ = −65°C to +200°C P_T = 44 W @ T_C = 25°C $R\theta_{JC}$ = 4.0°C/Watt		V_{EB} = 7 V, I_B = 10A $T_{J\&STG}$ = −65°C to +200°C P_T = 85 W @ T_C = 100°C $R\theta_{JC}$ = 1°C/Watt		
Data Sheet	54-652: 1, 2		54-652: 9-16		

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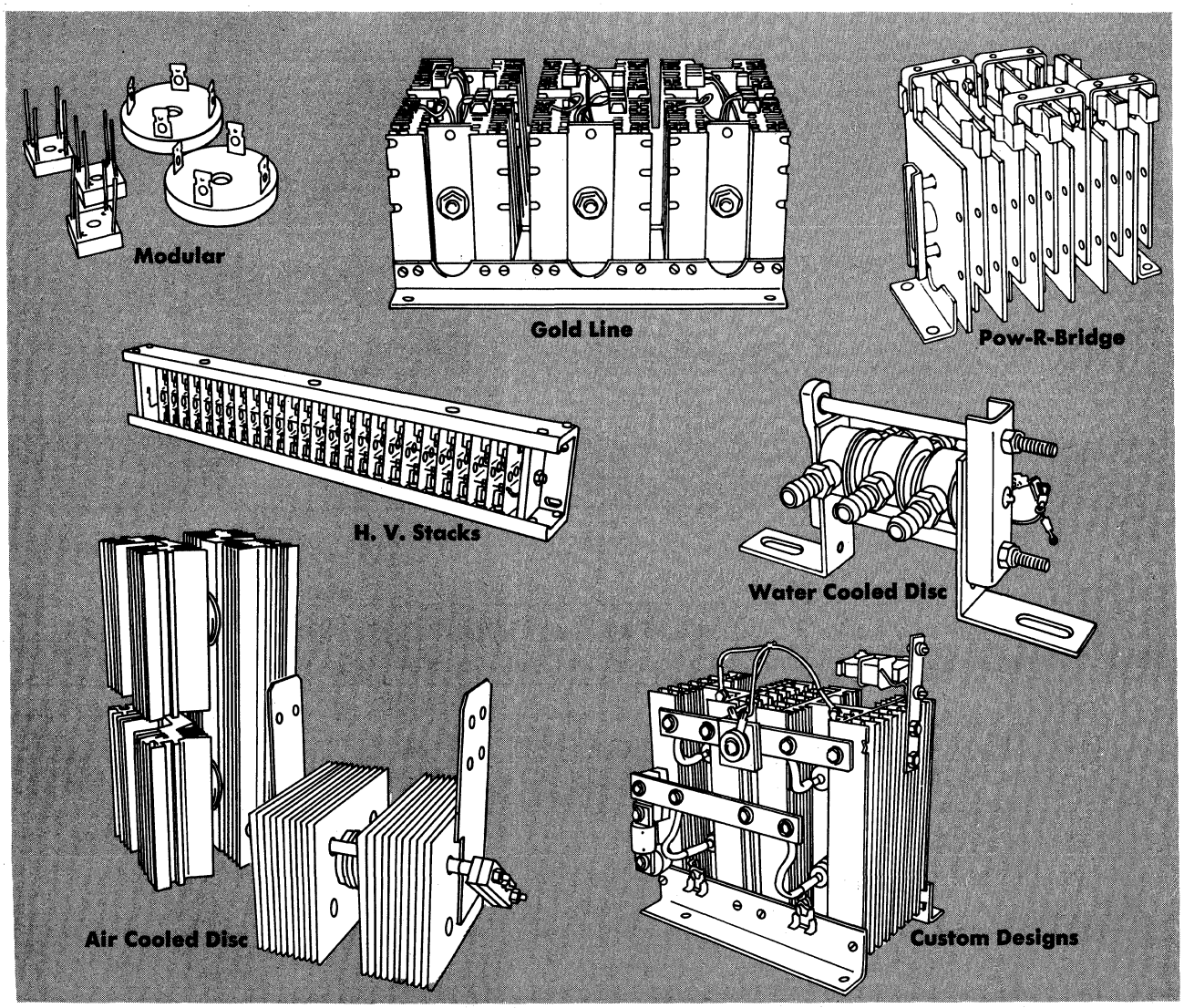
	Half Wave	Doubler	Center Tap	A-C Switch	1φ Bridge	3φ Bridge	6φ Bridge	Current Range (A)	Voltage Range (V)	Data Reference
Modular Outlines A-1, A-2		X	X		X			2-20	50-600	54-310
Gold Line	X	X	X	X	X	X	X	12-2500	100-2000	54-300
Pow-R-Bridge	X	X	X	X	X	X	X	160-700	100-600	54-410
H. V. Stacks	X	X	X					.5-400	15KV-400KV	54-200
Water Cooled Disc	X	X	X	X				300-3800	100-3000	54-450
Air Cooled Disc	X	X	X	X				250-3200	100-3000	54-420
Custom Designs	X	X	X	X	X	X	X	—	—	Consult Factory



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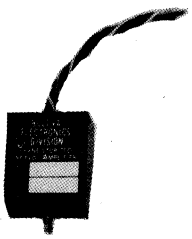

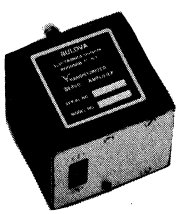

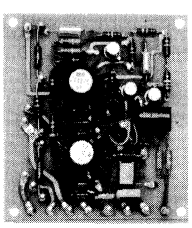

POWER OUTPUT		2 WATT	3.5 WATT	6 WATT	
PHASE SHIFT		0° or 90°	0° or 90°	0° or 90°	
MODEL NUMBER		S4121 S4131 S4141 S4161	S4221 S4231 S4241 S4261	S4321 S4331 S4341 S4351	S4322 S4332 S4342
INPUT SIGNAL (vrms max. at max. gain)		26	26	26	26
VOLTAGE OUTPUT (vrms nominal)	(linear region)	0-25	0-25	0-25	0-18
	(at rated power)	40	40	40	26
VOLTAGE GAIN ±1db (v/v max. adjustable down)		Model # Gain S4121 1000 S4131 2500 S4141 5000 S4161 25000	Model # Gain S4221 1000 S4231 2500 S4241 5000 S4261 25000	Model # Gain S4321 1000 S4331 2500 S4341 5000 S4351 10000	Model # Gain S4322 1000 S4332 2500 S4342 5000
OUT IMPEDANCE (ohms typical)		100	100	100	10
POWER SUPPLY (voltage ±10%)		28 V DC	28 V DC	28 V DC	26 VRMS
INPUT POWER (watts)	(at zero signal)	1	1	2	2
	(at rated load)	5	7	12	12
MOTOR LOAD	winding	TCT**	TCT**	TCT**	USE***
	voltage	33-40	33-40	33-40	26
	effec. resistance	800 ±25%	460 ±25%	270 ±25%	100-350
AMBIENT TEMP. RANGE	operating	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C
	storage	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C
TYPICAL DIMENSIONS		.81" x .43" x 1.1"	.81" x .43" x 1.1"	.81" x .43" x 1.1"	1.2" x 1.2" x 1.3"
WEIGHT (ounces, approximate)		1.5	1.5	1.5	2

POWER OUTPUT		9 WATT	16 WATT	25 WATT	40 WATT	
PHASE SHIFT		0° or 90°	0° or 90°	0° or 90°		
MODEL NUMBER		S4421 S4431 S4441 S4461	S4521 S4531 S4541 S4551	S4621 S4631 S4641 S4651	S4721 S4731 S4741 S4751	S4722 S4732 S4742
INPUT SIGNAL (vrms max. at max. gain)		26	26	26	26	26
VOLTAGE OUTPUT (vrms nominal)	(linear region)	0-25	0-25	0-25	0-25	0-18
	(at rated power)	40	40	40	40	26
VOLTAGE GAIN ±1db (v/v max. adjustable down)		Model # Gain S4421 1000 S4431 2500 S4441 5000 S4461 25000	Model # Gain S4521 1000 S4531 2500 S4541 5000 S4551 10000	Model # Gain S4621 1000 S4631 2500 S4641 5000 S4651 10000	Model # Gain S4721 1000 S4731 2500 S4741 5000 S4751 10000	Model # Gain S4722 1000 S4732 2500 S4742 5000
OUT IMPEDANCE (ohms typical)		50	50	40	25	2
POWER SUPPLY (voltage ±10%)		28 V DC	28 V DC	28 V DC	28 V DC	26 VRMS
INPUT POWER (watts)	(at zero signal)	3	3	3	3	3
	(at rated load)	20	32	50	100	100
MOTOR LOAD	winding	TCT**	TCT**	TCT**	TCT**	USE***
	voltage	33-40	33-40	33-40	33-40	26
	effec. resistance	177 ±25%	100 ±25%	60 ±25%	40 ±20%	20-100
AMBIENT TEMP. RANGE	operating	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C	−55°C to 125°C
	storage	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C	−65°C to 150°C
TYPICAL DIMENSIONS		1.43" x 1.87" x 2.03"	1.43" x 1.87" x 2.03"	2.21" x 2.51" x 2.37"	2.21" x 2.51" x 2.37"	2.21" x 2.51" x 2.37"
WEIGHT (ounces, approximate)		8	8	12	12	12

Notes: **1.** Operating frequency: 400Hz ±20. 60Hz available. **2.** Input Signal (Max): 26V. **3.** Gain Stability: ±2 db over environment. **4.** Input Impedance: 10K ohms minimum. **5.** Deadband: 500/V. Gain. [mv, no output referred to input.] **6.** Noise: 250 MV, max, output with input shorted. **7.** Bandwidth: 200Hz minimum. **8.** **TCT - Tuned center tap; ***USE - untuned single ended. **9.** Mechanical Configuration: Consult factory over 25 Standard Packages available for units shown.

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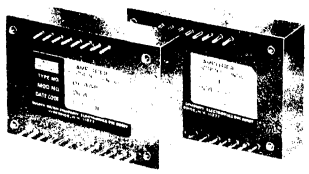
BULOVA SERVO PRODUCTS
ELECTRONICS DIVISION
OF BULOVA WATCH COMPANY, INC.
61-20 WOODSIDE AVENUE
WOODSIDE, N. Y. 11377 • 212 335-6000

BULOVA SERVO PRODUCTS

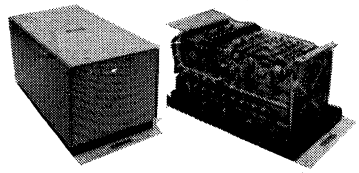
DC SERVO AMPLIFIERS 25 to 1000 WATTS

TYPICAL CONFIGURATIONS

DCA 25/60
DCA 50/60



Models DCA 200 & 300



Models DCA 1000

FEATURES:

- Adjustable Gain
- Current Limiting
- Voltage or Current Feedback
- Wide Bandwidth
- Low Cost

DESIGNED TO DRIVE:

- DC Torque Motors
- Low Inertia Motors
- DC Servo Motors
- Deflection Coils

SPECIFICATIONS

SPECIFICATIONS (Nominal @ 25°C)	DCA 25	DCA 25/60	DCA 50/60	DCA 200	DCA 300
OUTPUT (at nominal power supply voltage)					
Current, Amperes Continuous	±1.25	±0.5	±1	±5	±6
Voltage, peak	±20	±50	±50	±20	±20
Current, Amperes peak	±1.25	±0.5	±1	±10	±15
Current Limit Adjust Range, Amperes	0.2 to 1.25	0.2 to .5	0.2 to 1	0.2 to 10	0.2 to 15
INPUT					
Supply Voltage (VDC)	+28 ±3	+60 ±5	+60 ±5	+28 ±3	+28 ±3
Supply Quiescent Current (ADC)	0.05	0.05	0.05	0.05	0.05
Bias Supply Voltage (VDC)	−15 ±2	−15 ±2	−15 ±2	−15 ±2	−15 ±2
Bias Supply Current (MADC)	20	20	20	20	20
POWER AMPLIFIER PARAMETERS					
Input Impedance K ohms	10	10	10	10	10
Gain (adjustable)					
As voltage amplifier (V/V)	20	20	20	20	20
As current amplifier (A/V)	0.5	0.5	0.5	0.5	0.5
Frequency Response (KHz)					
Small signal	10	10	10	10	10
Full output	1	1	1	1	1
Output Impedance (Dynamic, ohms)	0.1	0.1	0.1	0.1	0.1
Output Offset Null (MVDC)	100	100	100	100	100
Offset Drift (micro V/°C) (4)	10	10	10	10	10
DC Dead Band (micro volts)	±50	±50	±50	±50	±50
PREAMPLIFIER	(7)	(7)	(7)	(7)	(7)
INTERNAL DISSIPATION					
Operating Temp. Range (°C)	−55 to +125(5)	−55 to +125(5)	−55 to +125(5)	−55 to +125(5)	−55 to +125(5)
Continuous, at 25°C (watts)	25 (5)	25 (5)	50 (5)	200 (5)	300 (5)
Derating for Temperature (watts/°C)	.15	.15	.3	1.2	1.75
WEIGHT	3 oz.	3 oz.	6. oz.	9 oz.	9 oz.

SPECIFICATIONS (Nominal @ 25°C)	DCA 300/60	DCA 600/60	DCA 1000-1	DCA 1000-2	DCA 1000-3
OUTPUT (at nominal power supply voltage)					
Current, Amperes Continuous	±6	±6	±15	±15	±15
Voltage, peak	±50	±50	±65	±65	±65
Current, Amperes peak	±6	±12	±15	±15	±15
Current Limit Adjust Range, Amperes	0.2 to 6	0.2 to 12	1.5 to 15(1)	1.5 to 15(1)	1.5 to 15(1)
INPUT					
Supply Voltage (VDC)	+60 ±5	+60 ±5	+75 ±5	+75 +5	+7 +5
Supply Quiescent Current (ADC)	0.05	0.05	0.1	0.1	0.15
Bias Supply Voltage (VDC)	−15 ±2	−15 ±2	(8)	−15 ±2	(8)
Bias Supply Current (MADC)	20	20	(8)	20	(8)
POWER AMPLIFIER PARAMETERS					
Input Impedance K ohms	10	10	10		
Gain (adjustable)					
As voltage amplifier (V/V)	20	20	10	10	10
As current amplifier (A/V)	0.5	0.5	2.5	2.5	2.5
Frequency Response (KHz)					
Small signal	10	10	10	10	10
Full output	1	1	1	1	1
Output Impedance (Dynamic, ohms)	0.1	0.1	0.1	0.1	0.1
Output Offset Null (MVDC)	100	100	100	100	100
Offset Drift (micro V/°C) (4)	10	10	10	10	10
DC Dead Band (micro volts)	±50	±50	±50	±50	±50
PREAMPLIFIER	(7)	(7)	uA 741 (2) (3)	uA 741 (2) (3)	uA 741 (2) (3)
INTERNAL DISSIPATION					
Operating Temp. Range (°C)	−55 to +125(5)	−55 to +125(5)	−20 to +70(6)	−20 to +70(6)	−20 to +70(6)
Continuous, at 25°C (watts)	300 (5)	600 (5)	1,000 (6)	1,000 (6)	1,000 (6)
Derating for Temperature (watts/°C)	1.75	3.5	10	10	10
WEIGHT	9 oz.	16 oz.	14 lbs.	14 lbs.	14 lbs.

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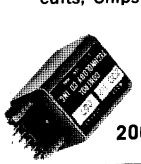
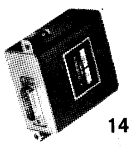
SERVO ELECTRONICS

STANDARD AND CUSTOM DESIGNED

A.C. Servo Amplifiers · D.C. Servo Amplifiers · D.C. Torquer Amplifiers · Demodulators · Modulators · Servo Valve Amplifiers · Digital Controllers · Clutch Control Amplifiers · Relay Control Amplifiers · Resolver Booster Amplifiers · Isolation Amplifiers

- Standard units available which will meet applicable MIL Specs.
- Amplifiers available which utilize state of the art Integrated Circuits, Chips and Hybrids.
- Units for industrial applications available
- SPECIAL electronics designed to your detailed specification


200 HP*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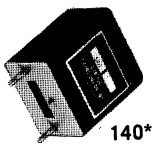
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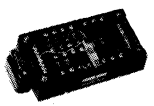
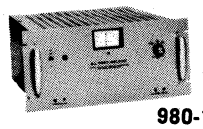
416-3


916 (Flat Pack)


980-1

AMPLIFIERS FOR A.C. SERVO MOTORS

MODEL	Output Power	Output Voltage	Output Frequency	Input Signal Frequency	Input Impedance	Gain	Power Required	Temperature Range
200-HP	3.5 W	40 VCT	400 CPS	400 CPS	10K	2,500	28 VDC	—55°C +125°C
200-5	3.5 W	40 VCT	400 CPS	400 CPS	10K	5,000	28 VDC	—55°C +125°C
930	3.5 W	40 VCT	400 CPS	400 CPS	250K	2,000	28 VDC	—55°C +125°C
200-8	3.5 W	40 VCT	400 CPS	400 CPS	10K	2,500	115V 400 CPS	—55°C +125°C
216B	6 W	40 VCT	60 CPS	60 CPS	10K	1,000	28 VDC	—55°C +85°C
140	6 W	40 VCT	400 CPS	400 CPS	50K	1,000	28 VDC	—55°C +125°C
141	6 W (90°)	40 VCT	400 CPS	400 CPS	30K	1,000	28 VDC	—55°C +125°C
416-3	16 W	40 VCT	400 CPS	400 CPS	10K	1,000	28 VDC	—55°C +71°C
416A/D	16 W (0°/90°)	40 VCT	400 CPS	400 CPS (2)	10K	1,000	28 VDC	—55°C +100°C
416E	16 W (90°)	40 VCT	400 CPS	DC (2)	50K	1000	28 VDC 115V 400 CPS	—55°C +125°C
159	16 W	40 VCT	60 CPS	60 CPS	10K	1,000	28 VDC	—55°C +100°C
159A	16 W	40 VCT	60 CPS	DC	100K	1000	28 VDC	—55°C +100°C
174	40 W (90°)	40 VCT	60 CPS	60 CPS	20K	1000	28 VDC	—55°C +71°C
956B	40 W (90°)	40 VCT	400 CPS	400 CPS	10K	1,000	28 VDC	—55°C +100°C
956C	40 W (90°)	40 VCT	400 CPS	DC	10K	500	28 VDC 115V 400 CPS	—55°C +100°C
170-1	100 W (90°)	40 VCT	400 CPS	400 CPS	10K	1000	28 VDC	—55°C +85°C

MODIFICATIONS to gain, input impedance, signal frequency, and power level are available. Matching transformers for driving motors at other voltages in stock.

AMPLIFIERS FOR D.C. TORQUERS

916	110W (Flat Pack - Short Circuit Proof)	20 V	DC	DC (2)	10K	$3x10^5$	28 VDC −15 VDC	−55°C +100°C
996-5	20 W	22V	DC	DC (2)	10K	500	28 VDC	—55°C +85°C
998-6	40 W (Short Proof)	22V	DC	DC (2)	10K	500	28 VDC	—55°C +85°C
987	125 W (Short Proof)	20V	DC	DC (1)	100K	10	28 VDC	—55°C +71°C
914-3	220 W (Short Proof)	20V	DC	DC (2)	25K	200	28 VDC	—55°C +71°C
980-1	500 W (Short Proof)	50V	DC	DC	10K	100	50-400 CPS 3 Phase (1 Phase Available.)	—55°C +71°C
980-8	800 W	50V	DC	DC	10K	100	50-400 CPS 3 Phase (1 Phase Available.)	—55°C +71°C

MODIFICATIONS . to gain, input impedance, signal frequency, power level and operating temperature available.

AMPLIFIERS FOR SERVO VALVES AND CLUTCHES

985	6.5 W	23 VDC	DC	DC	10K	20	28 VDC 115V 400 CPS	—55°C +71°C

Provisions for Balance and Null current adjustment. Will drive either a single center tapped coil or two separate coils.

MODULATORS AND DEMODULATORS

312	Full Wave	10V	DC	60 CPS	10K	100	28VDC 115V Reference	—55°C +125°C
334-1	Full Wave	50V	DC	400 CPS	10K	180	28VDC 115V 400 CPS	—55°C +125°C
312-1	Full Wave	10V	DC	60 to 5000 CPS	10K	10	28VDC 115V Reference	—55°C +125°C
350-1	Full Wave	15V	DC	400 CPS	10K	10	28VDC 115V 400 CPS	—55°C +125°C

MODIFICATIONS to gain, output voltage and input impedance available.

RESOLVER BOOSTER & ISOLATION AMPLIFIER

328	0.1% Accuracy	10V	400 CPS	400 CPS	200K	1 ±.1%	28 VDC	—55°C +125°C

Available as single channel or dual channel unit. Will operate size 8 or size 11 resolvers. Amplifiers with modifications to above parameters available.

TEMPERATURE CONTROLLERS

703 Will drive heaters with power ranges up to 500 watt. Operates directly from 115 volt power line. Noise free switching with built in over current protection.

MODIFICATIONS to sensing circuit, accuracy and power output available.

CONTROL TECHNOLOGY CO., inc., 41-16 29th Street, Long Island City, N.Y. 11101 • 212 EMpire 1-2133

DIGITAL • ANALOGUE CONTROL SYSTEMS

STANDARD AND CUSTOM DESIGNED

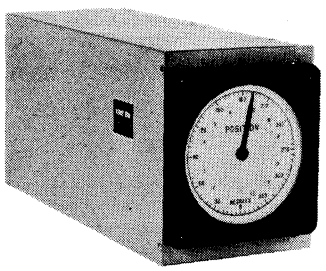
Servo Indicators	Two Speed Servos	Computer Interface Systems	
Servo Actuators	Servo Computers	Analogue to Digital Converters	Process Controllers
Servo Repeaters	Data Transmission Systems	Nuclear Control Rod Indicators	Special Control Systems

- Units available which will meet applicable MIL Specifications
- Devices designed to operate with A.C., D.C., synchro or resolver command signals.
- All units feature self-contained solid state high reliability electronics and power supplies.
- Units now in use on numerous systems involving:

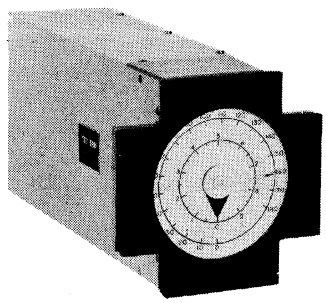
Simulators	Ground Support	Aircraft instrumentation
Fire Control	Missile Tracking	Missile instrumentation
ASW	High Accuracy Positioning	Stable Platforms

- Special systems can be designed in accordance to your detailed specifications. CTC will also design **"Interface"** equipment to integrate major control systems.

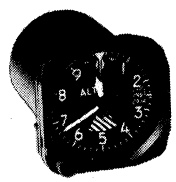
INDICATORS



CS-106 Single Pointer Indicator

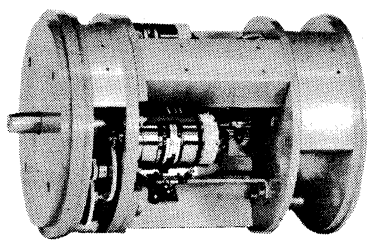


CS-109 Dual Pointer Indicator

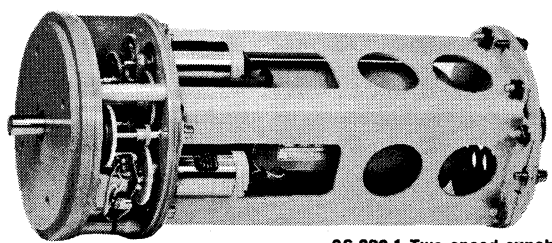


Simulated Altimeter

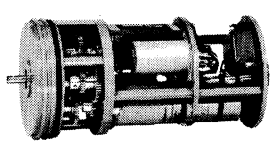
SERVO ACTUATORS



CS-202-2 300 lb. in. actuator

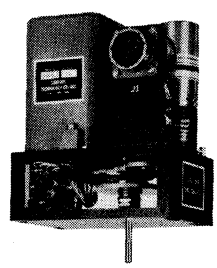


CS-202-1 Two speed synchro high accuracy actuator



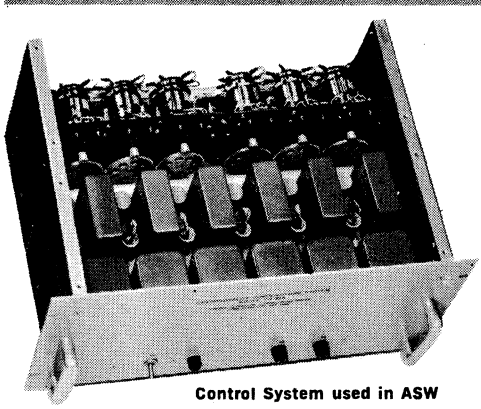
CS-198 250 oz. in. 0.1% accuracy actuator

Although CTC is best known for its system engineering, a most significant part of the company is in the field of CUSTOMIZING of electronics and electromechanical assemblies for control systems applications. By using the off-the-shelf modules shown in this short form catalogue, we can accomplish such MODIFICATIONS in a short time and in most cases without extra cost.

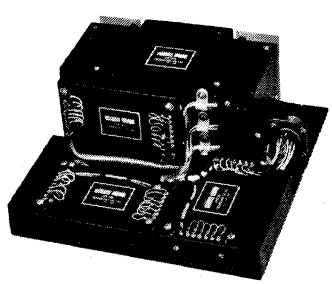


Custom Servo Actuator

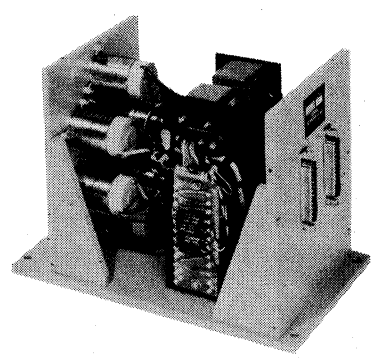
SPECIAL SYSTEMS



Control System used in ASW



Digital Control System



Dual Channel Resolver Angle Computer

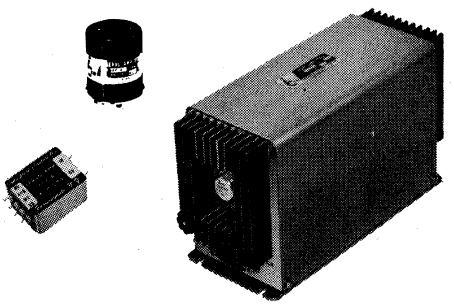
CONTROL TECHNOLOGY CO., inc., 41-16 29th Street, Long Island City, N.Y. 11101 • 212 EMpire 1-2133

SERVO COMPONENTS

INSTRUMENTS, AMPLIFIERS and ACCESSORIES

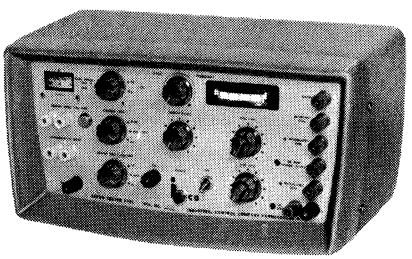
FOR MILITARY AND INDUSTRIAL CONTROL SYSTEMS

SERVO AMPLIFIERS



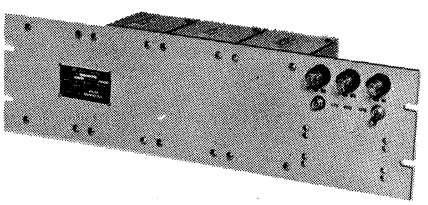
- *DC, pot and synchro inputs*
- *60 and 400∼ outputs*
- *Hybrid 972A (.5 cu in, 9 watts) to Triac 893A (800 watts)*
- *160 different models*

SERVO TESTERS



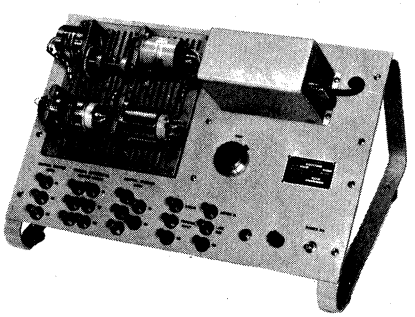
- *100C, general purpose use*
- *103A, prod and field test*
- *Frequency and transient response*
- *For DC and AC servos*

SYNCHRO AMPLIFIERS



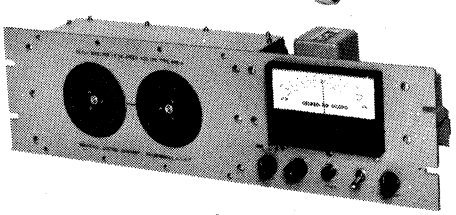
- *929R, 90V./line, 400∼ stators*
- *820A, 90V./line, 60∼ stators*
- *Buffer CX's from CT and TR loads*
- *High accuracy and fast response*

SERVO DEMONSTRATORS



- *Laboratory experiments*
- *Industrial training*
- *Synchro and pot data*
- *60 and 400∼ models*

SYNCHRO DIRECTORS



- *Generate 1 and 36 speed stator voltages*
- *Constant velocity and harmonic motion modes*
- *Computer programmed*
- *60 and 400∼ stator outputs.*

Write for Catalog of our COMPLETE Servo Line.

INDUSTRIAL CONTROL COMPANY

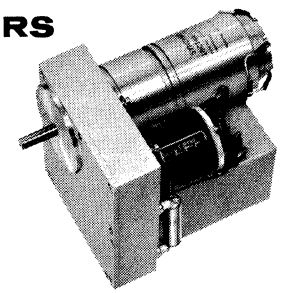
CENTRAL AVENUE AT PINELAWN ▪ FARMINGDALE, L.I., N.Y. 11735 ▪ 516-694-3000

SERVO SYSTEMS

STANDARD MODULES *or* SPECIALS

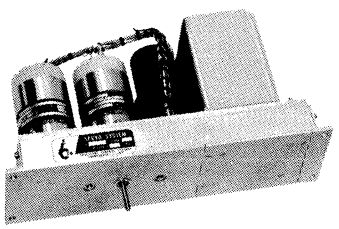
MIL-GRADE AND FAST DELIVERY

High Torque SYNCHRO REPEATERS



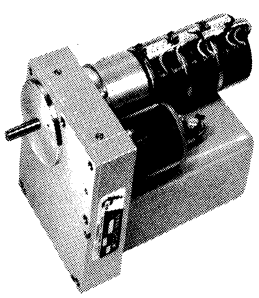
- *770 Series for 400 ∿*
- *847 Series for 60 ∿*
- *8′ error*
- *300 oz in shaft torque*
- *117V. line power*

Two Speed SYNCHRO REPEATERS



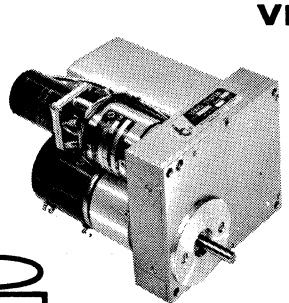
- *771 Series for 400 ∿*
- *921 Series for 60 ∿*
- *16, 25 and 36 speed*
- *Shaft at hi speed*
- *117V. line power*

DC and AC POT FOLLOWERS



- *900 Series*
- *DC, 60 or 400 ∿ inputs*
- *1, 3 or 10 turn pots*
- *Torques to 300 oz in*
- *117V. 60 or 400 ∿ power*

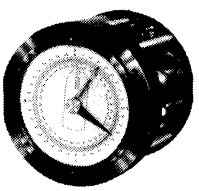
Precision DC VELOCITY SERVOS



- *982 Series for 60~*
- *983 Series for 400~*
- *±10V. DC command*
- *117V. line power*
- *Wide range of torques and speed.*

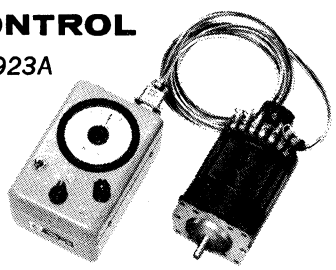
3 Axis SERVO INDICATOR

- *type 909A*



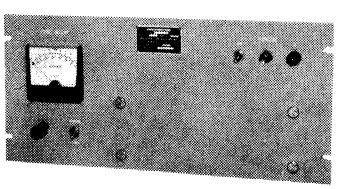
Bi-Directional PRECISION SPEED CONTROL

- *type 923A*



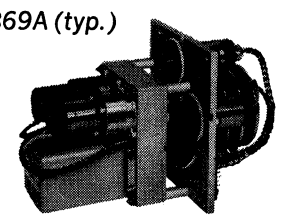
Process Control DELAYED SIGNAL GENERATOR

- *type 849B*



Custom Assemblies TO CUSTOMER SPECS.

- *type 869A (typ.)*



Modifications from Standards readily available.

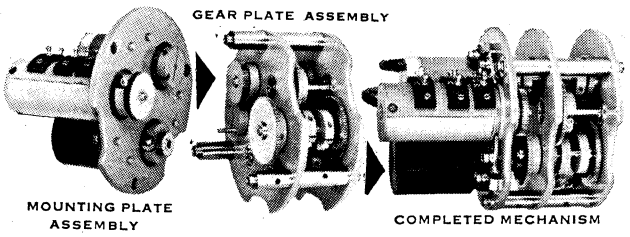
INDUSTRIAL CONTROL COMPANY

CENTRAL AVENUE AT PINELAWN ▪ FARMINGDALE, L.I., N.Y. 11735 ▪ 516-694-3000

PMC SERVO MECHANISMS & COMPONENTS

PREDESIGNED MECHANISMS

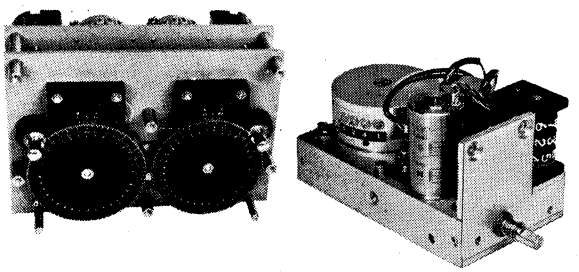
A complete line of off-the-shelf components for assembling an unlimited variety of geared mechanisms. Gear ratios to 78,125:1, zero-backlash spring-loaded gears and torque-limiting slip clutches are featured. Assembled units meet design and materials requirements of MIL-E-5400 and MIL-E-16400.



For complete data and catalog of stocked components, request Bulletin 102.

CUSTOM DESIGNS

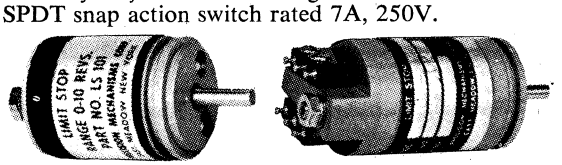
PMC specializes in design and manufacture servo mechanisms and mechanical modules to user requirements for airborne, ground support, communications, fire control and other critical applications. The units shown below are typical of the mechanisms designed and manufactured for military and industrial equipments.



Short lead time delivery on both prototypes and production quantities.

ADJUSTABLE LIMIT SWITCHES & STOPS

0-10, -20, -40 revolutions without snap action switch, 0-25 revolutions with snap action switches actuated just before mechanical stops. All models infinitely adjustable with single external screw. SPDT snap action switch rated 7A, 250V.



Limit Stop
Series LS 100
⅝ and ⅞" dia.

Limit Stop And Switch
Series LS 300
$1\frac{5}{16}$" dia.

For complete data, request Bulletins 103 and 104

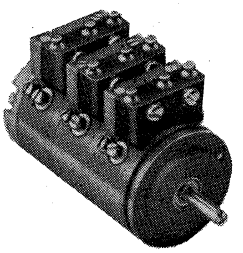
CAM SWITCHES

Adjustable-In-Motion

PMC's patented cam switch design incorporates in a single component all the functions of a conventional plate cam, cam follower and snap-action switch, eliminating the need for separately-mounted cam mechanisms and switches and their associated hardware. Externally-adjustable dwell angles can be set to any position with respect to the shaft. All models available as single- or multi-switch types, with ganged switches independently adjustable.

Model CS 402 Miniature Cam Switches

Miniature units designed and manufactured to military and aerospace specifications.

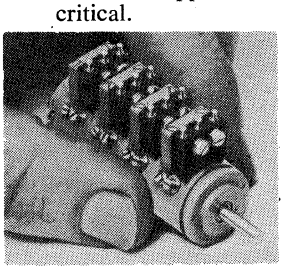


Diameter: 1-1/16", equivalent to to BuOrd Size 11
Length: 0.8", one switch, plus 0.5" per switch
Dwell Angle: 3° to 357°
Switch: SPDT
Rating: 5A, 250VAC, 30VDC
Multi-Switch Models: up to 10 switches
Shaft: 0.125" dia.

For complete data, request Bulletin 106

Model CS 601 Subminiature Cam Switches

Subminiature units for airborne, space vehicle and other applications where size and weight are critical.

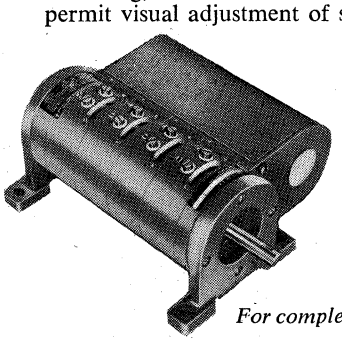


Diameter: 0.75", equivalent to BuOrd Size 8
Length: 0.730" one switch, plus 0.437" per switch
Dwell Angle: 3° to 357°
Switch: SPDT
Rating: 7A, 250VAC, 30VDC
Shaft: 0.125" dia.
Multi-Switch Models: up to 8 switches

For complete data, request Bulletin 109

Model CS 501 High-Power Cam Switches

Industrial types for control, cycling and sequencing of machine operations. End- or side-mounting, with or without switch covers. Dials permit visual adjustment of switching points and dwell angles.



Dwell Angle: 5° to 355°
Diameter: 3.5"
Length: 3" one switch, plus 1.5" per switch
Shaft: 0.5" dia.
Switches: SPDT, DPDT. Special types to requirements.
Ratings: to 25A and 600 V, inrush current to 75A.

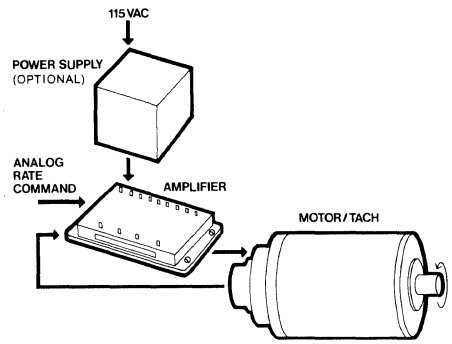
For complete data, request Bulletin 108

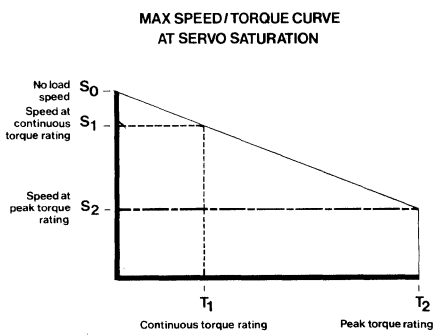
PRECISION MECHANISMS CORPORATION
44 BROOKLYN AVENUE, WESTBURY, L.I., NEW YORK 11590 • (516) ED 3-5955

Snapper Series Wide Bandwidth

SPEED/POSITION CONTROL SYSTEMS

(FOR SNAPPER MOTOR AND AMPLIFIER COMPONENTS, SEE **EEM** Vol.2•322 & 2•668)





The SNAPPER Series of wideband, direct drive, servo systems consists of a low inertia, permanent magnet, DC motor/tachometer and a transistorized servo controller. In contrast to an SCR control system, the high gain and wide bandwidth of the SNAPPER system assures response to rapidly varying command signals, rejection of torque disturbances and freedom from parameter variations. In addition to precise average speed regulation, it minimizes instantaneous speed fluctuations.

Features include:

Choice of Output Power	— .01 to .5 HP
Wide Speed Range	— 2000 to 1 bidirectional
Precise speed regulation	— 1 RPM from no load to full load
Low Flutter	— 1% instantaneous speed variation
Excellent Linearity	— 1% of set speed or 1 RPM
Fast Dynamic Response	— Over 200 Hz servo bandwidth

In addition to its use as a speed control system, the SNAPPER can be used as the inner loop of a wideband, high gain position control system. For such applications, provisions are included for adding related position loop circuitry.

The SNAPPER system is modular in concept. Available options include power supply, DC reference, and panel mount. The motor/tachometer can be furnished with an integral optical encoder and a brake.

Listed below are several standard speed control systems. These, however, represent only a few configurations. Many other speed/torque combinations can be supplied.

STANDARD SPEED CONTROL SYSTEMS

Motor/Tach/ Amp Rate Loop Model No.	Rated Torque oz-in T_1	Peak Torque oz-in T_2	No Load RPM S_0	Rated Speed RPM S_1	RPM @ Peak Torque S_2	Motor/Tach* Inertia oz-in-sec^2 x 10^{-3}	Motor Frame Included†	Amplifier Included†	Price 100 Lot	Power Supply (Optional) at Extra Cost
RL-3201B	30	30	800	Stall	Stall	5.0	3210	PA-011	177	DPS-24-3
RL-3211C	30	30	2400	1500	1500	5.0	3210	PA-112	217	DPS-24-3
RL-3211B	30	44	1200	350	Stall	5.0	3210	PA-112	217	DPS-24-3
RL-3260A	30	90	3500	2500	500	5.0	3210	PA-601	311	DPS-24-15
RL-5011A	150	150	400	Stall	Stall	50	5010	PA-112	236	DPS-24-3
RL-5060A	150	390	2800	2400	1700	50	5010	PA-601	331	DPS-40-25
RL-5060B	150	600	1750	1350	Stall	50	5010	PA-601	331	DPS-40-25
RL-5060C	400	960	1100	650	Stall	120	5030	PA-601	398	PDS-40-25
RL-5060D	400	500	2100	1700	1550	120	5030	PA-601	398	DPS-40-25

*The servo compensation is based upon load inertias of zero to twice the motor/tach inertia. Higher load inertias may require the adjustment of a single feedback resistor.

†For Motor Details see Vol.2•668, for Amplifiers Details see Vol.2•322

Torque Systems Inc.
P.O. Box 167, 225 Crescent Street, Waltham, Mass. 02154 (617) 891-0230

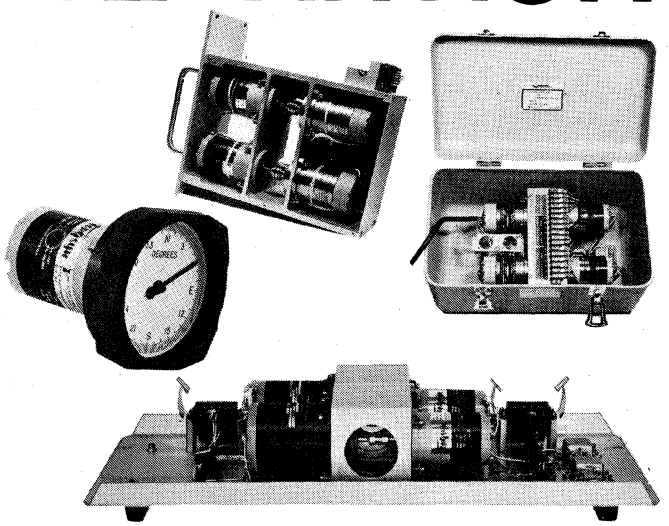
VERNITRON

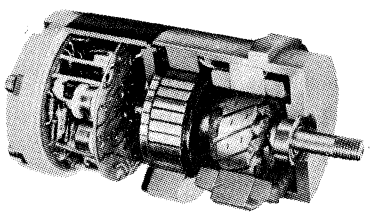
Torqsyn® REMOTE POSITIONERS

The Torqsyn Remote Positioner is a complete gearless servo system in one small package. It is an integrated system that combines a synchro transformer, torque motor, amplifier, stabilization network in a single package. The Torqsyn thus can simplify design, procurement, assembly and maintenance, and improve reliability.

Torqsyn converts input synchro data into accurate shaft position. High input impedance allows it to be driven by low power signal sources. The Torqsyn Remote Positioner may be used to drive potentiometers, encoders, resolvers, indicators, etc. Size 16, 23 and 37 housings are available.

Complete subsystems and assemblies incorporating Torqsyn units can be designed and or produced to requirements. These include synchro signal amplifiers, synchro signal position-indicators and error detectors. In most cases, these subsystem packages are more compact and reliable than conventional systems.





Typical Torqsyn Performance Characteristics @ 25°C

MODEL	DIAM. (In)	LENGTH (In)	VOLTS Primary	VOLTS Signal	FREQ. (Hz)	STATIC Acc. (± Min.)	STALL Torque (Oz-In)	TORQUE Gradient (Oz-In)	POWER Stall (Watts)	POWER Quiescent (Watts)	NO LOAD Speed (Rpm)	INPUT Impedance (Ohms)	VELOCITY Constant (1/Sec)
VTSN16-4A2	1.600	3.478	26.0	11.8	360-440	15	2.7	10	9	2.5	650	600	15,000
VTSN23-4A2	2.250	3.445	26.0	11.8	360-440	15	3.0	7	4	2.5	400	2200	4,000
VTSN23-64E2	2.250	3.445	115	90	50-440	10	4.0	20	16	5.0	500	4600/24,500	10,000/13,000

NOTE: Length is from front face to terminal block not including terminal screws.

vernitorq® BRUSHLESS DC LIMITED ROTATION TORQUE MOTORS

These versatile, wide angle, two and four-pole motors combine accuracy, quality and economy for positioning, drive, actuation or tensioning systems.

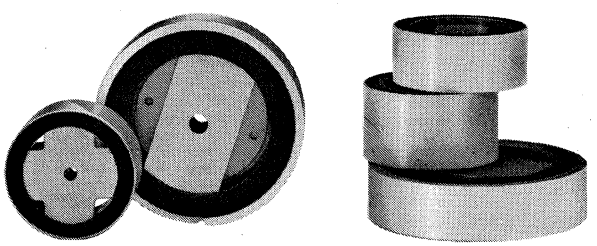
Their high torque to power ratio and rapid acceleration at slow speeds allows direct coupling without gears, with resulting smooth, quiet, reliable operation and compact packaging.

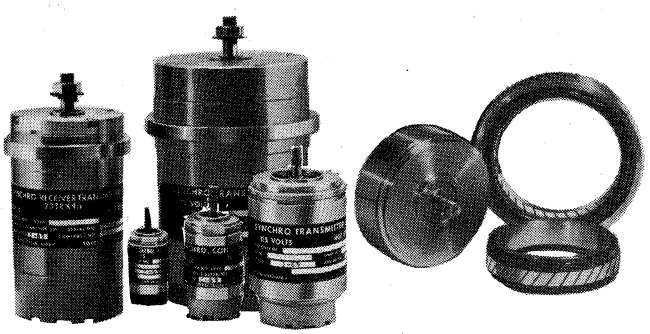
Brushless design of VERNITORQ motors provides infinite resolution, high linearity and sensitivity. Ripple slot-lock effect, electrical/mechanical noise and wear are eliminated.

Many models are available with peak torque ratings from 2 to 500 oz-in. Typical angular excursions are approximately 50 degrees for four-pole designs and 120 degrees for two-pole designs.

Space saving pancake units are only 1.7 to 5.2 inches in diameter. Housed versions also are available. Special designs to individual requirements can be provided.

Brushless AC tachs are also available in these same sizes.





VERNITRON SYNCHROS & RESOLVERS

Standard synchros include frame sizes 8 thru 45, with accuracies down to 3 minutes, in the latest Mil-Spec designs.

Standard resolvers can be furnished in BuWeps frame sizes 8, 11, 15 and 23. Accuracies are to .05% on computing types and 20 seconds on data transmission units. Additional features include temperature compensation, varying voltage, frequency and impedance levels.

Pancake synchros and resolvers are available in single speed, multi-speed (2X to 72X), and dual or triple combinations of speeds. Single speed units have accuracies to 10 seconds, multi-speed units have accuracies to 3 seconds.

VERNITRON CORPORATION
Control Components Division
2440 West Carson Street, Torrance, California 90501 / (213) 328-2504, TWX: 910-349-6250

Arcolectric™

SWITCHES • INDICATOR LIGHTS

Serving Industry Since 1932

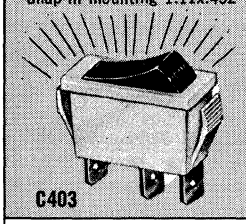
The very finest switches, indicator lights, and accessories for manufacturers of electronic, automotive, electrical, marine, appliance, industrial control, and allied equipment.

Illustrated here are but a few of the many styles, circuit arrangements, and colors available. For specifications on our full line, ask for Catalog 140A.

SERIES 400 ROCKER SWITCHES

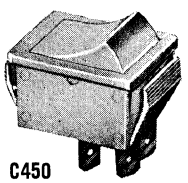
10A 125/250V AC • .250" Tab Terminals
Available in various circuit arrangements; lighted; spring return

Single Pole
Snap-in mounting 1.11x.452"



C403

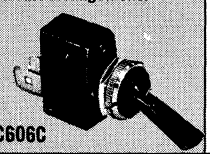
Double Pole
Snap-in mounting 1.11x.88"



C450

SERIES 600 SINGLE POLE LEVER SWITCHES

3A 125/250V AC
½" dia. mounting hole
Available with various terminals, lever styles, circuit arrangements

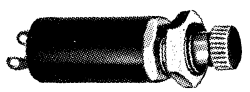


BC606C

SERIES 900 MOMENTARY PUSHBUTTON SWITCHES

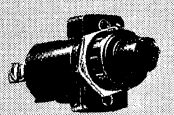
Single Pole • Normally Open or Normally Closed
Button Colors: Black, White, Red, Green

MINIATURE SWITCHES
1A 125/250V AC
1.19x.355" dia.

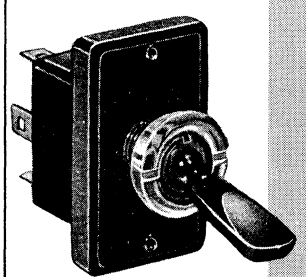


T906 and T908

STANDARD SWITCHES
1A 125V AC
Tab or screw terminals
½" dia. mounting hole



S936/DI and S938/DI



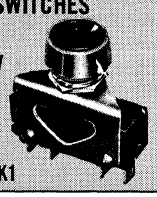
C2721/5

SERIES 2700 LEVER SWITCHES

Heavy Duty Switches with Solid Silver Contacts
Single Pole • Double Pole
Chrome Plated Brass or All Insulated Nylon Levers
13A 125/250V AC
.250" Tab Terminals
Choice of Lever Styles and Sizes
Various Circuit Arrangements Available

SERIES 290 MOMENTARY 2-CIRCUIT MANUAL-OPERATION SNAP-ACTION SWITCHES

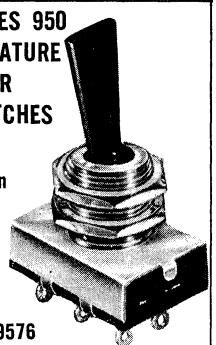
15A 125/250V AC



C290/K1

SERIES 950 MINIATURE LEVER SWITCHES

Light Action

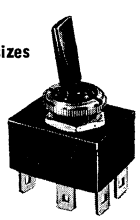


T9576

SERIES 8000 LEVER SWITCHES

Single Pole • Double Pole
10A 125/250V AC
.250" Tab Terminals
½" dia. Mounting Hole
Nylon levers in several styles and sizes
Various circuit arrangements

C8005

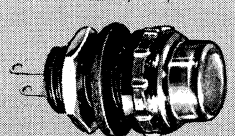


C8606

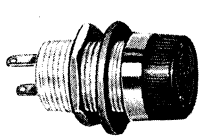
INDICATOR LAMP HOLDERS

Many styles available in various voltages and wattages
Stock Colors: Red, Green, Amber, Blue, Clear
Some lenses can be custom engraved or hot stamped to your specifications

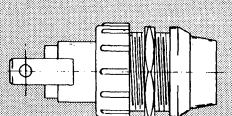
SL60
Midget Screw Base, T1¾
Available 6V, 12V, 24V



SL62
Midget Flange Base, T1¾
For 327, 330, etc. bulbs



SL392/C
Miniature Bayonet Base, T3¼



SUBMINIATURE INDICATOR LIGHTS

LED • Low Voltage • Neon
Overall Length .45" • Mounting Dia. .25"

SL40/12V
Low Voltage Filament Bulb
Red, green, amber, blue, clear

SL41/WL
Neon 125V
Red, amber

SL 42
LED Solid State
Red

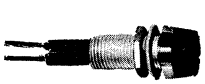
SL43 LED Solid State
Red

SL40/SL41/SL42

NEON INDICATOR LIGHTS

Over Fifty Styles to Choose From
Square • Oblong • Round • Flush
All with Built-In Resistors 125V
Snap-In • Tab Terminals • Wire Leads

SL77 125V
Nylon threaded barrel;
8" leads
Max. panel thickness 11/16"
⅜" mounting dia.
Red, amber



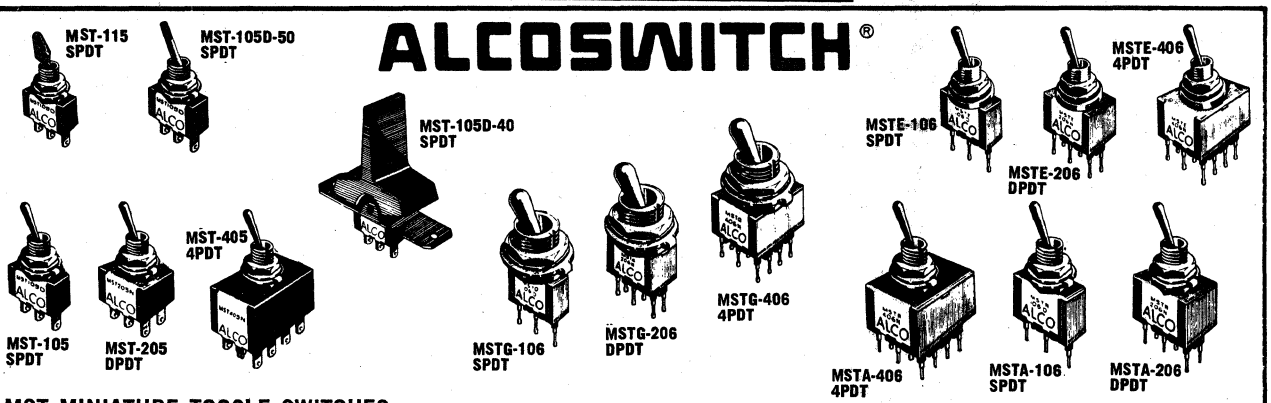
SL180/K 125V
Chrome bezel
½" mounting dia.
Red, amber

SL267B 125V
Snap-in mounting
⅜" mounting dia.
Red, amber

ARCOLECTRIC SWITCH CORPORATION

P. O. Box 348 / North Hollywood, California 91603 / Phone (213) 985-3130 / TELEX 65-1349

ALCOSWITCH®



MST MINIATURE TOGGLE SWITCHES

The original Alcoswitch Series of high quality ultra-miniature toggle switches combines high current capacity and long life in a ½" case. Slim, bat handle or optional white caps (*) are provided. Terminals and contacts are solid silver. Case material is black phenolic resin; ¼-40 threaded bushing. Rated 5 amps at 115 VAC. SPDT and DPDT types have life cycle of over 80,000 on-off operations. High voltage barriers between terminals and contacts. F-1 and R-1 have full throw of 28° no center position. Hardware supplied mounted. (On) Indicates momentary positions.

MINIATURE TOGGLE SWITCHES Available with gold plate at 25¢ additional per pole. (All Columns)

Model	Type	Description ▼	(Pkg.)	One-24	25-99	100-499	500-999
MST-115D	SPDT	On-None-On, White Cap	(25)	1.70	1.16	1.02	.85
MST-215N	DPDT	On-None-On, White Cap	(25)	2.25	1.53	1.35	1.13
MST-315D	3PDT	On-None-On, White Cap	(25)	3.75	2.55	2.25	1.87
MST-415N	4PDT	On-None-On, White Cap	(25)	4.80	3.26	2.88	2.40
MST-105D	SPDT	On-None-On	(25)	1.65	1.12	.99	.83
MST-105E	SPDT	On-Off-On	(25)	1.95	1.33	1.17	.98
MST-105F	SPDT	None-On-(On)	(25)	1.95	1.33	1.17	.98
MST-105G	SPDT	(On)-Off-(On)	(25)	1.95	1.33	1.17	.98
MST-105H	SPDT	On-Off-(On)	(25)	1.95	1.33	1.17	.98
MST-205N	DPDT	On-None-On	(25)	2.20	1.50	1.32	1.10
MST-205P	DPDT	On-Off-On	(25)	2.55	1.74	1.53	1.28
MST-205PA	DPDT	On-On-On	(25)	2.80	1.90	1.68	1.40
MST-205R	DPDT	None-On-(On)	(25)	2.55	1.74	1.53	1.28
MST-205S	DPDT	(On)-Off-(On)	(25)	2.55	1.74	1.53	1.28
MST-205SA	DPDT	(On)-On-(On)	(25)	3.10	2.11	1.86	1.55
MST-205T	DPDT	On-Off-(On)	(25)	2.55	1.74	1.53	1.28
MST-205TA	DPDT	(On)-On-On	(25)	3.10	2.11	1.86	1.55
MST-305D	3PDT	On-None-On	(25)	3.70	2.52	2.22	1.85
MST-305E	3PDT	On-Off-On	(25)	4.00	2.72	2.40	2.00
MST-305F	3PDT	None-On-(On)	(25)	4.00	2.72	2.40	2.00
MST-305H	3PDT	On-Off-(On)	(25)	4.00	2.72	2.40	2.00
MST-305HA	3PDT	(On)-On-On	(25)	4.25	2.89	2.55	2.12
MST-405N	4PDT	On-None-On	(25)	4.75	3.23	2.85	2.38
MST-405P	4PDT	On-Off-On	(25)	5.15	3.50	3.09	2.58
MST-105F-1	SPDT	On-None-(On) Long Throw	(25)	1.95	1.33	1.17	.98
MST-205R-1	DPDT	On-None-(On) Long Throw	(25)	2.55	1.74	1.53	1.28
MST-105D-30	SPDT	On-None-On Rocker	(25)	2.00	1.36	1.20	1.00
MST-205N-30	DPDT	On-None-On Rocker	(25)	2.55	1.74	1.53	1.28
MST-105D-40	SPDT	On-None-On Paddle	(25)	2.00	1.36	1.20	1.00
MST-205N-40	DPDT	On-None-On Paddle	(25)	2.55	1.74	1.53	1.28
MST-105D-49	SPDT	On-None-On Flat Lever	(25)	2.25	1.53	1.35	1.13
MST-105E-49	SPDT	On-Off-On Flat Lever	(25)	2.55	1.74	1.53	1.28
MST-105G-49	SPDT	(On)-Off-(On) Flat Lever	(25)	2.55	1.74	1.53	1.28
MST-205N-49	DPDT	On-None-On Flat Lever	(25)	2.80	1.90	1.68	1.40
MST-205P-49	DPDT	On-Off-On Flat Lever	(25)	3.15	2.14	1.89	1.58
MST-105D-50*	SPDT	On-None-On Long Lever	(25)	1.90	1.29	1.14	.95
MST-105E-50*	SPDT	On-Off-On Long Lever	(25)	2.20	1.50	1.32	1.10
MST-105F-50*	SPDT	None-On-(On) Long Lever	(25)	2.20	1.50	1.32	1.10
MST-205N-50*	DPDT	On-None-On Long Lever	(25)	2.45	1.67	1.47	1.23
MST-205P-50*	DPDT	On-Off-On Long Lever	(25)	2.80	1.90	1.68	1.40
MST-205T-50*	DPDT	On-Off-(On) Long Lever	(25)	2.80	1.90	1.68	1.40
MST-305D-50*	3PDT	On-None-On Long Lever	(25)	3.95	2.69	2.37	1.98
MST-405N-50*	4PDT	On-None-On Long Lever	(25)	5.00	3.40	3.00	2.50

* Patent Pending.
▼ Indicates Keyway.

MSTA SERIES MINIATURE TOGGLE SWITCHES

Similar in specs to Alco "E" Series but without waterproof feature. "No Tear" shoulder or bushing. 6A 125V/3A 250 VAC. Hardware supplied mounted. (On) Indicates momentary positions.

'A' SERIES MINIATURE TOGGLE SWITCHES Available with gold plate at 25¢ additional per pole. (All Columns)

MSTA-106D	SPDT	On-None-On	(25)	1.80	1.22	1.08	.90
MSTA-106E	SPDT	On-Off-On	(25)	2.25	1.53	1.35	1.13
MSTA-106F	SPDT	None-On-(On)	(25)	2.25	1.53	1.35	1.13
MSTA-106G	SPDT	(On)-Off-(On)	(25)	2.25	1.53	1.35	1.13
MSTA-106H	SPDT	On-Off-(On)	(25)	2.25	1.53	1.35	1.13
MSTA-206N	DPDT	On-None-On	(25)	2.35	1.60	1.41	1.18
MSTA-206P	DPDT	On-Off-On	(25)	2.85	1.94	1.71	1.43
MSTA-206R	DPDT	None-On-(On)	(25)	2.85	1.94	1.71	1.43
MSTA-206S	DPDT	(On)-Off-(On)	(25)	2.85	1.94	1.71	1.43
MSTA-206T	DPDT	On-Off-(On)	(25)	2.85	1.94	1.71	1.43
MSTA-206PA	DPDT	On-On-On	(25)	3.15	2.14	1.89	1.58
MSTA-306D	3PDT	On-None-On	(25)	4.05	2.75	2.43	2.03
MSTA-306E	3PDT	On-Off-On	(25)	4.45	3.03	2.67	2.22
MSTA-406N	4PDT	On-None-On	(25)	5.10	3.47	3.06	2.55
MSTA-406P	4PDT	On-Off-On	(25)	5.65	3.84	3.39	2.83
MSTA-406PA	4PDT	On-On-On	(25)	6.15	4.18	3.69	3.08

MSTE SERIES MINIATURE TOGGLE SWITCHES

"E" Series has the most-wanted features. Waterproof 'O' rings are located inside toggle and on shoulder. A mechanical shoulder on the bottom of bushing prevents "tear-offs" when single mounting nut is employed. High voltage barriers between terminals inside as well as outside. Case has superior plastic material capable of withstanding higher impact; guards against accidental damage. Low-loss case has extremely high resistance between terminals and case ground, and its high temperature coefficient is ideally suited for prolonged soldering and printed circuits. Turret type terminals are used for simplified wiring or for P.C. Extra-wide, solid silver contacts are bonded, not riveted, on copper-silver plated terminals. Long life cycle over 100,000 On-Off operatons. (SPDT). 6 amps @ 125 VAC. Hardware supplied mounted. (On) Indicates momentary positions.

'E' SERIES WATERPROOF TOGGLE SWITCHES Available with gold plate at 25¢ additional per pole. (All Columns)

MSTE-106D	SPDT	On-None-On	(25)	1.95	1.33	1.17	.97
MSTE-106E	SPDT	On-Off-On	(25)	2.55	1.74	1.53	1.28
MSTE-106F	SPDT	None-On-(On)	(25)	2.55	1.74	1.53	1.28
MSTE-106G	SPDT	(On)-Off-(On)	(25)	2.55	1.74	1.53	1.28
MSTE-106H	SPDT	On-Off-(On)	(25)	2.55	1.74	1.53	1.28
MSTE-206N	DPDT	On-None-On	(25)	2.55	1.74	1.53	1.28
MSTE-206P	DPDT	On-Off-On	(25)	3.15	2.14	1.89	1.58
MSTE-206PA	DPDT	On-On-On	(25)	3.45	2.35	2.07	1.73
MSTE-206R	DPDT	None-On-(On)	(25)	3.15	2.14	1.89	1.58
MSTE-206S	DPDT	(On)-Off-(On)	(25)	3.15	2.14	1.89	1.58
MSTE-206T	DPDT	On-Off-(On)	(25)	3.15	2.14	1.89	1.58
MSTE-306D	3PDT	On-None-On	(25)	4.25	2.89	2.55	2.13
MSTE-306E	3PDT	On-Off-On	(25)	4.75	3.23	2.85	2.38
MSTE-406N	4PDT	On-None-On	(25)	5.35	3.64	3.21	2.68
MSTE-406P	4PDT	On-Off-On	(25)	5.95	4.05	3.57	2.98

MSTG SERIES MINIATURE TOGGLE SWITCHES

Mustang Series is for designers who prefer the feel of a larger toggle switch but have space limitations behind today's compact panel. Alcoswitch ½" case is utilized, however Mustang mounting requirements are the same as larger switches with 15/32" bushings. This concept is a space-saver in all Mustang models and is especially true in 3 Pole and 4 Pole Series where non-miniature switches are bulky in size. Mustang switches have the most-wanted features as itemized in the "E" Series story with the exception of waterproof 'O' rings. Case construction is of low-loss, high impact and high temperature materials with turret terminals and silver contacts. 6 amps @ 125 VAC. Hardware supplied mounted.

'MUSTANG' TOGGLE SWITCHES Available with gold plate at 25¢ additional per pole. (All Columns)

MSTG-106D	SPDT	On-None-On	(25)	2.15	1.46	1.29	1.08
MSTG-106E	SPDT	On-Off-On	(25)	2.75	1.87	1.65	1.38
MSTG-206N	DPDT	On-None-On	(25)	2.75	1.87	1.65	1.38
MSTG-206P	DPDT	On-Off-On	(25)	3.35	2.28	2.01	1.68
MSTG-206PA	DPDT	On-On-On	(25)	3.65	2.48	2.19	1.83
MSTG-306D	3PDT	On-None-On	(25)	4.45	3.03	2.67	2.23
MSTG-306E	3PDT	On-Off-On	(25)	4.95	3.37	2.97	2.48
MSTG-406N	4PDT	On-None-On	(25)	5.55	3.78	3.33	2.78
MSTG-406P	4PDT	On-Off-On	(25)	6.15	4.18	3.69	3.08

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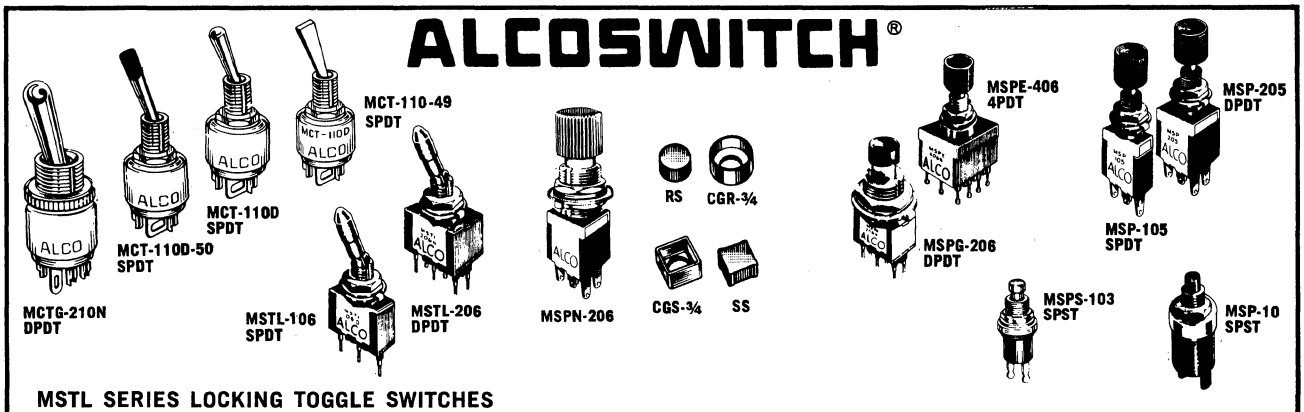
ALCOSWITCH®



MSTL SERIES LOCKING TOGGLE SWITCHES

Lever-Lock Alcoswitch is the world's first "pull-to-unlock"toggle switch for use in hazardous applications. The toggle locks in position to safeguard against accidents. Optional interchangeable color-coded toggle tips available. Rated 6 amps @ 125 VAC. Hardware supplied mounted.

MINIATURE SWITCHES WITH LOCKING TOGGLES Available with gold plate at 25¢ additional per pole. (All columns) (On) Indicates momentary positions.

Model	Type	Description	(Pkg.)	One-24	25-99	100-499	500-999
MSTL-106D	SPDT	On-None-On	(25)	3.15	2.14	1.89	1.58
MSTL-106E	SPDT	On-Off-On	(25)	3.85	2.62	2.31	1.93
MSTL-106F	SPDT	(On)-On-None	(25)	3.85	2.62	2.31	1.93
MSTL-106G	SPDT	(On)-Off-(On)	(25)	3.85	2.62	2.31	1.93
MSTL-206N	DPDT	On-None-On	(25)	3.85	2.62	2.31	1.93
MSTL-206P	DPDT	On-Off-On	(25)	4.45	3.03	2.67	2.22
MSTL-206PA	DPDT	On-On-On	(25)	4.75	3.23	2.85	2.38
MSTL-206R	DPDT	(On)-On-None	(25)	4.45	3.03	2.67	2.22
MSTL-206S	DPDT	(On)-Off-(On)	(25)	4.45	3.03	2.67	2.22
MSTL-306D	3PDT	On-None-On	(25)	5.65	3.84	3.39	2.83
MSTL-306E	3PDT	On-Off-On	(25)	6.25	4.25	3.75	3.13
MSTL-406N	4PDT	On-None-On	(25)	6.95	4.73	4.17	3.48
MSTL-406P	4PDT	On-Off-On	(25)	7.45	5.07	4.47	3.73
MSTL-406PA	4PDT	On-On-On	(25)	7.95	5.41	4.77	3.98
C16‡		Colored Anodized Caps	(25)	.20	.12	.11	.10
C16K‡		Knurled Natural Aluminum Cap	(25)	.25	.17	.15	.14

‡ Hardware

Stocked with natural aluminum caps. Extra caps available in anodized red, blue, green, black. (Specify color).

MINIATURE CYLINDRICAL TOGGLE SWITCHES

All metal construction, high impact terminal insulator. 10 amps @ 125 VAC. Internal contact resistance; under 20 milliohms @ 2-4 VDC, 1 amp. Life 250,000 on-off operations. Contact material, silver on copper. U/L listing available. New Baton Lever is available in the MCT series. The toggle lever is .618" long with black tip for distinctive look. Hardware supplied mounted.

MINIATURE CYLINDRICAL TOGGLE SWITCHES

MCT-110D	SPDT	On-None-On	(25)	1.95	1.33	1.17	.98
MCT-210N	DPDT	On-None-On	(25)	2.55	1.74	1.53	1.28
MCTG-110D	SPDT	On-None-On	(25)	1.95	1.33	1.17	.98
MCTG-210N	DPDT	On-None-On	(25)	2.55	1.74	1.53	1.28
MCT-110D-49	SPDT	On-None-On	(25)	2.55	1.74	1.53	1.28
MCT-210N-49	DPDT	On-None-On	(25)	3.15	2.14	1.89	1.58
MCT-110D-50	SPDT	On-None-On	(25)	2.30	1.57	1.38	1.15
MCT-210N-50	DPDT	On-None-On	(25)	2.90	1.97	1.74	1.45

ILLUMINATED PUSH BUTTON SWITCHES

MSPN Illuminated Push Button Switches are snap-action types capable of handling a high current rating for its small size. DPDT action in a miniature case with separate connections to its replaceable T-1¾ grooved base lamps. Side terminals for simplified wiring or P.C. use. Metal construction, phenolic case hole. Wide choice of plastic buttons. **TRANSPARENT** colors: Red, Amber, Blue, Green, Clear. **TRANSLUCENT:** Red, Yellow, Green, White. Uses grooved base lamps, listed below.

ILLUMINATED PUSH BUTTON SWITCHES, LENS BUTTON. Price less lens button.

MSPN-206N-4	DPDT	Push On-Push Off	(25)	5.65	3.84	3.39	2.83
MSPN-206R-4	DPDT	Momentary	(25)	5.65	3.84	3.39	2.83
RS‡		½" Round Lens Button	(25)	.15	.10	.09	.08
RM‡		⅝" Round Lens Button	(25)	.18	.12	.11	.10
RL‡		¾" Round Lens Button	(25)	.20	.14	.12	.11
SS‡		½" Square Lens Button	(25)	.15	.10	.09	.08
SM‡		⅝" Square Lens Button	(25)	.18	.12	.11	.10
SL‡		¾" Square Lens Button	(25)	.20	.14	.12	.11
CGR-½		½" Chrome Guard, Round	(25)	.35	.24	.21	.19
CGR-⅝		⅝" Chrome Guard, Round	(25)	.45	.31	.27	.25
CGR-¾		¾" Chrome Guard, Round	(25)	.55	.37	.33	.30
CGS-½		½" Chrome Guard, Square	(25)	.35	.24	.21	.19
CGS-⅝		⅝" Chrome Guard, Square	(25)	.45	.31	.27	.25
CGS-¾		¾" Chrome Guard, Square	(25)	.55	.37	.33	.30

‡ Hardware Specify Lens Color

MINIATURE PUSH BUTTON SWITCHES

MSP Miniature Pushbutton Switches, snap-action, 5 amps @ 115 VAC. Solid silver contacts, terminals. Bushing size, ¼-40 with keyway. Black phenolic case. 25,000 life cycle.

MSPE Waterproof Pushbutton Switches, 6 amps resistive, 2 amps.inductive @ 125 VAC. Double "O" waterseals, low-loss "E" Series case; turret terminals. Versatile "double-throw".

MSP-103 Economy Pushbutton Switches, 3 amps @ 125 VAC. Low-Pressure. Silverplated brass contacts, terminals. Plunger travels .098". Depth behind panel, ¾". 1-pc. ¼-40 bushing.

MSPS-103C is similar to MSP-103C except smaller diameter .310. Rated 0.1 amps @ 125 VAC.

MSPG Mustang Push Button Switches rated 6 amps @ 125 VAC (Specs same as MSPE series, less waterproof). 13/32" bushings.

PUSH BUTTON SWITCHES
Available with gold plate at 25¢ additional per pole. (All Columns)

MSP-105D	SPDT	Push On-Push Off	(25)	2.35	1.60	1.41	1.18
MSP-105F	SPDT	Push Button (Mom)	(25)	2.35	1.60	1.41	1.18
MSP-205N	DPDT	Push On-Push Off	(25)	3.20	2.18	1.92	1.60
MSP-205R	DPDT	Push Button (Mom)	(25)	3.20	2.18	1.92	1.60

'E' SERIES WATERPROOF PUSH BUTTON

MSPE-106D	SPDT	Push On-Push Off	(25)	2.75	1.87	1.65	1.38
MSPE-106F	SPDT	Push Button (Mom)	(25)	2.75	1.87	1.65	1.38
MSPE-206N	DPDT	Push On-Push Off	(25)	3.65	2.48	2.19	1.83
MSPE-206R	DPDT	Push Button (Mom)	(25)	3.65	2.48	2.19	1.83
MSPE-406N	4PDT	Push On-Push Off	(25)	5.95	4.05	3.57	2.98
MSPE-406R	4PDT	Push Button (Mom)	(25)	5.95	4.05	3.57	2.98

Normally shipped with black top unless otherwise stated.

ULTRA MINIATURE PUSH BUTTON SWITCHES

MSP-103B	SPST	Normally Closed (Black)	(25)	.85	.58	.51	.47
MSP-103C	SPST	Normally Open (Red)	(25)	.85	.58	.51	.47
MSP-103C-B	SPST	Normally Open (Black)	(25)	.85	.58	.51	.47
MSPS-103B	SPST	Normally Closed (Black)	(25)	.65	.44	.39	.36
MSPS-103C	SPST	Normally Open (Red)	(25)	.65	.44	.39	.36

'MUSTANG' PUSH BUTTON SWITCHES Supplied with either black or red top. Specify

MSPG-206N	DPDT	Push On-Push Off	(25)	3.65	2.48	2.19	1.83
MSPG-206R	DPDT	Momentary	(25)	3.65	2.48	2.19	1.83

Normally shipped with C-12 black button unless otherwise stated.

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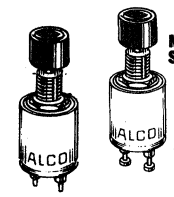

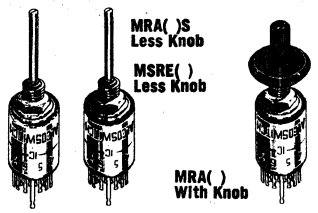

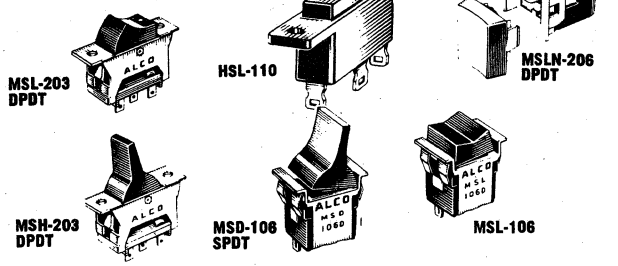

MAGNETIC REPULSION PUSH BUTTON SWITCHES

Momentary switches designed for data entry. Ceramic magnets eliminate springs. Contacts are glass-encapsulated reeds. Plunger is keyed, non-rotating. Metal case withstands abuse, serves as shield. Rated 100 mA @ 50 VDC, resistance 100 milliohms. Contact bounce 1 m/sec. Plunger travel 5/64". Operating force, under 2 ozs. Life, 10 million cycles.

MAGNETIC KEYBOARD PUSH BUTTON SWITCHES — Supplied with C-12 cap. All SPST.

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
MSPM-101B	N.C. (Blk Cap) Solder Lug	(25)	4.25	3.40	2.98	2.76
MSPM-101C	N.O. (Red Cap) Solder Lug	(25)	3.90	3.12	2.73	2.54
MSPM Series also accepts C-13, C-14 and C-14L.						

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
MSPM-101B-1	N.C. (Blk Cap) .110" Term.	(25)	4.25	3.40	2.98	2.76
MSPM-101C-1	N.O. (Red Cap) .110" Term.	(25)	3.90	3.12	2.73	2.54

ILLUMINATED ROCKER SWITCHES

New brilliance in a miniature rocker featuring convenient front panel lamp replacement. Entire switch simply snaps into a .655" x .728" hole. Choice of 3 double pole switching actions, 4 lens colors & 3 voltages. Rated 6 amps @ 125 VAC. Supplied with one red, green, amber or white lens cap; specify.

MINIATURE ROCKER SWITCHES
New series of economy "snap-in" switches ave unusually high 6 amps @ 125 VAC rating. Features ease of installing in .50" x .60" hole. Exclusive molded silver terminals and contacts. Supplied wihh one red, black, gray or white cap; specify.

MINIATURE LEVER SWITCHES
Adds distinction to the front panel. "Snap-in" miniature switches have 6 amps @ 125 VAC rating. Ease of installation in .50" x .60" hole. Has molded silver terminals and contacts. Supplied with red, black, gray or white lever; specify.

U/L LISTED ROCKER SWITCHES
10 Amps @ 125 VAC, 6A @ 250 VAC. Over 100,000 operations. Extra-wide surface silver-clad contacts; tab terminals. Black.

MSH LEVER AND MSL ROCKER SWITCHES
Versatile DPDT action. Rated 3 amps @ 125 VAC; 25,000 life cycle; contacts silverplated.
Natural & Black anodized aluminum Switch Frames are available for MSD & MSL-106 switches. Plastic Switch Frames are available for MSD-106, MSL-106 & MSLN switches (not illustrated).

ILLUMINATED ROCKER SWITCHES

MSLN-206N	DPDT	On-None-On	(25)	4.45	3.03	2.67	2.22
MSLN-206P	DPDT	On-Off-On	(25)	4.75	3.23	2.85	2.38
MSLN-206R	DPDT	None-On-(On)	(25)	4.75	3.23	2.85	2.38

MINIATURE ROCKER SWITCHES

MSL-106D	SPDT	On-None-On	(25)	1.90	1.29	1.14	.95
MSL-106E	SPDT	On-Off-On	(25)	2.10	1.43	1.26	1.05
MSL-206N	DPDT	On-None-On	(25)	2.25	1.53	1.35	1.13
MSL-206P	DPDT	On-Off-On	(25)	2.70	1.84	1.62	1.35
Specify Rocker Color: Red, Black, White, Gray, Amber, Green, Blue or Pink							

MINIATURE LEVER SWITCHES

MSD-106D	SPDT	On-None-On	(25)	1.90	1.29	1.14	.95
MSD-106E	SPDT	On-Off-On	(25)	2.10	1.43	1.26	1.05
MSD-106F	SPDT	On-None-(On)	(25)	2.25	1.53	1.35	1.13
MSD-206N	DPDT	On-None-On	(25)	2.25	1.53	1.35	1.13
MSD-206P	DPDT	On-Off-On	(25)	2.70	1.84	1.62	1.35
MSD-206R	DPDT	On-None-(On)	(25)	2.85	1.94	1.71	1.43
Specify Lever Color: Red, Black, White, Gray, Amber, Green, Blue or Pink							

U/L APPROVED ROCKER SWITCHES Supplied with Black Actuator

HSL-110A	SPST	Push On-Off	(25)	.95	.65	.57	.48
HSL-110D	SPDT	Push On-On	(25)	1.10	.75	.66	.55

LEVER & ROCKER SWITCHES

MSH-203N-3	DPDT	Lever (On-On)	(25)	1.65	1.12	.99	.83
MSL-203N-7	DPDT	Rocker (On-On)	(25)	1.55	1.05	.93	.78

MINIATURE ROTARY SWITCHES

MRA Adjustable-Stop Rotary Switches are miniature types rated 500 mA @ 125 VAC. Features: adjustable-stop; non-shorting; 36° spacing; up to 4 poles on single deck; solid silver terminals and contacts. Types with suffix S, 1/8" dia. shaft less knob. Bushing, 1/4-40.

MRA 30° Position Rotary Switches are slightly larger than standard MRA Series and have 1/8" shaft. Other specs similar to MRA Series. Knobs not included. Type MRA 30° can be converted to an adjustable-stop switch when used with KCVS-500 knob (see Alco miniature knob listings).

MRA Printed Circuit Rotary Switches are miniature versions of above types created for printed circuit mounting. Terminals are silver clad and designed to facilitate firm anchoring to the P.C. board. Available in 1, 2, 3 or 4 poles on a single deck with a maximum of 12 positions. The 1, 2 and 3 pole models have an adjustable-stop feature. 1/8" dia. shaft, less knob. See MRA story for specs.

MSRE Waterproof Rotary Switches are non-adjustable. Similar to MRA Series but feature internal and external 'O' rings. One-piece metal case construction, and molded in terminals. 1/8" shaft. Ideal for printed circuits. Supplied less knob. Rated 500 mA @ 125 VAC. Can be converted to an adjustable-stop switch when used with KCVS-500 knob (see knob listings).

MINIATURE ROTARY — These switches have no adjustable stops.

MRA-1-10	1-Pole, 2 to 10 positions	(25)	4.95	3.37	2.97	2.48
MRA-2-5	2-Pole, 2 to 5 positions‡	(25)	4.95	3.37	2.97	2.48
MRA-3-3	3-Pole, 2 to 3 positions‡	(25)	4.95	3.37	2.97	2.48
MSRA-4-2*	4-Pole, 2 positions	(25)	4.95	3.37	2.97	2.48
MRA-1-10S	1-Pole, 2 to 10 positions	(25)	4.90	3.33	2.94	2.45
MRA-1-10S-PC†	1-Pole, 2 to 10 positions	(25)	5.60	3.81	3.36	2.80
MRA-1-10SC*	1-Pole, 10 positions (Cont.)	(25)	4.90	3.33	2.94	2.45
MRA-1-10SC-PC*†	1-Pole, 10 positions (Cont.)	(25)	Special Production			
MRA-2-5S	2-Pole, 2 to 5 positions	(25)	4.90	3.33	2.94	2.45
MRA-2-5S-PC†	2-Pole, 2 to 5 positions	(25)	5.60	3.81	3.36	2.80
MRA-3-3S	3-Pole, 2 to 3 positions	(25)	4.90	3.33	2.94	2.45
MRA-3-3S-PC†	3-Pole, 2 to 3 positions	(25)	5.60	3.81	3.36	2.80
MSRA-4-2S*	4-Pole, 2 positions	(25)	4.90	3.33	2.94	2.45
MSRA-4-2S-PC*†	4-Pole, 2 positions	(25)	5.60	3.81	3.36	2.80

MRA-1-12S	1-Pole, 2-12 positions§	(25)	6.25	4.25	3.75	3.13
MRA-1-12S-PC*†	1-Pole, 2-12 positions§	(25)	6.95	4.73	4.17	3.48
MRA-1-12SC*	1-Pole, 12 positions (Cont.)	(25)	6.25	4.25	3.75	3.13
MRA-1-12SC-PC*†	1-Pole, 12 positions (Cont.)	(25)	6.95	4.73	4.17	3.48
MRA-4-3S	4-Pole, 2-3 positions§	(25)	6.25	4.25	3.75	3.13
MRA-4-3S-PC†	4-Pole, 2-3 positions§	(25)	6.95	4.73	4.17	3.48
MSRE-1-10	1-Pole, 10 positions	(25)	5.95	4.05	3.57	2.98
MSRE-2-5	2-Pole, 5 positions	(25)	5.95	4.05	3.57	2.98
MSRE-3-3	3-Pole, 3 positions	(25)	5.95	4.05	3.57	2.98
MSRE-4-2	4-Pole, 2 positions	(25)	5.95	4.05	3.57	2.98

† Printed circuit connections ‡ With Knob
§ With Stop

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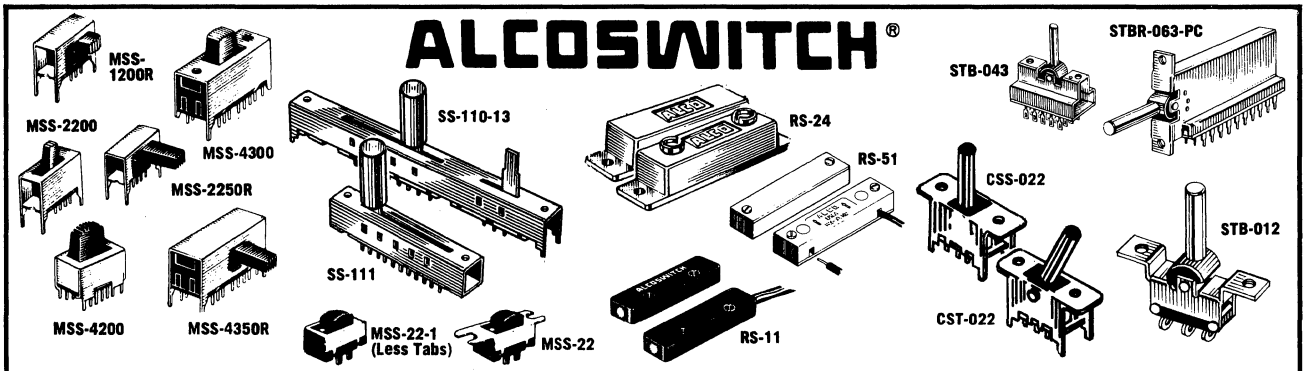

MINIATURE PRINTED CIRCUIT SLIDE SWITCHES (All switches make before break).

Two mounting styles are available: The MSS-1200R, 2250R, 4200R and 4300R are furnished with right angle levers for side mounting. MSS-1200, 2200, 2250, 4200, 4300 and 6300 with upright levers are for direct mounting to the printed circuit board. The MSS-4300 and 6200 have threaded screw holes on the top of the mounting frame for 4-40 screws. Metal tabs extend downward into the printed circuit board for a firm mounting.

All contact, movable parts and terminals are silver or gold plated. The standard models have silverplated brass with the movable contact of plated beryllium brass. The others are gold-plated over nickel. The positive wiping action assures a low contact resistance over the life of 15,000 cycles at rated load. Rated at 0.3 amp @ 125 VAC.

MINIATURE PRINTED CIRCUIT SLIDE SWITCHES

Model	Type	Description	(Pkg.)	One-24	25-99	100-499	500-999
MSS-1200R	SPDT	Right Angle	(25)	.60	.41	.36	.30
MSS-1200RG*	SPDT	Right Angle, Gold	(25)	.80	.54	.48	.40
MSS-2200	DPDT	Upright	(25)	.65	.44	.39	.33
MSS-2200G*	DPDT	Upright, Gold	(25)	1.05	.71	.63	.53
MSS-2220	DPDT	Upright, .200" Lever	(25)	.65	.44	.39	.33
MSS-2220G*	DPDT	Upright, .200" Lever, Gld.	(25)	1.05	.71	.63	.53
MSS-2250	DPDT	Upright, Long Handle	(25)	.70	.48	.42	.35
MSS-2250G*	DPDT	Uprt., Long Handle, Gold	(25)	1.10	.75	.66	.55
MSS-2250R	DPDT	Right Angle, Long Handle	(25)	.80	.54	.48	.40
MSS-2250RG*	DPDT	Rt. An., Long Handle, Gld.	(25)	1.20	.82	.72	.60
MSS-2450	DP4T	Upright, Long Handle	(25)	.95	.65	.57	.48
MSS-2450G*	DP4T	Uprt., Long Handle, Gold	(25)	1.55	1.05	.93	.78
MSS-4200	4PDT	Upright	(25)	.75	.51	.45	.38
MSS-4200G*	4PDT	Upright, Gold	(25)	1.55	1.05	.93	.78
MSS-4200R	4PDT	Right Angle	(25)	.85	.58	.51	.43
MSS-4200RG*	4PDT	Right Angle, Gold	(25)	1.65	1.12	.99	.83
MSS-4300	4P3T	Upright	(25)	.95	.65	.57	.48
MSS-4300G	4P3T	Upright, Gold	(25)	1.95	1.33	1.17	.98
* Gold Contacts		† Minimum order of 1,000 pieces					

Model	Type	Description	(Pkg.)	One-24	25-99	100-499	500-999
MSS4350R	4P3T	Right Angle, Long Handle	(25)	1.20	.82	.72	.60
MSS-4350RG*	4P3T	Rt. An., Long Handle, Gld.	(25)	2.20	1.50	1.32	1.10
MSS-6200	6PDT	Upright	(25)	.95	.65	.57	.48
MSS-6200G*	6PDT	Upright, Gold	(25)	2.15	1.46	1.29	1.08
MSS-6300	6P3T	Upright	(25)	1.25	.85	.75	.63
MSS-6300G *	6P3T	Upright, Gold	(25)	2.75	1.87	1.65	1.38
MSS-8200†	8PDT	Upright	(25)	1.15	.78	.69	.58
MSS-8200G*†	8PDT	Upright, Gold	(25)	2.75	1.87	1.65	1.38
MSS-8300	8P3T	Upright	(25)	1.55	1.05	.93	.78
MSS-8300G*	8P3T	Upright, Gold	(25)	3.55	2.41	2.13	1.78
MSS-10200†	10PDT	Upright	(25)	1.35	.92	.81	.68
MSS-10200G*†	10PDT	Upright, Gold	(25)	3.35	2.28	2.01	1.68
MSS-10300	10P3T	Upright	(25)	1.85	1.26	1.11	.93
MSS-10300G*	10P3T	Upright, Gold	(25)	4.35	2.96	2.61	2.18
MSS-12200†	12PDT	Upright	(25)	1.55	1.05	.93	.78
MSS-12200G*†	12PDT	Upright, Gold	(25)	3.95	2.69	2.37	1.98
MSS-12300	12P3T	Upright	(25)	2.15	1.46	1.29	1.08
MSS-12300G*	12P3T	Upright, Gold	(25)	5.15	3.50	3.09	2.58

MSS SERIES MINIATURE SLIDE SWITCHES

Anti-tease design. Rated 2 amps @ 120 VAC. Gold on nickel or silver-plated brass contacts. 250,000 operations. .500" x .305".

MINIATURE SLIDE SWITCHES — BREAK BEFORE MAKE

MSS-22	SPDT	2 Circuit N.O.-N.C. w/o tabs	(25)	1.75	1.17	.88	.73
MSS-22-1	SPDT	2 Circuit N.O.-N.C. w/o tabs	(25)	1.75	1.17	.88	.73
MSS-22-2	SPDT	2 Circuit N.O.-N.C. w/o tabs‡	(25)	1.75	1.17	.88	.73
MSS-44	DPDT	On-None-On w/tabs	(25)	3.15	2.11	1.58	1.31

BATON LEVER SWITCH SERIES

Selection of terminals for P/C or hand wired use. Available in a wide range of poles (2 to 8 circuits) in two or three active positions. Rated to carry 300 ma @ 30 VDC. They are make before break, have silver terminals and all terminals are sealed against solder flux to limit wicking. A mating power switch rated at 10 @ 125 VAC is also provided to complete the series and further enhance your front panel appearance.

STB-012	1 Pole, 2 Positions	(10)	1.85	1.26	1.11	.93
STB-042	4 Pole, 2 Positions	(10)	3.45	2.35	2.07	1.73
STB-082	8 Pole, 2 Positions	(10)	3.65	2.48	2.19	1.83
STB-023	2 Pole, 3 Positions	(10)	3.65	2.48	2.19	1.83
STB-043	4 Pole, 3 Positions	(10)	4.15	2.82	2.49	2.08
STB-042-PC	4 Pole, 2 Positions, PC Terminals	(10)	3.45	2.35	2.07	1.73
STB-082-PC	8 Pole, 2 Positions, PC Terminals	(10)	3.65	2.48	2.19	1.83

ECONOMY BATON SERIES

CST Series switches will modernize your control panel with the new toggle action baton lever. DPDT, rated .3 amps @ 125V. Features positive wiping action and low contact resistance. Sealed terminals to prevent wicking.

CST Break Before Make and CSS Make Before Break Series is made for your slide applications. DPDT, rated .3 amps @ 125V. Both features printed circuit sealed terminals and are self-cleaning.

ECONOMY SWITCHES

CST-022	DPDT	On-None-On, Toggle	(25)	.95	.65	.57	.48
CSS-022	DPDT	On-None-On, Slide	(25)	.85	.58	.51	.43

MULTIPLE-POLE SLIDE SWITCH SERIES

The SS series is designed for printed circuit boards, saving space plus time and errors in wiring. They offer operational versatility, high density, light weight, and a broad variety of control functions. Rated to carry 300 ma @ 30 VDC, they are make before break, silver contacts, and sealed terminals. Uses: matrix applications, adjustable voltage dividers, x-y positioning applications and others.

MULTI-POSITION SLIDE SWITCHES

SS-110-13*	Single Pole, 10 +3 Positions	(10)	2.65	1.80	1.59	1.33
SS-111*	Single Pole, 11 Positions	(10)	1.95	1.33	1.17	.98
SS-24	Double Pole, 4 Positions	(25)	1.25	.85	.75	.63

*Shipped less knobs. See below.

KSS ACTUATOR KNOBS

Model	Description	(Pkg.)	One-99	100-249	250-499	500-999
KSS-1A	Actuator Knob w.o./hairline, Small	(100)	.30	.27	.26	.24
KSS-1B	Actuator Knob w.o./hairline, Small	(100)	.30	.27	.26	.24
KSS-2A	Actuator Knob w.o./hairline, Large	(100)	.35	.32	.30	.28
KSS-2B	Actuator Knob w.o./hairline, Large	(100)	.35	.32	.30	.28
KSS-3A	Actuator Knob Double hairline, Large	(100)	.40	.36	.34	.32
KSS-3B	Actuator Knob Double hairline, Large	(100)	.40	.36	.34	.32

STB-023-PC	2 Pole, 3 Positions, PC Terminals	(10)	3.65	2.48	2.19	1.83
STB-043-PC	4 Pole, 3 Positions, PC Terminals	(10)	4.15	2.82	2.49	2.08
STBR-022-PC	2 Pole, 2 Pos., PC Term., Rt. Angle	(10)	2.95	2.01	1.77	1.48
STBR-042-PC	4 Pole, 2 Pos., PC Term., Rt. Angle	(10)	3.55	2.41	2.13	1.78
STBR-062-PC	6 Pole, 2 Pos., PC Term., Rt. Angle	(10)	4.15	2.82	2.49	2.08
STBR-023-PC	2 Pole, 3 Pos., PC Term., Rt. Angle	(10)	3.65	2.48	2.19	1.83
STBR-043-PC	4 Pole, 3 Pos., PC Term., Rt. Angle	(10)	4.25	2.89	2.55	2.12
STBR-063-PC	6 Pole, 3 Pos., PC Term., Rt. Angle	(10)	4.85	3.30	2.91	2.43

PROXIMITY MAGNETIC REED SWITCH ASSEMBLIES

RS-24 — Alnico-5 magnet actuates reed switch within distance of 1". Rated 0.5 amps break, 1.0 amps carry, over 5-million operations.

Miniature RS-11 — Alnico-5 magnet actuates reed switch within distance of .39". Current rating @ 50 VDC: .15 amps breaks, .5 amps carry. 200 VDC breakdown. Life: 10-million cycles.

PROXIMITY MAGNETIC SWITCHES

RS-24-NC	Normally Closed (Apart)	(Pr.)	3.15	2.14	1.89	1.58
RS-24-NO	Normally Open (Apart)	(Pr.)	2.85	1.94	1.71	1.43
RS-11-NC	Normally Closed (Apart)	(Pr.)	3.05	2.08	1.83	1.53
RS-11-NO	Normally Open (Apart)	(Pr.)	2.75	1.87	1.65	1.38
RS-51-NO	Normally Closed (Apart)	(Pr.)	1.95	1.33	1.17	.98
RS-51-NC	Normally Open (Apart)	(Pr.)	2.25	1.53	1.35	1.13

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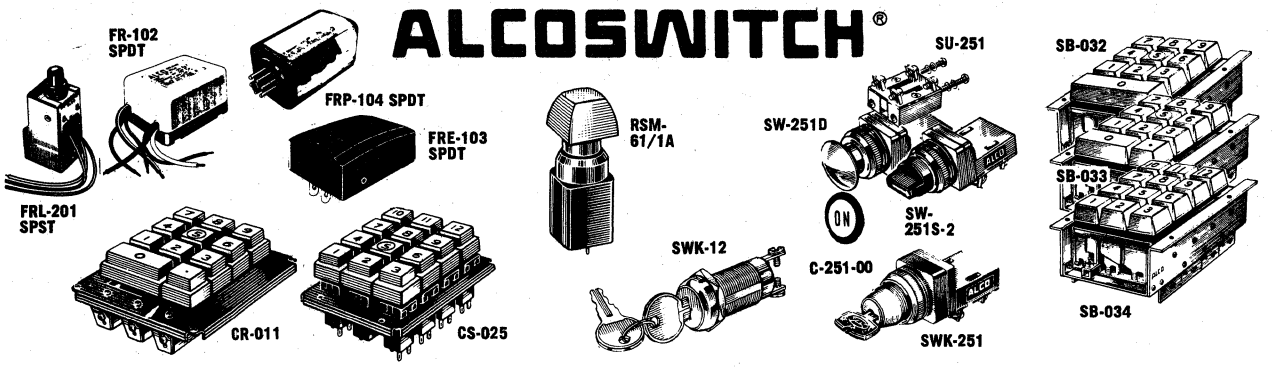
TWX: 710 342–0552

ALCOSWITCH®



REMOTE CONTROL RELAYS

All units are capable of handling up to 7 Amps @ 117 VAC and may be operated from remote switches located up to several hundred feet away. The remote circuit carries a low voltage which is fully isolated to minimize any possibility of shock hazards.

REMOTE CONTROL ISOLATION RELAYS

Model	Type	Description	(Pkg.)	One-99	100-499	500-999
FR-102	SPDT	Basic Relay for 117 VAC	(10)	4.45	3.47	3.03
FR-102-230	SPDT	Basic Relay for 230 VAC	(10)	4.95	3.82	3.37
FRE-103	SPDT	Plug-in for 117 VAC	(10)	5.95	4.64	4.05
FRP-104	SPDT	Octal for 117 VAC	(10)	5.45	4.25	3.71
FR-105A1*	SPST	Basic Relay for 117 VAC	(10)	3.95	3.08	2.69
FR-105-230	SPST	Basic Relay for 230 VAC	(10)	4.45	3.47	3.03
FRL-201	SPST	P.B. Switch Relay for 117 VAC	(1)	5.95	4.64	4.05
FRL-201-6	SPST	P.B. Switch Relay for 6 VAC	(1)	5.95	4.64	4.05
FRL-201-12	SPST	P.B. Switch Relay for 12 VDC	(1)	5.95	4.64	4.05

U.L. Listed.

REED SWITCH OPERATED KEYBOARD BANKS

Now designers can be assured of highest reliability in data processing equipment. Short strokes provide a smooth operation of the switch plunger resulting in one of the finest keyboard actions obtainable. It is also suitable for test equipment, communication gear, and many other applications. All details of this switch line are designed for light pressure (5 ounces), operator's convenience, and positive input of data with long life under heavy office type of usage. Highly efficient "single-pole open circuit" reed switches are used assuring reliability and extremely long life expectancy. Square light grey keys (1⅝″) have an industry standard 0-9 marking and format. All switch positions contain a "positive lockout" between sections and rows. This feature prevents more than one position from operating at the same time. This basic keyboard system is designed for flexibility and can be customized to meet the special needs of quantity users. Up to 12 switches may be installed in the basic module in any combination including momentary, or lockout design. FRL must be reset after power failure.

Keyboard switches are supplied with Light Grey Key Tops. Colored Blank Key Tops are available separately (see below); Key Tops with special markings are quoted on request.

KEYBOARD SWITCHES

Model	Description	(Pkg.)	One-24	25-99	100-499
SB-032	Lockout 0-9 ("0" Triple Bar)	(1)	28.50	22.80	19.95
SB-033	Lockout 0-9 and Period	(1)	28.50	22.80	19.95
SB-034	Lockout 1-12 Numerals	(1)	29.95	23.96	20.67
SB-035	Momentary 1-12 Numerals	(1)	28.50	22.80	19.95
SB-032PC	Lockout 0-9 ("0" Triple Bar) w/PC Term.	(1)	29.50	23.60	20.65
SB-033PC	Lockout 0-9 and Period, w/PC Term.	(1)	29.50	23.60	20.65
SB-034PC	Lockous 1-12 Numerals, w/PC Term.	(1)	30.95	24.76	21.67
SB-035PC	Momentary 1-12 Numerals, w/PC Term.	(1)	29.50	23.60	20.65

ECONOMY-PRICED MECHANICAL KEYBOARDS

"CR" Series has norm. open momentary action; also features unique contact system that utilizes spring resilience of wire contacts. Uniform spacing of gold-clad contacts. Specs: Current, 100 ma @ 24 VDC; Contact Resistance, below 100 mΩ; Resistance, over 500 megΩ @ 500 VDC; Operating Force, 90 ±30 grams. Over 2 million operations @ 30 ma, 24 VDC. Dimensions: 3.040″ W. x 3.750″ L. x 1.612″ D.

BOARDS AND CS SERIES REED KEYBOARDS

CR-04	1 x 4 Keyboard Module, Momentary	(1)	4.95	3.96	3.47
CR-011	Momentary 0-9 Numerals & Decimal	(1)	12.95	10.36	9.07
CR-015	Momentary 1-12 Numerals	(1)	13.95	11.16	9.77
CS-04	1 x 4 Reed Assembly, Momentary	(1)	6.95	5.56	4.87
CS-021	Momentary 0-9 Numerals & Decimal	(1)	18.25	14.60	12.78
CS-025	Momentary 1-12 Numerals	(1)	19.85	15.88	13.90
CSM	Single Keyswitch w/o Keytop	(1)	1.45	1.16	1.02

LOW-PROFILE REED KEYBOARDS

Uses single pole "open circuit" reed modular switches mounted as keyboard assembly. May be ordered as complete assembly with gray, 2-shot, molded keytops or as single switches. Blank keytops are available in a selection of colors. Specs: Current, 100 ma @ 48 VDC; Operating Force, 5 ozs., Reed Switch Life, 10,000,000 cy. Dimensions: 2.375″ W. x 3.375″ L. x 1.946″ D.

BASE MOUNTED KEYBOARD SWITCH

Reed actuated low profile, single pole Normally Open unit provides the low operating force and high reliability required in keyboards. RSM-61/1A is suitable for an 0.75 inch matrix, and is free from interaction between units. The switch is molded in high quality glass filled nylon and acetal resin, and is an FR Hamlin reed switch actuated by a permanent magnet.

Black Keytops — Specify Choice of Figures: 1 through 12.

BASE MOUNTED KEYBOARD PUSH BUTTON SWITCHES

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
RSM-61/1A	2-Shot Molded Keytop, Black¶	(25)	1.95	1.46	1.37	1.30
RSB-1†	Keyboard Switch (Flat Base)	(25)	.15	.11	.105	.10
RSB-1N	Blank Keytop (Specify Color)	(25)	.20	.16	.14	.13

† Specify choice of color: Black, White, Blue, Red, Gray - blank keys only.

MINIATURE PUSH BUTTON MOTOR START SWITCHES

Mounts in a 1″ hole. Rated on carry 6 amps @ 230 VAC. These switches may be used to control circuits independently or with optional relays. All models supplied with a singe (N.O.-N.C.) contact block but have provisions for additional (SU) blocks thereby converting to DPDT, 3PDT, 4PDT.

3-Way Selector Power Switch is the same basic model as above but instead has a bar knob with pointer. Electrical and physical specifications are the same available in black only.

Key-Lock Push Button type is an accident-proof power switch that has its own key lock to prevent unwanted operations of machines and controls. The switch functions only when the key disengages the lock. Same specs as the series described above.

KEYLOCK SWITCH

Keylock Switch — A roller-action switch. Positive contact, mechanical action, and key removal at both positions. Flatted barrel — ¾″ D — for panels up to ¾″. Choice of 25 keys. Current rating; 115 VAC, 5 amp resistive load; 24 VDC, 15 amp resistive load.

MINIATURE POWER SWITCHES

Model	Description	(Pkg.)	One-24	25-99	100-499	500-999
SWK-251	Key/Lock Switch — On-Off-On	(10)	8.95	6.09	5.37	4.48
SW-251*	Standard Button — Momentary	(10)	3.95	2.69	2.37	1.98
SW-251D*	Mushroom Head — Momentary	(10)	4.45	3.03	2.67	2.23
SW-251L*	Long Button — Momentary	(10)	4.35	2.96	2.61	2.18
SW-251S-2	Selector, N.O.-None-N.C.	(10)	3.65	2.48	2.19	1.83
SW-251S-3	Selector, N.O.-Off-N.C.	(10)	3.95	2.69	2.37	1.98
SU-251	Extra Block (NO-NC) for 251 Ser.	(10)	1.95	1.35	1.17	.98
C-251-00‡	"ON-OFF" Buttons	(Pr.)	.50	.34	.30	.25
C-251-SS‡	"STOP-START" Buttons	(Pr.)	.50	.34	.30	.25
C-251-HL‡	"HIGH-LOW" Buttons	(Pr.)	.50	.34	.30	.25
C-251-UD‡	"UP-DOWN" Buttons	(Pr.)	.50	.34	.30	.25
SWK-12	Remove key/OFF or ON Position	(10)	4.95	3.37	2.97	2.48
SWK-12-1	Remove key/OFF Position	(10)	4.95	3.37	2.97	2.48
SWK-12-3	Remove key/ON Position	(10)	4.95	3.37	2.97	2.48

* Push button models are equipped with spare (snap-on) colored buttons offering a choice of use in red, black or green.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

Prices and specifications are subject to change without notice.

ALCO® ELECTRONIC PRODUCTS, INC.

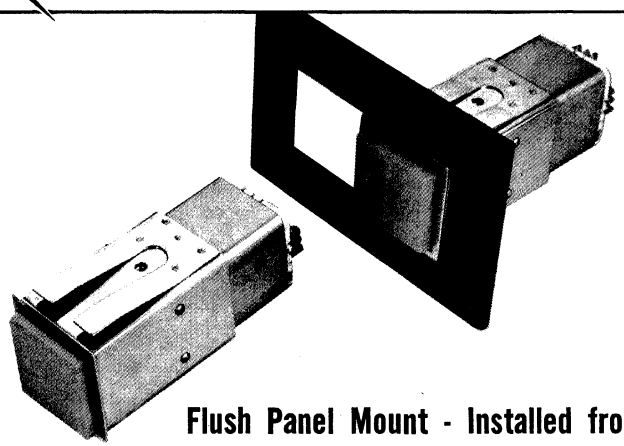
1551 OSGOOD ST., NO. ANDOVER, MASS. 01845

TEL: (617) 685–4371

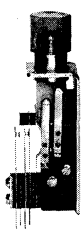
TWX: 710 342–0552

CAPITOL CIRCUIT SELECTOR SWITCHES

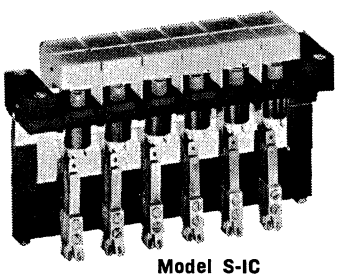
RF SERIES FRONT MOUNTING SWITCH



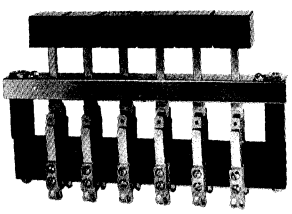
Flush Panel Mount - Installed from Front of Panel.



Model PLH

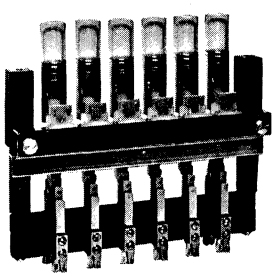


Model S-IC

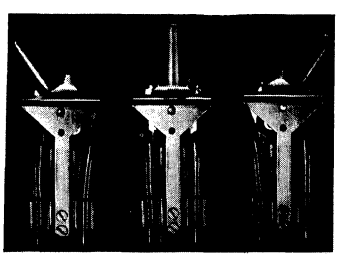


Model S

Model PSL-IC

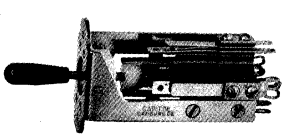


Model S-IA



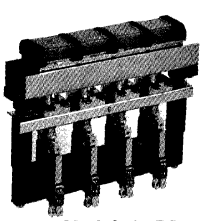
Model HLB

Model HLL illuminated multicolor coded lever switch

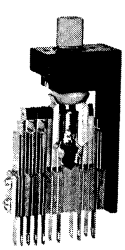


Model 4HLB

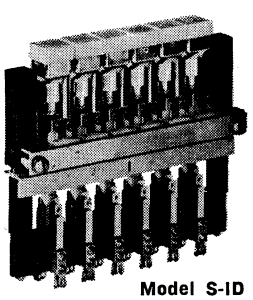
Model HLBS



Model S-IDR



Model HPC



Model S-ID
features New illuminated square button

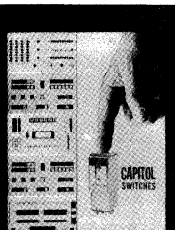
CAPITOL SWITCHES are rated at 3 amps, 110 v. AC, non inductive.
Capitol manufactures many standard and special switches in addition to those shown.

CAPITOL

THE CAPITOL MACHINE AND SWITCH CO.
87 Newtown Road, Danbury, Conn. 06810

Representatives in principal cities Tel: 203-744-3300 TWX:710-456-0365

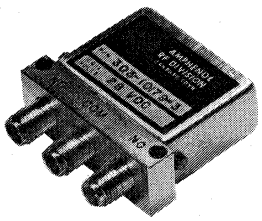
WRITE FOR **NEW** 28 PAGE CATALOG



COAXIAL SWITCHES

BUNKER RAMO AMPHENOL

303 Series/ High Isolation Miniature & Standard Size Microwave Coaxial Switches



AMPHENOL 303 SERIES
High Isolation Miniature
Fail-Safe 1P2T

Broadband Miniature Switch Series Offering State-of-the-Art Characteristics through 18 GHz

Ideally suited for applications where crosstalk interference must be kept to an absolute minimum, Amphenol's miniature 303 Series provides uniform characteristics through KU band (18 GHz) with isolation of 60 dB minimum, VSWR of 1.5:1 maximum and insertion loss of 0.5 dB maximum. When operating at lower frequencies, isolation can be greater than 90 dB with 0.2 dB insertion loss and VSWR of 1.2:1.

New Amphenol SMA connectors . . . offering significantly better electrical and mechanical performance than competitive designs . . . contribute to the switch's high reliability and fine electrical performance. The miniature 1P2T weight only 2 ozs. and, excluding terminals, is less than 1½ inches high by $1\frac{11}{32}$ inches wide by ½ inch. In addition to its compact design and reliable RF performance, this switch is capable of operating in environments where temperatures reach 100°C.

Standard Size 303 Series Switches offering High Isolation Qualities through 12.4 GHz

Amphenol's 303 Series of standard size switches is constantly expanding. Cataloged here are a representative collection of the more popular variations. Many combinations of these basic items are available. The ideal switching device tailored for your specific application can be selected from the options described in the table of General Characteristics. This is true of the miniature size 303 Series as well. Whatever combination of specifications you select . . . whether other coil voltage, hermetic sealing, auxiliary contacts, cut-throat latching, etc. . . . the same high isolation and uniform RF performance characteristic of Amphenol's 303 Switch Series will prevail.

RF PERFORMANCE

Frequency (GHz)	VSWR (Max.)	Isolation (dB)	Insertion Loss (Max.)
MINIATURE SIZE			
0-3.0	1.2	>90 dB	0.2 dB
3.0-8.0	1.3	>80 dB	0.3 dB
8.0-12.4	1.4	>70 dB	0.4 dB
12.4-18.0	1.5	>60 dB	0.5 dB
STANDARD SIZE			
0-3.0	1.3	>80 dB	0.25 dB
3.0-6.0	1.4	>75 dB	0.35 dB
6.0-10.0	1.5	>65 dB	0.50 dB
10.0-12.4	1.5	>60 dB	0.50 dB
MINIATURE ECONOMY AND 1P1T SHUTTER			
0-3.0	1.3	>80 dB	0.25 dB
3.0-8.0	1.4	>70 dB	0.35 dB
8.0-12.4	1.5	>60 dB	0.50 dB

RF POWER @ STP (watts CW)

Freq. (GHz)	SMA	N & TNC	Freq. (GHz)	SMA	N & TNC
0.1	400W	1000W	5.0	50W	100W
0.4	200W	500W	10.0	35W	70W
1.0	120W	280W	12.0	30W	60W
3.0	70W	145W	18.0	24W	45W

GENERAL CHARACTERISTICS

ELECTRICAL

FREQUENCY RANGE

Miniature Size:	0-18.0 GHz
Others:	0-12.4 GHz

CONNECTORS

Miniature Size:	SMA
Standard Size:	N, TNC, SMA

SWITCHING TIME: 15 mS (maximum)

SWITCHING ACTION: Break before make

28 VDC COIL RESISTANCE

1P2T Fail-Safe:	Miniature 250 ohms Standard 200 ohms
1P2T Latching:	Miniature 150 ohms
Transfer:	Miniature Latching 18 ohms Standard Fail-Safe 90 ohms
1P2T Economy:	200 ohms
1P1T Shutter:	135 ohms

(Also available with 6, 12, 48, 110 VDC and 115 VAC coils.)

MECHANICAL

LIFE: 1 x 10^6 cycles minimum

WEIGHT

1P2T: Miniature 2 oz., standard 7 oz.
Transfer: Miniature 5 oz., standard 8 oz.
1P2T economy 3½ oz.
1P1T shutter 4 oz.

ENVIRONMENTAL (MIL-S-3928B)

TEMPERATURE RANGE

1P2T Miniature −55°C to 100°C. Others −55°C to 85°C (higher temperature operation available upon request).

MOISTURE RESISTANCE: 10 day cycle

SHOCK

MIL-STD-202D, Method 202C
Test Condition A, 15 G's peak

VIBRATION

Test Condition A
55 to 2000 Hz @ ± 10 G's

HERMETIC SEALING: Available when required

MINIATURE SIZE (28 VDC COIL■)		Fail-Safe (Non-Latching)	Cut-Throat Latching	Fail-Safe with Aux. Contacts	Manual
Connector	Function	AMPHENOL PART NUMBERS			
SMA	1P2T	303-10179-3	303-10179-23	303-10179-53	—
	1P2T Economy	303-10116-3	—	—	—
	Transfer	303-11022-3	303-11022-23	303-11022-53	303-11028

STANDARD SIZE (28 VDC COIL■)		Fail-Safe (Non-Latching)	Fail-Safe with Aux. Contacts	Manual
Connectors	Function	AMPHENOL PART NUMBERS		
TNC	1P1T Shutter	303-10969-3	—	—
	1P2T	303-10168-3	303-10168-53	303-10171
	Transfer	303-11020-3	303-11020-53	—
N	1P2T	303-10167-3	303-10167-53	303-10170
	Transfer	303-11017-3	303-11017-53	—
SMA	1P2T	303-10166-3	303-10166-53	303-10175
	Transfer	303-11016-3	303-11016-53	—

■ Also available with 6, 12, 48, 110 VDC and 115 VAC Coils.

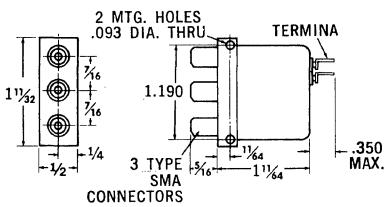
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

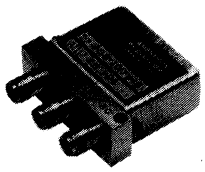
COAXIAL SWITCHES

BUNKER RAMO AMPHENOL

303 Series/High Isolation Miniature & Standard Size Microwave Coaxial Switches (cont'd)

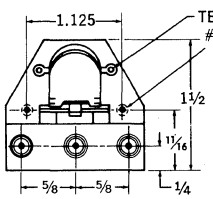
MINIATURE SIZE 1P2T FAIL-SAFE

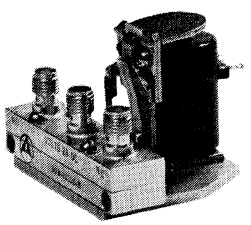




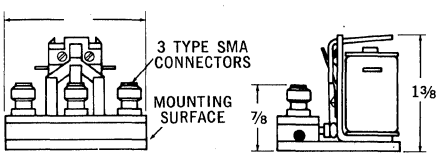
303-10179-3

MINIATURE SIZE 1P2T ECONOMY VERSION

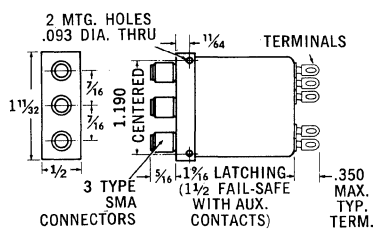




303-10116-3

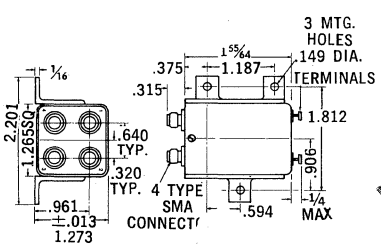


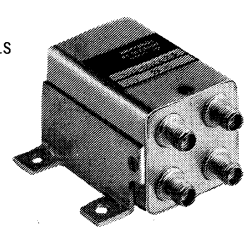
MINIATURE SIZE 1P2T LATCHING AND FAIL-SAFE WITH AUXILIARY CONTACTS



303-10179-23

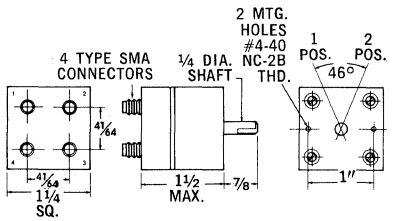
MINIATURE SIZE TRANSFER LATCHING

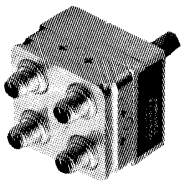




303-11022-23

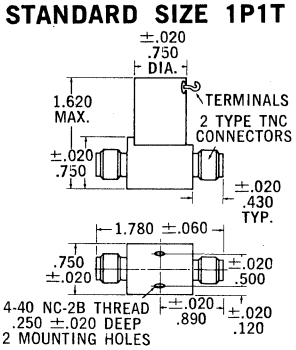
MINIATURE SIZE TRANSFER MANUAL

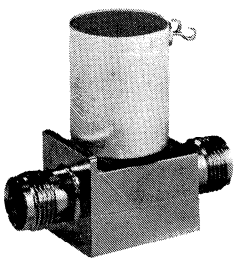




303-11028

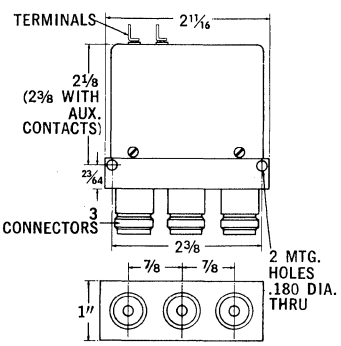
STANDARD SIZE 1P1T SHUTTER

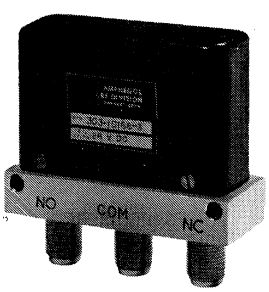




303-10969-3

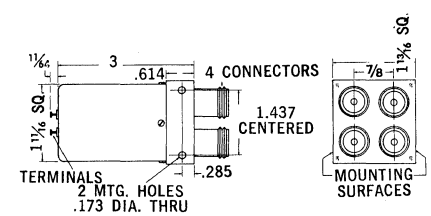
STANDARD SIZE 1P2T FAIL-SAFE AND AUXILIARY CONTACT VERSION

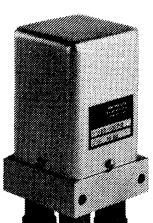




303-10168-3

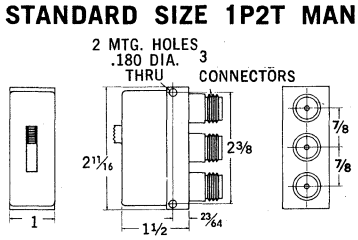
STANDARD SIZE TRANSFER

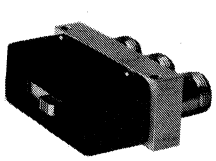




303-11017-3

STANDARD SIZE 1P2T MANUAL





303-10170

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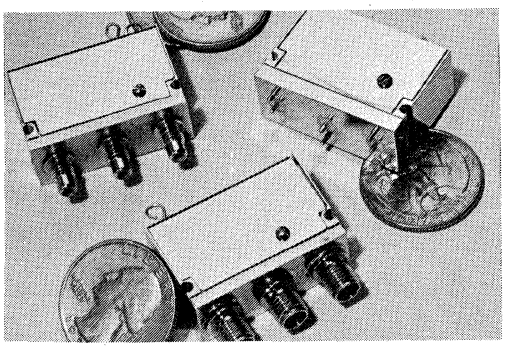
COAXIAL SWITCHES

BUNKER RAMO AMPHENOL

MINIform / Sub-Miniature, High Power, Microwave Coaxial Switches



For Applications Requiring Minimum Size, High Power, Minimum Crosstalk and Low Cost

GENERAL CHARACTERISTICS

ELECTRICAL
- Frequency Range: 0-6.0 GHz
- Connectors: SMA, SUB-Minax 27 Series and Printed Circuit Pins
- Switching Time: 15 ms Maximum
- Switching Action: Break Before Make
- Coil Resistance: 12 VDC Coil: 65 ohms, 28 VDC Coil: 250 ohms (Also available in other DC coil voltages)
- Function: 1P2T Failsafe

ENVIRONMENTAL (per MIL-S-3928B)
- Temperature Range: −55°C to 100°C
- Moisture Resistance: 10 Day Cycle
- Shock: MIL-STD-202D, Method 202C, Test Condition A, 15 G's Peak
- Vibration: MIL-STD-202D, Test Condition A, 55 to 2000 Hz at ±10 G's

RF PERFORMANCE (SMA)

VSWR
- 0-2 GHz: 1.1 max.
- 2-4 GHz: 1.2 max.
- 4-6 GHz: 1.3 max.

Isolation
- 0-1 GHz: >80 dB
- 1-3 GHz: >70 dB
- 3-6 GHz: >50 dB

Insertion Loss
- 0-3 GHz: 0.1 dB max.
- 3-5 GHz: 0.2 dB max.
- 5-6 GHz: 0.3 dB max.

RF Power
- 0.1 GHz: 400 watts
- 1.0 GHz: 120 watts
- 3.0 GHz: 70 watts
- 6.0 GHz: 45 watts

MECHANICAL
- Life: 1 million cycles min.
- Weight: 1.2 oz.

Amphenol 303 Series MINIform is the industry's most inexpensive miniature high-power, high-performance line of microwave coaxial switches — offering for the first time superior operational performance through six GHz in an economical unit weighing only 1.2 ounces.

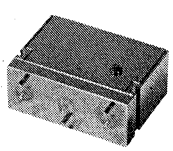
The switches are the smallest and least expensive of this type ever introduced by Amphenol and are designed to outperform all comparable offerings by industry available until now. Displacing less than one-half cubic inch volume, the tiny switches' ratings include performance through 150 watts below specified frequency limitations, offering immediate physical and operational compatibility for a host of signalling, communications and EDP matrix switching applications.

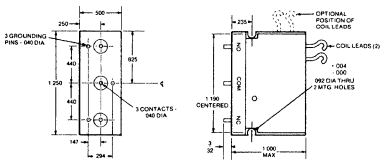
Amphenol 303 Series MINIform switches are 1P2T configurations offered in choice of three popular termination styles: SMA connectors, Amphenol SUB-Minax 27 Series connectors, or printed circuit contacts suitable for solder and solderless wrap board termination. All switches can be provided with coil voltages of 6, 12, 26, 48 and 120 VDC.

Although ideal for typical microwave applications through six GHz where 60 dB isolation is offered by new units, Amphenol's MINIform switches also offer unusually high power handling capabilities for communciations applications for the first time. Through 0 to 1.0 GHz, for example, the MINIform can switch up to 150 watts CW while maintaining maximum VSWR of only 1.1, 0.1 dB insertion loss and 80 dB minimum crosstalk attenuation. Over the range of 1.1 through 3 GHz, VSWR climbs only to 1.2 with power handling capacity of up to 70 watts CW while maintaining 75 dB minimum crosstalk attenuation and 0.1 dB maximum insertion loss.

PRINTED CIRCUIT

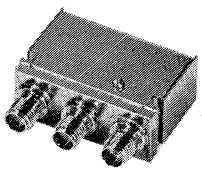
Coil Volts	AMPHENOL Part No.
12 VDC	303-10001-2
28 VDC	303-10001-3

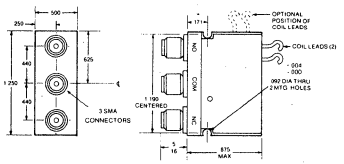




CONNECTORS (SMA shown)

Coil Volts	SMA Conn.	27 Series
12 VDC	303-10002-3	303-10003-2
28 VDC	303-10002-3	303-10003-3

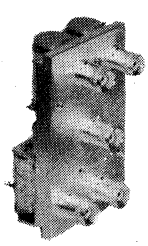




Coaxial Relays

Precision coax units. Maximum time to operate and release is 20 milliseconds. Gold-plated, fine silver contacts assure reliable low-level operation. Minimum life expectancy is 1,000,000 cycles, when switch is operated at speeds of less than 10 Hz. Switches are impedance matched to 50-ohm cable, though loss is negligible with 75-ohm cable. Operation is break-before-make. All materials are corrosion resistant.

Units meet applicable portions of military connector specs as follows: BNC — Mil-C-3608 and N — Mil-C-71.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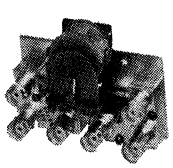
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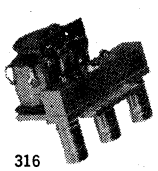
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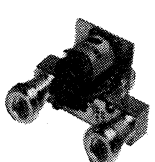
317

Part No.	Termination	Function	Connectors	Frequency (MHz)	RF Power (W)	Coil Volts	Coil Ohms
315-10002-3	Open	SPDT	BNC	1000	100	26 DC	280
316-10082-3	Short	SPDT	BNC	2000	100	26 DC	280
316-10082-6	Short	SPDT	BNC	2000	100	120 DC	6000
316-10102-8	Short	SPDT	BNC	2000	100	115 AC	550
317-10202-3	Short	SPDT	BNC	2000	100	26 DC	280
317-10215-8	Short	SPDT	BNC	2000	100	115 AC	550
317-10242-3	Short	SPDT	N	2000	100	26 DC	280
317-10255-8	Short	SPDT	N	2000	100	115 AC	550
318-10407-3	Open	SPDT	BNC	2000	100	26 DC	280
318-10381	Short	SPDT	BNC	2000	100	lever manual	—
318-10382-3	Short	SPDT	BNC	2000	100	26 DC	280
318-11165-3	Res.	SPDT	BNC	2000	100	26 DC	280
318-11576-8	Res.	SPDT	BNC	2000	100	115 AC	550
319-11141	Open	SPDT	BNC	2000	100	rotary manual	—
320-10931-3	Open	SPDT	N	3000	1000	26 DC	200
321-11062	Open	DPDT	BNC	1000	100	lever manual	—
321-11064-3	Open	DPDT	BNC	1000	100	26 DC	200
322-11431	Open	1P4T	BNC	3000	100	rotary manual	—
323-11651-3	Open	1P4T	BNC	1000	100	26 DC	280
322-11442	Open	1P6T	BNC	3000	100	rotary manual	—
325-11635-3	Short	1P6T	BNC	400	100	26 DC	280
325-11641-3	Open	1P6T	BNC	400	100	26 DC	280

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RF SWITCHES

BUNKER RAMO AMPHENOL

Series 360 DYNAFORM FUNCTIONS AND PART NUMBERS

Conn.	Term.	Schematic	Coil Volts	SPDT Outline Dwg. A	SPDT Outline Dwg. B	DPDT Outline Dwg. C	DPDT Outline Dwg. D	Transfer Outline Dwg. E
BNC	SH	1	26 DC 110 DC 115 AC	360-11891-12 360-11891-34 360-11891-45	360-11891-13 360-11891-35 360-11891-46	360-11896-12 360-11896-34 360-11896-45	360-11896-13 360-11896-35 360-11896-46	
	NS	2	26 DC 110 DC 115 AC	360-11891-14 360-11891-36 360-11891-47	360-11891-15 360-11891-37 360-11891-48	360-11896-14 360-11896-36 360-11896-47	360-11896-15 360-11896-37 360-11896-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11891-16 360-11891-38 360-11891-49	360-11891-17 360-11891-39 360-11891-50	360-11896-16 360-11896-38 360-11896-49	360-11896-17 360-11896-39 360-11896-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11891-18 360-11891-40 360-11891-51	360-11891-19 360-11891-41 360-11891-52	360-11896-18 360-11896-40 360-11896-51	360-11896-19 360-11896-41 360-11896-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11891-20 360-11891-42 360-11891-53	360-11891-21 360-11891-43 360-11891-54	360-11896-20 360-11896-42 360-11896-53	360-11896-21 360-11896-43 360-11896-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11891-22 360-11891-44 360-11891-55
TNC	SH	1	26 DC 110 DC 115 AC	360-11892-12 360-11892-34 360-11892-45	360-11892-13 360-11892-35 360-11892-46	360-11897-12 360-11897-34 360-11897-45	360-11897-13 360-11897-35 360-11897-46	
	NS	2	26 DC 110 DC 115 AC	360-11892-14 360-11892-36 360-11892-47	360-11892-15 360-11892-37 360-11892-48	360-11897-14 360-11897-36 360-11897-47	360-11897-15 360-11897-37 360-11897-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11892-16 360-11892-38 360-11892-49	360-11892-17 360-11892-39 360-11892-50	360-11897-16 360-11897-38 360-11897-49	360-11897-17 360-11897-39 360-11897-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11892-18 360-11892-40 360-11892-51	360-11892-19 360-11892-41 360-11892-52	360-11897-18 360-11897-40 360-11897-51	360-11897-19 360-11897-41 360-11897-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11892-20 360-11892-42 360-11892-53	360-11892-21 360-11892-43 360-11892-54	360-11897-20 360-11897-42 360-11897-53	360-11897-21 360-11897-43 360-11897-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11892-22 360-11892-44 360-11892-55
N	SH	1	26 DC 110 DC 115 AC	360-11890-12 360-11890-34 360-11890-45	360-11890-13 360-11890-35 360-11890-46	360-11895-12 360-11895-34 360-11895-45	360-11895-13 360-11895-35 360-11895-46	
	NS	2	26 DC 110 DC 115 AC	360-11890-14 360-11890-36 360-11890-47	360-11890-15 360-11890-37 360-11890-48	360-11895-14 360-11895-36 360-11895-47	360-11895-15 360-11895-37 360-11895-48	
	50 Ω RT	3	26 DC 110 DC 115 AC	360-11890-16 360-11890-38 360-11890-49	360-11890-17 360-11890-39 360-11890-50	360-11895-16 360-11895-38 360-11895-49	360-11895-17 360-11895-39 360-11895-50	
	75 Ω RT	3	26 DC 110 DC 115 AC	360-11890-18 360-11890-40 360-11890-51	360-11890-19 360-11890-41 360-11890-52	360-11895-18 360-11895-40 360-11895-51	360-11895-19 360-11895-41 360-11895-52	
	95 Ω RT	3	26 DC 110 DC 115 AC	360-11890-20 360-11890-42 360-11890-53	360-11890-21 360-11890-43 360-11890-54	360-11895-20 360-11895-42 360-11895-53	360-11895-21 360-11895-43 360-11895-54	
	TRANS	4	26 DC 110 DC 115 AC					360-11890-22 360-11890-44 360-11890-55

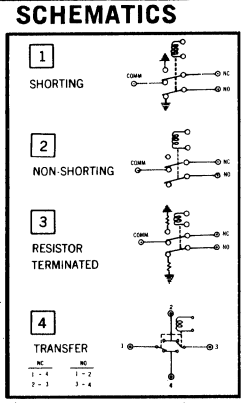
COIL CHARACTERISTICS @ 20°C

Nominal Voltage	Operating Range	Resistance, ohms ±10%
26 DC	20 - 32	260 ohms
110 DC	85 - 130	5100 ohms
115 AC (50 - 400 Hz)	90- 130	1500 ohms thru diodes

ELECTRICAL CHARACTERISTICS

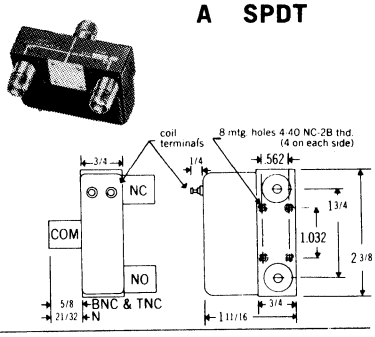
Conn.	Term.	Typical VSWR (Frequency GHz) .03	0.2	0.4	1.0	2.0	4.0	6.0	Typical Crosstalk - db (Frequency GHz) .03	0.2	0.4	1.0	2.0	4.0	6.0
BNC	SH	1.03	1.06	1.08	1.10	1.20	1.25	1.35	70	66	60	53	42	30	20
	NS	1.03	1.06	1.08	1.10	1.21	1.27	1.40	50	45	41	30	27	24	18
	50 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	75 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	95 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—
TNC	SH	1.03	1.06	1.08	1.10	1.20	1.25	1.35	70	66	60	53	42	35	25
	NS	1.03	1.06	1.08	1.10	1.21	1.27	1.40	51	43	41	30	27	26	21
	50 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	75 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	95 Ω RT	1.03	1.06	1.08	1.14	1.25	1.50	—	40	35	31	24	17	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—
N	SH	1.03	1.04	1.07	1.10	1.15	1.18	1.30	70	66	60	53	42	35	25
	NS	1.03	1.04	1.07	1.10	1.17	1.20	1.35	51	43	41	30	27	26	21
	50 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	41	35	31	24	17	14	—
	75 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	39	32	30	23	16	14	—
	95 Ω RT	1.03	1.05	1.08	1.12	1.18	1.50	—	37	31	29	22	15	14	—
	TRANS	1.05	1.10	1.15	1.20	1.50	—	—	45	38	32	24	17	—	—

SCHEMATICS

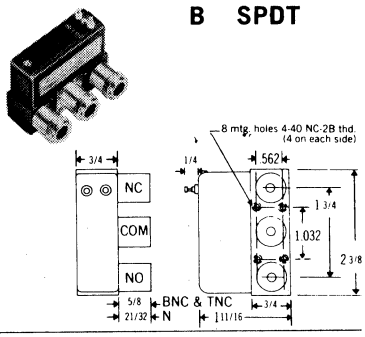


NOTE: High frequency electrical characteristics are typical values (not maximum) as measured in a 50 ohm circuit and may be used for most design analyses. For more exacting applications, maximum values in the frequency range may be obtained upon request. SWR measured to common with a matched 50 ohm termination. **For additional specifications request Amphenol RF Switches Catalog SS-1.**

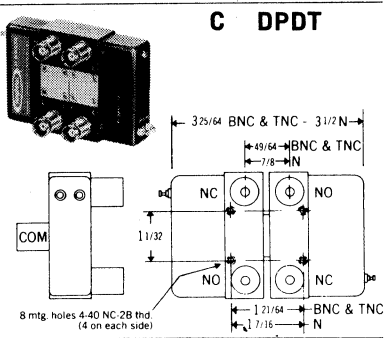
A SPDT



B SPDT



C DPDT



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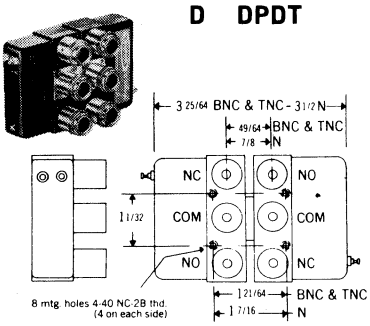
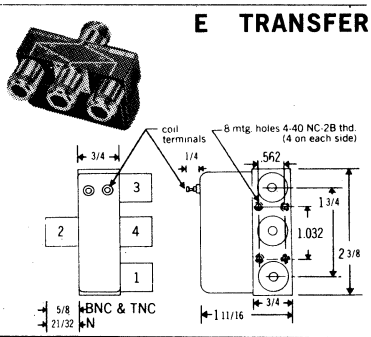


E TRANSFER



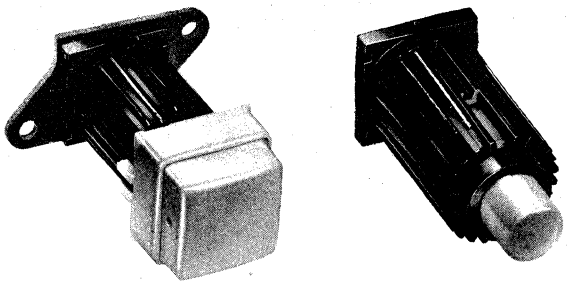
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

American Zettler, inc.

PUSHBUTTON SWITCHES SERIES K500

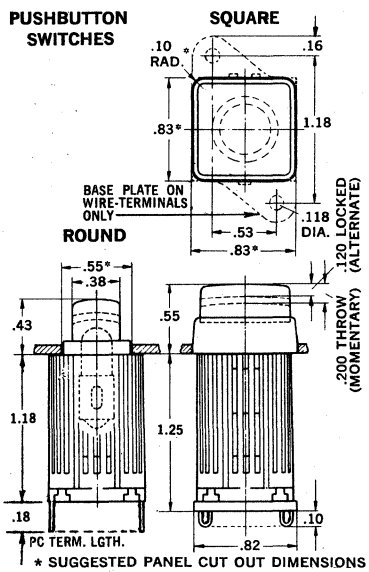
SERIES K-500 PUSHBUTTON SWITCHES

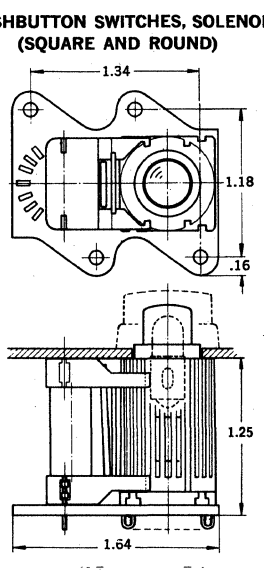
For chassis or PC board mounting only. No front panel screws. Six PDT silver alloy self-cleaning slide-action contacts. Occupies less one square inch of panel space. Only 1½" depth behind panel. Long-life special nylon parts used throughout. Pushbutton switches can be furnished with round ⅜" diameter or ¾" square button in white (W), black (BK), red (R), yellow (Y), green (G), or blue (B). Square buttons may be engraved or hot stamped. Illuminated pushbutton switches are available using lamps which are accessible from front. Special unbased lamps in 6, 12, 24 v 1 watt are available all over the world.

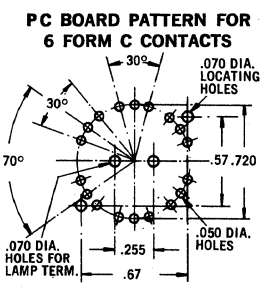


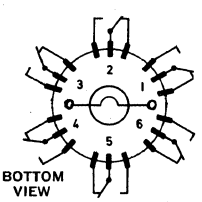
FEATURES

- Six PDT contacts in less than one square inch
- Overall depth behind panel only 1.5 inches
- No mounting screws needed on front panel
- Self-cleaning, slide-action contacts
- Long-life special nylon parts used throughout
- No lubricant needed; metal parts rub against nylon
- All pushbutton switches can be illuminated
- Lamps are accessible from front
- Available with solder lugs or PC pins









SOCKET DIAGRAM

CONTACTS	SECTION
2 pole	1 + 4
4 pole	1 + 3 + 4 + 6
6 pole	all

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

SPECIFICATIONS

Contact Rating: 1 amp at 30 vdc or 0.2 amp at 115 vac
Contact Arrangement: Two, four, and six form C contacts
Life Expectancy: 10^6 mechanical; 5 x 10^4 at rated load
Ambient Temperature Range: −20°C to 60°C
Dielectric Strength: Under room conditions, 500v rms
Insulation Resistance: Under room conditions, 10^9 ohms.
Terminals: Solder lugs or PC pins

HOW TO ORDER

Your part number consists of the switch part number, color of button, contact arrangement and PC if printed circuit terminals are desired. Add letters "PC' 'at end of part number.

For example: to order a pushbutton switch with a push lock, push release function, a non-illuminated square black button, four form C contacts, and printed circuit terminals, the following part number would be used: **K560 BK-4C-PC.**

Note: Solder temperature: Max. 270°C (500°F) Solder time: Max. 5 sec.

PART NUMBERS FOR PUSHBUTTON SWITCHES

Function	Non-Illuminated		Illuminated	
	Round	Square	Round	Square
Momentary	K 500	K 520	K 600	K 620
Push Lock, Push Release	K 540	K 560	K 640	K 660
Push Lock, Reset Solenoid*	K 502	K 522	K 602	K 622

PART NUMBERS

For Incandescent Lamps and Accessories

P/N	Description
2305	6 - 7V, 1W Unbased Lamp
2321	12 - 15V, 1W Unbased Lamp
2341	24 - 30V, 1W Unbased Lamp
LTa110Z1	Lamp Inserter
Z1693	Button Remover

* Standard solenoid is for 24 vac or vdc (200 ohms); other coils can be supplied to special order.

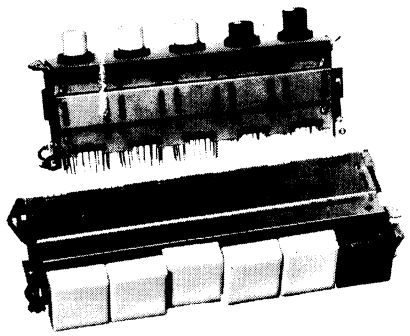
American Zettler, inc.
16881 HALE AVE. ■ IRVINE, CALIF. 92705 ■ PHONE (714) 540-4190 ■ TELEX: 67-8472

ALL SPECIFICATIONS IN THIS CATALOG SUBJECT TO CHANGE WITHOUT NOTICE

American Zettler, inc.

MULTIPLE SWITCH SERIES T-596

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

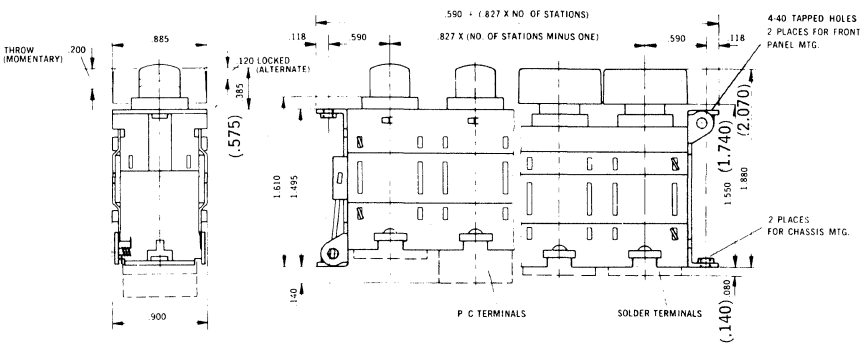


SERIES T596 MULTIPLE SWITCHES

For front panel, chassis, or PC board mounting using 4-40 screws. Up to 6 PDT silver-nickel self-cleaning slide-action contacts. Occupies less than one square inch of panel space. Only 1½" depth behind panel. Long-life special nylon parts used throughout. Pushbutton switch can be furnished with round ⅜" diameter or square ⅞" x 13/16" with 0.827" center-to-center spacing, in white, black, red, yellow, green, or blue buttons. Square buttons may be engraved or hot stamped. Illuminated pushbutton switches are available using lamps, which are accessible from front. Special unbased lamps in 6, 12, 24 v 1 watt are available all over the world.

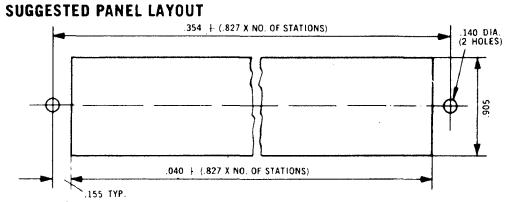
FEATURES

- Illuminated or non-illuminated
- Up to 6 PDT contacts per station
- All contacts are inside of switch
- Self-cleaning slide action contacts
- From 2 to 11 stations in one frame
- Easy front or back panel mounting
- PC or solder lug terminals
- Square buttons can be mounted in tight parallel rows to form a block.



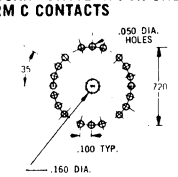
Dimensions in parenthesis for square button PC-Version only.

SUGGESTED PANEL LAYOUT



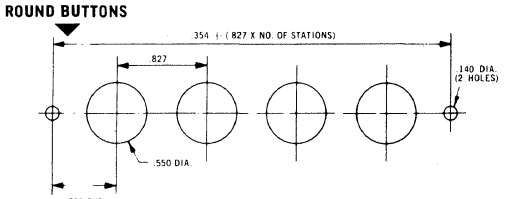
SQUARE BUTTONS

P/C BOARD PATTERN FOR ONE STATION 6 FORM C CONTACTS

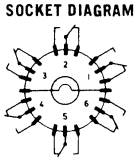


Hole for PC - Center Guide

ROUND BUTTONS



SOCKET DIAGRAM



CONTACTS	SECTION
2 pole	1 + 4
4 pole	1 + 3 + 4 + 6
6 pole	all

Button colors:

white	W
black	BK
red	R
yellow	Y
green	G
blue	B

SPECIFICATIONS

Contact Rating: 1 amp at 30 vdc or 0.2 amp at 115 vac
Contact Arrangement: Two, four, and six form C contacts
Life expectancy: 10^5 mechanical; 5 x 10^4 at rated load.
Ambient Temperature Range: −20°C to 60°C
Dielectric Strength: Under room conditions, 500v rms
Insulation Resistance: Under room conditions, 10^9 ohms
Terminals: Solder lugs or PC terminals

MOUNTING

2 holes 4-40 NC-2B in front
2 holes 4-40 NC-2B in back
Required Screw Length: .125 Max., .080 Min. + Material Thickness

PART NUMBERS

For Incandescent Lamps and Accessories

P/N	Description
2305	6-7V, 1W Unbased Lamp
2321	12-15V, 1W Unbased Lamp
2341	24-30V, 1W Unbased Lamp
LTa110Z1	Lamp Inserter

SWITCH CHARACTERISTICS

Switch Function	Frame Part Number
Non-lock (momentary) Push lock, push release	T596.10
Interlock	T596.20
Interlock with one non-locking reset button	T596.30

STATION PART NUMBERS

Function	Non-illuminated Round	Non-illuminated Square	Illuminated Round	Illuminated Square
Non-lock (momentary)	500.1	520.1	600.1	620.1
Interlock	500.2	520.2	600.2	620.2
Push lock, push release	540.4	560.4	640.4	660.4
Reset	500.0	520.0	600.0	620.0

FOR EXAMPLE, TO ORDER:

A multiple-station pushbutton switch with: Ten interlock, non-illumnated stations with white round buttons, four form C contacts, and printed circuit terminals, the following part number would be developed: (See example at right)

T 596.20-10 / 500.2W / 4C / PC

- **Frame #** — T 596.20
- **Number of stations** — 10
- **Station part #** — 500.2
- **Color of buttons** — W
- **Contacts on each station** — 4C
- **PC pins** — PC

Note: Solder temp.: Max. 270°C (500°F) Solder time: Max. 5 sec.

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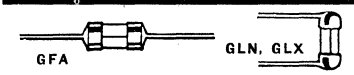
fuses and holders

TRON® SUBMINIATURE PIG-TAIL FUSES



Glass-tube construction with 1-1/2″ leads of #24 tinned copper for 1/100-5 amp ratings, #18 tinned copper for 7-15 amp ratings. Hermetically sealed. Color coded to indicate amp ratings. For circuits with fault current of 50 amps or less (1/100-5 amps for 125 V or less, 7-15 amps for 32 V or less). GLN, GLX body size, .140″ x .3″; GFA body size, .145″ x .3″.

Buss No.	Amperes	Net Price For Ten	100
GLN	1/100	$14.60	$122.00
GLN	1/32, 1/20, 1/16, 1/10, 1/8, 3/10, 4/10, 7, 8, 15	12.40	103.00
GLX	15/100, 2/10, 1/4, 1/2, 6/10, 3/4, 1, 1-1/2, 2, 3, 4, 5	16.00	133.00
GFA	1/100, 1/32, 1/20, 1/16, 1/10, 1/8, 15/100, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10	5.30	44.00
GFA	3/4, 1, 1-1/2, 2, 3, 4, 5, 7, 8, 15	4.50	38.00

SUBMINIATURE PRONG TYPE UNIT

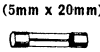
Rated 125 V or less, fault current not over 300 amps; open at 200% within 10 sec or less. Use AF knob for waterproof. Size, .270″ dia., .250″ lg. (body).

Buss No.	Amperes	Net Price For Ten	100
GMW	1/200, 1/100, 1/64, 1/32, 1/16	$8.80	$74.00
GMW	1/10, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10, 3/4, 1, 1-1/2, 2, 3, 4, 5	6.80	57.00
HWA*	Holder, fits all GMW	8.60	72.00
HWA†	Holder, fits all GMW	7.50	63.00
AF	Knob only, fits HWA	1.10	9.00

*With AF knob. †Without AF knob.

13/64 x 45/64 inch FUSES

(5mm x 20mm)



Protection of miniaturized circuits — commonly used in foreign equipment. Carry 100%, open at 200% in 10 sec.

Buss No.	Amperes	Volts	Net Price For Five	100
GMA	1/8	125	$2.00	$33.00
GMA	1/4, 1/2, 7/10	125	1.60	27.00
GMA	1, 1-2/10, 1-1/2, 2, 3, 4, 5, 6, 10	125	1.30	22.00

1/4 x 5/8 inch FUSES

FAST ACTING FUSE

Glass tube, 1/4″ x 5/8″. Carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For Five	100
AGA	1, 1-1/2, 2, 2-1/2	32	$0.48	$8.50
AGA	3	32	.48	8.50
AGA	5, 6, 7-1/2, 10, 15, 20	32	.38	6.50
AGA	25, 30	32	.38	6.50

1/4 x 7/8 inch FUSES

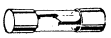
FAST ACTING FUSE

Glass tube, carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For Five	100
AGW	1, 2-1/2, 3, 4	32	$0.48	$8.50
AGW	5, 6, 7-1/2, 15, 20, 30	32	.38	6.50

1/4 x 1 inch FUSES

FAST ACTING FUSES



Glass tube, 1/4″ x 1″. Carry 100%, open at 200% in 5 seconds. 1/500 to 1/32 amp sizes have bridge construction; all others straight-through element. U/L Approved.

Buss No.	Amperes	Volts	Net Price For Five	100
AGX	1/500	250	$7.15	$119.00
AGX	1/200	250	3.10	52.00
AGX	1/100	250	2.65	44.00
AGX	1/32	250	2.25	38.00
AGX	1/16	250	1.50	25.00
AGX	1/10, 1/8, 3/16, 2/10	250	1.15	19.00
AGX	1/4, 3/8, 4/10, 1/2, 3/4	250	.70	12.00
AGX	1, 1-1/2, 2, 3, 4	125*	.48	8.50
AGX	5, 8, 10, 15, 20	32†	.38	6.50
AGX	25, 30	32	.38	6.50

*1 A, 250. †5 A, 125.

1/4 x 1-1/4 inch FUSES

FAST ACTING FUSES

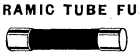
Glass tube, 1/4″ x 1-1/4″. Carry 110%, open at 135% in 1 hour or less. 1/500 to 2 amp sizes will open at 200% in 5 seconds or less. 1/500 to 1/32 amp have bridge construction; all others straight-through element. U/L Approved.

Buss No.	Amperes	Volts	Net Price For Five	100
AGC	1/500	250	$7.15	$119.00
AGC	1/200	250	3.10	52.00
AGC	1/100	250	2.65	44.00
AGC	1/32	250	2.25	38.00
AGC	1/16, 1/8, 15/100, 175/1000, 3/16, 1/10, 2/10	250	1.15	19.00
AGC	1/4, 3/10, 3/8, 45/100, 1/2, 6/10, 3/4	250	.70	12.00
AGC	1, 1-1/4, 1-1/2, 1-6/10, 2	250	.48	8.50
AGC	2-1/2, 3	250	.48	8.50
AGC	4	32‡	.48	8.50
MTH	4, 5, 6	250	.55	9.50
AGC	5, 6, 7-1/2, 8, 10, 15	32‡	.38	6.50
AGC	20	32‡	.38	6.50
AGC	25, 30	32‡	.38	6.50

‡Not U/L listed.

1/4 x 1-1/4 inch FUSES

CERAMIC TUBE FUSES

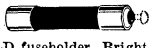


High interrupting capacity for use on circuit delivering as high as 25,000 amps at 125 V, or 10,000 amps at 250 V. 1/4″ x 1-1/4″. Carry 110%, open at 135% in 1 hour. Up to 15 amp size U/L Approved.

Buss No.	Amperes	Volts	Net Price For Five	100
ABC	1/4	250	$0.95	$16.00
ABC	1, 2, 3	250	.95	16.00
ABC	5, 6, 8, 10	250	.80	14.00
ABC	12, 15, 20	250	.95	16.00
ABC	25, 30	125	1.25	21.00

1/4 x 1-1/4 inch FUSES

VISUAL INDICATING FUSES



For use with HLD fuseholder. Bright red dot on indicating pin extends from end of fuse when fuse is open even after power is off. Rated 125 V or less, carries 110%, opens at 135% in 1 hour or less. Only 1/4″ x 1-1/4″.

Buss No.	Amperes	Net Price For Five	100
GBA	3/4	$3.10	$52.00
GBA	1, 1-1/2, 2, 3, 4, 5	2.25	38.00

Fiber tube with silver plated indicating pin which extends when fuse is blown. May be used to actuate a signal when used in HKA fuseholder or Signal Fuse Block. Dual tube construction in sizes larger than 5 amps (cannot be used in HKA fuseholder). Voltage, 125 volts, except 8 amp and over which are 32 volts. Size, 1/4″ x 1-1/4″.

Buss No.	Amperes	Net Price For Five	100
GLD	3/4	$2.80	$47.00
GLD	1, 1-1/2, 2, 3, 4, 5	2.15	36.00
GLD	6, 8, 10, 12, 15, 20	3.10	52.00

1/4 x 1-1/4 inch FUSES

FUSETRON PIG-TAIL FUSES

Body 1/4″ x 1-1/4″, #20 tinned leads, 1-1/4″. 1/100 to 2-8/10 same as MDL type; 3 to 7 amps same as MDX type. U/L Approved.

Buss No.	Amperes	Volts	Net Price For Five	100
MDV	1/100, 1/32	250	$2.35	$39.00
MDV	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 3/4, 8/10, 1	250	1.75	30.00
MDV	1-1/4, 1-1/2, 1-6/10, 2	125	1.70	28.00
MDV	2-1/2, 2-8/10, 3, 3-2/10, 4, 5, 6-1/4, 7	125	1.50	25.00

FAST ACTING FUSE

PIG-TAIL FUSES

Glass tube 1/4″ x 1-1/4″ with 1-1/4″ leads of #20 tinned wire. Carry 110%, open 135% in 1 hour. 250 V. U/L Approved.

Buss No.	Amperes	Net Price For Five	100
GJV	1/16	$1.75	$30.00
GJV	1/8	1.40	24.00
GJV	1/4, 3/10, 3/8, 1/2, 3/4	1.15	19.00
GJV	1, 1-1/2, 2, 3	.85	14.00
GJV	4, 5, 6	.85	15.00

1/4 x 1-1/4 inch FUSES

FUSETRON GLASS TUBE FUSES

Dual-element slow-blowing type, 1/4″ x 1-1/4″. Fuse link operates only on very high overloads or short-circuits; thermal cutout functions on low overloads (cannot operate quickly on any load, thus providing long time-lag). Carry 110%, open at 135% in 1 hour. MDL 1/100 to 2-8/10 amp and MDX 3 to 7 amp sizes. U/L Approved. MDL type has longer time-lag than MDX type.

Buss No.	Amperes	Volts	Net Price For Five	100
MDL	1/100, 1/32	250	$2.00	$33.00
MDL	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 7/10, 3/4, 8/10, 1		1.50	25.00
MDX	1-1/4, 1-1/2, 1-6/10, 2	250	1.60	27.00
MDL	1-2/10, 1-1/4, 1-1/2, 1-6/10, 2	125	1.40	24.00
MDL	2-1/2, 2-8/10	125	1.15	19.00
MDX	3, 3-2/10, 4, 5	125	1.15	19.00
MDX	6-1/4, 7	125	1.30	22.00
MDL	3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20, 25, 30	32	1.15	19.00

1/4 x 1-1/4 inch FUSES

Fusetron dual-element fuse, slow-blowing type, ceramic tube. Carry 110%, open at 135% in 1 hour.

Buss No.	Amperes	Volts	Net Price For Five	100
MDA	1/100, 1/32	250	$2.45	$41.00
MDA	1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 3/4, 8/10, 1, 1-1/4, 1-1/2, 1-6/10, 2	250	2.05	35.00
MDA	2-1/2, 2-8/10, 3, 3-2/10, 4, 5, 6-1/4, 7, 8, 10, 15, 20	250	1.50	25.00
MDA	25, 30	125	1.50	25.00

bussmann manufacturing div.

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fuses and holders

9/32 x 1-1/4 inch FUSES

AGS GLASS TUBE FUSES

Test specification; carry, 110%, open at 135% within 1 hour except 35 and 40 amp units which open at 300% in 2 to 4 seconds when tested in standard 30-amp test circuit. **Note:** These units in sizes larger than 30 amps are not recommended for use in fuse clips or fuseholders as clips will not carry the high currents.

Buss No.	Amperes	Volts	Net Price For Five	100
AGS	1/16	250	$2.05	$35.00
AGS	1/8	250	1.60	27.00
AGS	1/4, 1/2	250	75	13.00
AGS	1, 2, 2-1/2, 3	250	.70	12.00
AGS	5, 10, 15, 20 ,25, 30	32	.60	10.00
AGS	35, 40, 50	32	.70	12.00

9/32 x 1-1/4 inch FUSES

CERAMIC TUBE FUSES

Carrry 110%, at 135% in 1 hour. 35 and 40 amp. open at 300% in 2 to 4 seconds when tested in a standard 30 amp. test circuit.

Buss No.	Amperes	Volts	Net Price For Five	100
ABS	1, 2, 3	250	$1.50	$25.00
ABS	5, 8, 10, 15, 20	250	1.40	24.00
ABS	25, 30	125	1.40	24.00
ABS	35, 40	32	1.50	25.00

9/32 x 1-1/4 inch FUSES

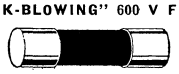
FUSETRON DUAL-ELEMENT FUSES

Glass tube, slow-blowing. Avoid needless blows from starting currents or surges, yet provides protection against short-circuits or continuous overloads. Carry 110%, open at 135% in 1 hour. Approximate blowing time: at 200% load, 25 seconds; at 300% load, 8 seconds; at 500% load, 3 seconds.

Buss No.	Amperes	Volts	Net Price For Five	100
MDM	1/10, 15/100, 2/10, 1/4, 3/10, 4/10, 1/2, 6/10, 3/4, 8/10, 1	250	$1.90	$32.00
MDM	1-1/4, 1-6/10, 2	125	1.90	32.00
MDM	2-1/2, 2-8/10, 3	125	1.50	25.00
MDM	3-2/10, 4, 5, 6-1/4, 8, 10, 10, 15, 20, 25, 30, 35, 40	32	1.50	25.00

13/32 x 1-3/8 inch FUSES

"QUICK-BLOWING" 600 V FUSES



Designed to protect control circuits, fluorescent lighting circuits or similar uses where quick-blowing characteristics are desired. Use HPC-L fuseholder or 3845 fuse block. U/L Approved. Fiber tube 13/32" x 1-3/8".

Buss No.	Amperes	Net Price For Ten	100
BBS	4/10, 3/4, 8/10	$2.70	$23.00
BBS	1, 2, 3, 4, 5	2.50	21.00

13/32 x 1-1/2 inch FUSES

Glass tube, carry 110%, open at 135% in 1 hour. 3 amp. and smaller sizes U/L listed.

Buss No.	Amperes	Volts	Net Price For Ten	100
AGU	1, 2, 3, 4	250	$1.70	$15.00
AGU	5, 10, 15, 20, 25, 30	32	1.70	15.00

13/32 x 1-1/2 inch FUSES

MIDGET TYPE FUSES

Up to 15 amp size U/L Approved.

Buss No.	Amperes	Volts	Net Price For Ten	100
BAF	1, 3, 5, 6, 10	250	$1.50	$13.00
BAF	15, 20, 25, 30	125	1.50	13.00

13/32 x 1-1/2 inch FUSES

INDICATING, LAMINATED TUBE FUSES

Red button on indicating pin extends from end of fuse when fuse is blown. Units are built in accordance with Navy Specifications. These units may be used in Buss HPC-C fuseholders. Voltage, (1-15 amps), 250, others, 125 V.

Buss No.	Amperes	Net Price For Ten	100
MIN	1, 2, 3, 5, 10, 15, 20, 25, 30	$4.50	$38.00

SIGNAL OR VISUAL INDICATING FUSES

MIC fuses have silver-plated indicating pin. Pin may be used as visual indicator or may be used to actuate a signal. **MIJ** fuses are similar to MIC types except they have been specially designed for complex circuitry as in computers. Voltage, 250 except 20 amps and over which are 32 V.

Buss No.	Amperes	Net Price For Ten	100
MIC	1, 2, 3, 5, 10, 15, 20, 25, 30	$5.30	$44.00
MIJ	1, 2, 3, 5, 10, 15, 20, 25, 30	6.20	52.00

13/32 x 1-1/2 inch FUSES

HIGH INTERRUPTING CAPACITY FUSES

Type KTK — For use on circuits as high as 100,000 amps and sand filler surrounding a silver fuse at 600 volts or less, AC only. Glass fiber melamine tubes element. **Amperes:** 1/10, 1/8, 2/10, 1/4, 3/10, 1/2, 3/4, 1, 1-1/2, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30. Lot of 10. Net **$11.20.** Lot 100, Net **$94.00.**

13/32 x 1-1/2 inch FUSES

FUSETRON FIBER TUBE FUSES

Dual-element slow-blowing type, 13/32" x 1-1/2" overall. Fuse link operates only on very high overloads or short circuits; thermal cutout functions on low overloads (cannot operate quickly on any overload, thus providing longer time lag). Carry 110%, open at 135% in 1 hour. 125 and 250 volt sizes U/L Approved.

Buss No.	Amperes	Volts	Net Price For Ten	100
FNM	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4, 1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6-1/4, 7, 8, 9, 10	250	$4.00	$34.00
FNM	12, 15	125	4.00	34.00
FNM	20, 25, 30	32	4.00	34.00

Same as series FNM above, except glass tube instead of fibre tube.

Buss No.	Amperes	Volts	Net Price For Ten	100
MDR	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10	250	4.50	38.00
MDR	1, 1/2, 1-6/10	125	4.50	38.00
MDR	2-1/2, 3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20	32	3.80	32.00
MDR	25, 30, 35, 40	32	4.10	35.00

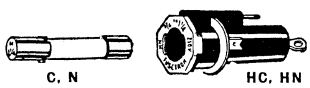
13/32 x 1-1/2 inch FUSES

INDICATING FUSETRON FUSES

Similar to FNM types. Indicating pin extends from fuse when fuse blows. Use in signal fuse block or HPC-C fuseholder (larger than 10 amps units cannot be used in HPC-C). U/L Approved in 0-15 amp sizes.

Buss No.	Amperes	Net Price For Ten	100
FNA	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4,1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6, 6-1/4, 7, 8, 10	$7.50	$62.00
FNA	12, 15, 20, 25, 30	8.40	70.00

TYPE C AND N FUSES, HOLDERS



C, N HC, HN

Matched glass fuses and fuseholders for specific size ranges. **Type N** fuses are dual-element time-delay or slow-blowing type. 0 to 1-1/4 amp sizes, 1/4" x 1-1/4"; 1-3/10 to 7 amp sizes, 1/4" x 1-7/16". **Type C** fuses are single-element quick-blowing type. 0 to 3-1/2 amp sizes, 1/4" x 1-1/16"; 3-6/10 to 10 amp sizes, 1/4" x 1-1/4". Holders rated at 250 volts.

TYPE N FUSES

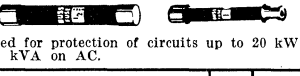
Amperes	Holder No. HN-	Volts	Net Price For Five	100
1/100, 1/32	0 to 3/10	250	$2.00	$33.00
1/16, 1/10, 15/100, 2/10, 1/4, 3/10	0 to 3/10	250	1.50	25.00
4/10	3/10 to 1/2	250	1.50	25.00
1/2	3/10 to 1/2	250	1.50	25.00
6/10	1/2 to 3/4	250	1.50	25.00
7/10, 3/4	1/2 to 3/4	250	1.50	25.00
8/10, 1	3/4 to 1-1/4	250	1.50	25.00
1-1/4	3/4 to 1-1/4	250	1.40	24.00
1-6/10	1-3/10 to	125	1.40	24.00
1-3/4	1-3/4	125	1.40	24.00
2	1-3/4 to 2-1/2	125	1.40	24.00
2-1/2	1-3/4 to 2-1/2	125	1.40	24.00
2-8/10	2-1/2 to 3-1/2	125	1.40	24.00
3-2/10	2-1/2 to 3-1/2	125	1.40	24.00
3-1/2	2-1/2 to 3-1/2	125	1.40	24.00
4	3-1/2 to 5	125	1.40	24.00
5	3-1/2 to 5	125	1.40	24.00
6-1/4	5 to 7	125	1.40	24.00
7	5 to 7	125	1.40	24.00

TYPE C FUSES

Amperes	Holder No. HC-	Volts	Net Price For Five	100
1/32	0 to 3/10	250	$2.15	$36.00
1/16	0 to 3/10	250	1.50	25.00
1/8, 3/16	0 to 3/10	250	1.15	19.00
1/4	0 to 3/10	250	.85	15.00
3/10	0 to 3/10	250	.85	15.00
3/8	3/10 to 1/2	250	.85	15.00
1/2	3/10 to 1/2	250	.85	15.00
3/4	1/2 to 3/4	250	.85	15.00
1	3/4 to 1-1/4	250	.55	9.00
1-1/4	3/4 to 1-1/4	250	.55	9.00
1-1/2	1-1/4 to 1-3/4	250	.55	9.00
1-3/4	1-1/4 to 1-3/4	250	.55	9.00
2	1-3/4 to 2-1/2	250	.55	9.00
2-1/2	1-3/4 to 2-1/2	250	.55	9.00
3	2-1/2 to 3-1/2	250	.55	9.00
3-1/2	2-1/2 to 3-1/2	250	.60	10.00
4	3-6/10 to 5	250	.60	10.00
5	3-6/10 to 5	250	.60	10.00
6	5 to 7	250	.60	10.00
7	5 to 7	250	.60	10.00
8	7 to 10	250	.60	10.00
10	7 to 10	250	.60	10.00

Type HC and Type HN Fuseholders— All sizes (specify). Net for 10 **$2.00** Net for 100 **$17.00**

HIGH VOLTAGE FUSES



Designed for protection of circuits up to 20 kW on DC and 30 kVA on AC.

Buss No.	Amperes	Volts	Net Price For Ten	100
HVA	3/8, 1/2, 3/4, 1, 1-1/2, 2	1000	$3.20	$26.00
HVB	1/2, 3/4, 1, 1-1/2, 2	2500	4.50	38.00
HVJ	1/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/2, 2	5000	8.10	68.00
HVL	1/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/2, 2	10K	15.80	131.00

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fuses and holders

SFE STANDARD FUSES

Different amperages are different lengths, making it impossible to over-fuse. Glass tube, 1/4" dia. Carry 110%, open at 135% in 1 hour. Made to SAE specifications and U/L Approved. 32 volts or less.

Buss No.	Amperes	Length In.	Net Price For Five	Net Price For 100
SFE	¾	5/8	$0.38	$6.50
SFE	6	3/4	.38	6.50
SFE	7-1/2, 9	7/8	.38	6.50
SFE	14	1-1/16	.38	6.50
SFE	20	1-1/4	.38	6.50
SFE	30	1-7/16	.38	6.50

SIGNAL-INDICATING ALARM ACTIVATING TYPE UNIT

Takes only 1/4" x 1-15/32" space. Color indicator. Rated 300 V or less; 100% for 10 min.; open at 150% within 5 min.

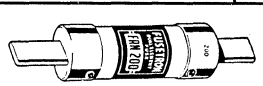
Buss No.	Amperes and Color of Indicator	Net Price For Ten	Net Price For 100
GMT	18/100*, 1/4†, 1/2‡, 65/100§, 3/4#, 1●, 1-1/3△, 2□, 3◀, 5∞, 7-1/2◭, 10**	$4.90	$41.00
HLT	Holder, fits all GMT	5.30	44.00

Color of Indicator: *Yellow; †violet; ‡red; §black; #brown; ●gray; △white; □orange; ◀blue; ∞green; ◭black-white; **red-white.

FUSETRON DUAL-ELEMENT FUSES

Long time-lag prevents useless shut-downs caused by ordinary fuses opening on starting currents or other harmless overloads, yet protects against short-circuits. On normal installations will guard motors against burn-out from overloads or single phasing. U/L Listed for motor running and circuit protection up to 250 volts.

Buss No.	Amperes	Net Price For Ten	Net Price For 100
FRN	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1-1/8, 1-1/4, 1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6-1/4, 7, 8, 9	$5.40	$46.00
	10, 12, 15, 17-1/2, 20, 25, 30	5.10	43.00
FRN	35, 40, 45, 50, 60	9.40	78.00



FRN	70, 80, 90, 100	$21.40	$178.00

BUSS ONE-TIME FUSES

FAST ACTING FUSE

Get same care in engineering and manufacture as other BUSS products. Each can be depended upon to operate as intended under all service conditions. Carry U/L label. For voltage up to 250.

Buss No.	Amperes	Net Price For Ten	Net Price For 100
NON	1, 3, 6, 10, 15, 20, 25, 30	$1.50	$13.00
NON	35, 40, 45, 50, 60	2.70	23.00

NON	70, 80, 90, 100	$11.70	$97.00

GRASSHOPPER FUSES

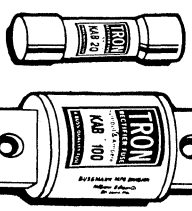
Alarm activating and signal indicating. Length: 1-43/64", except 35D (1-5/8"), 35E (1-63/64").

Buss No.	Amperes	Blowing Time Amp	Blowing Time Sec.	Net Price For Ten	Net Price For 100
35A*	1-1/3#	2	90	$3.50	$29.00
35B*	1-1/3**	2	90	3.50	29.00
35B*	2**	3	180	3.50	29.00
35C*	2#	3	180	3.50	29.00
35D*	1-1/3**	2	90	6.70	56.00
35E	3**	4	300	3.70	31.00
35F*	1/2#	3/4	9	3.50	29.00
35G*	3**	4-1/2	300	3.50	29.00
35H*	5**	6-1/2	300	3.50	29.00
35J†	1/2#	3/4	90	4.80	40.00
35K†	1-1/3#	2	180	6.70	56.00
35L†	2#	3	180	6.70	56.00
35M†	3**	4-1/2	300	6.10	51.00
35N†	5**	6-1/2	300	6.10	51.00
35P†	3/4#	1-1/8	90	4.50	37.00
35R*	18/100#	.270	90	4.50	37.00
35S†	1/4#	.375	90	4.80	40.00
35T*	65/100#	1.1	180	4.80	40.00

Volts: *90 or less. †160 or less. Mounting Screw: #No. 10. **No. 6.

TRON RECTIFIER FUSES

For Protection of Semiconductor Rectifiers and Similar Applications



Especially designed for protection of semiconductor rectifiers, thyristors and other solid state devices. High interrupting capacity and very fast clearing to restrict let-through current and energy to very low values. Give safe short-circuit protection for systems with fault current to 200 kA at 600 volts or less. Carry 100%, open at 1000 secs between 150% and 180% of rating; open within 1 sec at 250% of rating.

GBB SERIES

Size, 1-1/4" length x 1/4" diameter.

Buss No.	Amperes	Max. Volts	Net Each
GBB	1, 1-1/4, 2, 3, 4, 5, 6, 7, 8, 9, 10	130	0.79
GBB	12, 15, 20, 25, 30	65	.79

KAA SERIES

Size, 1-1/2" length x 13/32" diameter. Also available up to 1000 amps; prices on request.

KAA	1/2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30	130	1.08

KAW SERIES

Size, 1-1/2" length x 13/32" diameter.

KAW	1, 2, 3, 4, 5, 7, 8, 10, 12, 15, 20, 25, 30	130	1.08

KAB SERIES

Size, 9/16" diameter x 2" length, values to 30 amps; 1-7/32" diameter x 3-1/8" length, 70 amps to 200 amps. Also available up to 800 amps; prices on request.

KAB	1/2, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 17-1/2, 20, 25, 30	250	1.22
KAB	70, 80, 90, 100, 150, 200	250	6.16

KAC SERIES

Size, 2-7/8" length x 9/16" diameter. Also available up to 800 amps; prices on request.

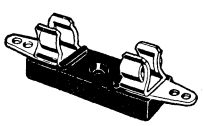
KAC	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 17-1/2, 20, 25, 30	600	1.63

BLOCKS FOR TRON RECTIFIER FUSES

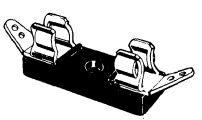
Buss No.	No. Poles	For Fuse* Symbol Amp.	Base Size In.	Net Each
4515	1	KAA	3/4 x 2-9/16	$0.68
4525	2	or 1 to 30	1-5/16 x 2-9/16	1.30
4535	3	KAW	2-1/16 x 2-9/16	1.91
4386	1		3/4 x 3-1/4	.98
4287	2	KAB 1 to 30	2 x 3-1/2	1.91
3959	3		3 x 3-1/2	2.98
3556	1	KAB 70 to 100	1-1/2 x 3-1/8	2.17
3521	3		5-23/32 x 3-1/8	6.50
3595	1		1-1/4 x 3-1/2	1.58
3528	2	KAC 1 to 30	2-1/2 x 3-1/2	3.15
2795	3		3-1/2 x 3-1/2	4.73

*GBB series — use any BUSS block for 1/4" x 1-1/4" fuse.

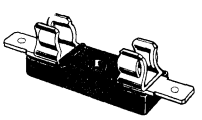
BLOCKS FOR 1/4 x 1 inch FUSES



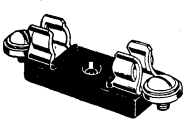
No. 4520 — 1 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.25



No. 3992 — 1 pole, small bakelite base, one piece solder terminals and spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.30

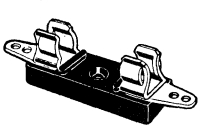


No. 2698 — 1 pole, small bakelite base, ¼ in. quick-connect terminals, spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.31

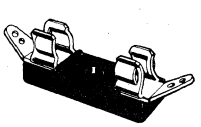


No. 4399 — 1 pole, small bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.375 inches. Net Each $0.35

BLOCKS FOR 1/4 x 1-1/4 inch FUSES



No. 4405 — 1 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.25



No. 3998 — 1 pole, small bakelite base, one piece solder terminals and suring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each $0.25

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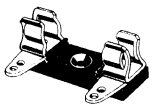
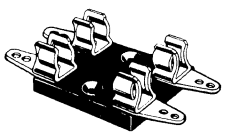
fuses and holders

BLOCKS FOR 1/4 x 1-1/4 inch FUSES (cont'd)

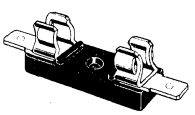


No. 4406 — 1 pole, small bakelite base, side solder terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each **$0.25**

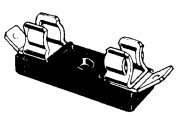


No. 4408 — 2 pole, small bakelite base, solder terminals. Spring bronze albaloy plated clips. Base dimensions, 1.000 x 1.625 inches. Net Each **$0.41**

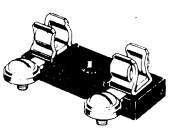
No. 2799 — 1 pole, small bakelite base, 3/16 in. quick-connect terminals. Beryllium copper albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each **$0.48**



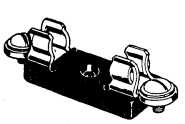
No. 2841 — 1 pole, small bakelite base, 1/4 in. quick-connect terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each **$0.31**



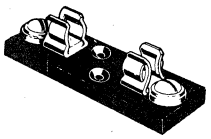
No. 2839 — 1 pole, small bakelite base, 1/4 in. quick-connect terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each **$0.31**



No. 2958 — 1 pole, small bakelite base, screw side terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.625 inches. Net Each **$0.37**

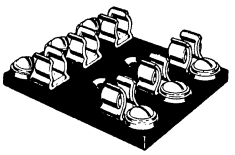


No. 4407 — 1 pole, small bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .500 x 1.652 inches. Net Each **$0.35**

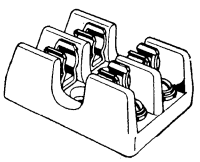


No. 4512 — 1 pole, full bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .750 x 2.1875 inches. Net Each **$0.43**

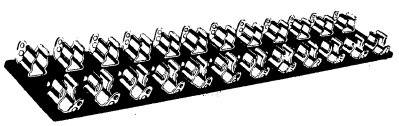
BLOCKS FOR 1/4 x 1-1/4 inch FUSES (cont'd)



No. 4532 — 3 pole, full bakelite base, screw terminals. Spring bronze albaloy plated clips. Base dimensions, 1.6875 x 2.1875 inches. Net Each **$1.31**



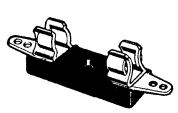
No. 4161 — 2 pole, full porcelain base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base dimensions, 1.3125 x 2.2500 inches. Net Each **$1.01**



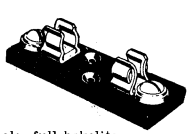
Molded black phenolic base; Albaloy plated spring clips for strong grip, high corrosion resistance. * x 1-5/8", 3823 Series.

Buss No.	No. Poles	Base Size* In.	Net Each
3823-1	1	1/2	$0.22
3823-2	2	1-1/8	.40
3823-3	3	1-3/4	.62
3823-4	4	2-3/8	.77
3823-5	5	3	.95
3823-6	6	3-5/8	1.12
3823-7	7	4-1/4	1.27
3823-8	8	4-7/8	1.43
3823-9	9	5-1/2	1.63
3823-10	10	6-1/8	1.81
3823-11	11	6-3/4	1.99
3823-12	12	7-3/8	2.17

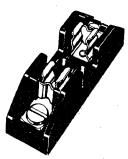
BLOCKS FOR 13/32 x 1-1/2 inch FUSES



No. 4421 — 1 pole, small bakelite base, solder terminals. Beryllium copper silver plated clips. Base dimensions, .6250 x 2.3125 inches. Net Each **$0.50**

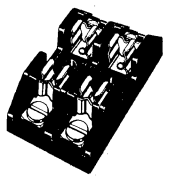


No. 4515 — 1 pole, full bakelite base, screw terminals. Beryllium copper silver plated clips. Base dimensions, .7500 x 2.5625 inches. Net Each **$0.68**



No. 2807 — 1 pole, molded phenolic base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base dimensions, .859 x 3.000 inches. Net Each **$0.68**

BLOCKS FOR 13/32 x 1-1/2 inch FUSES (cont'd)



No. 2808 — 2 pole, molded phenolic base with side barriers, screw terminals. Spring bronze albaloy plated clips. Base Dimensions, 1.625 x 3.000 inches. Net Each **$1.12**

Add-On Fuse Block — Each pole locks into each other. New poles can be added at any time, each has end barrier. Net Each **$0.14**

No. 3742 Specify End Barrier Only. Net Each **$1.01**

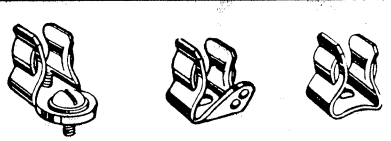
No. 3743 Specify One-Pole Only — Base dimensions, .787 x2.562 inches. Marking strip in 50 inch lengths. Net Each **$0.45**

TRON FUSE CLIPS FOR P.C. BOARDS

For ¼" diameter fuses — offer economical way to mount fuses on printed circuit boards. Clips with two tabs, especially bowed that snap in P.C. board to hold clip firmly while being wane soldered, eliminates riveting. Clips available with end stops and single tabs.

BUSS No.	No. Tabs	Clip Material	Clip Finish	Net Each
TA1310-05	1	Beryllium Copper	Tin	$0.12
TA0581-01	1	Spring Bronze	Albaloy	.12
TA0581-05	1	Beryllium Copper	Tin	.12
TA1119-05	2	Beryllium Copper	Silver	.11
TA1119-10	2	Spring Bronze	Albaloy	.083
TA1120-05	2	Beryllium Copper	Silver	.09
TA1120-10	2	Spring Bronze	Albaloy	.083

BUSS FUSE CLIPS



Buss No.	Description	For Dia Fuse In.	Net Each
3434	Insulated Twin Clip	1/4	$0.19
5681-15	Clip	1/4	.038
5678-14	Clip and Terminal	1/4	.043
4431	Clip Assembly	1/4	.11
4432	Clip Assembly	1/4	.14
5682-01	Clip	1/4	.066
5682-41	Clip	1/4	.034
5682-44	Clip	1/4	.034
4567	Clip Assembly	1/4	.11
4583	Clip Assembly	1/4	.13
5682-02	Clip	1/4	.066
5672-11	Clip	9/32	.058
5674-41	Clip	9/32	.058
4560	Clip Assembly	9/32	.17
4585	Clip Assembly	9/32	.25
5674-01	Clip	9/32	.11
5956-16	Clip	13/32	.058
5960-61	Clip	13/32	.075
5960-07	Clip	13/32	.17
5960-63	Clip	13/32	.075
4561	Clip Assembly	13/32	.17
4586	Clip Assembly	13/32	.30
5960-09	Clip	13/32	.17

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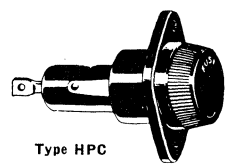
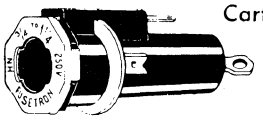
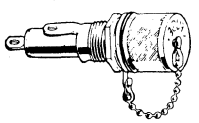
BUSS FUSEHOLDERS

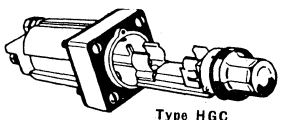
Carton Quantity 10 on all Fuseholders

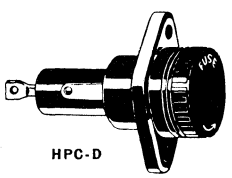

Type HPC

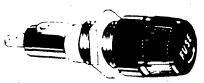

Type HC and HN

Type HKL


Type HMR and HMS

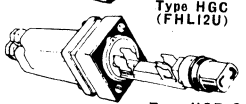

Type HGC (FHLI2U)

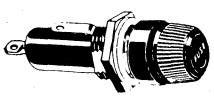

HPC-D

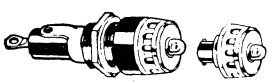

Series HJ and HK

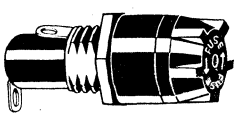
Type HKA

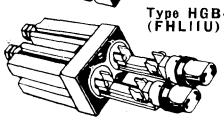
Series HR

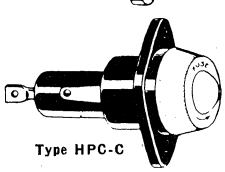

Type HGB-C (FHLIIU)

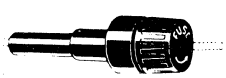

Series HCM


Type HLD No. 5487


Type HTA


Type HGA-C (FHLI0U)


Type HPC-C


Series HH and HI

Type HLQ and HLR

*VOLTAGE: On lamp indicating holders shows operating range for lamp indication. On non-indicating holders shows maximum voltage of fuses commercially available that will fit holders.

NON-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HDI	In-line	250 or less	15A	$0.19
HHI	In-line	250 or less	15A	.28
HJM	Panel	125 or less	30A	.47
HJM-CC	Panel	125 or less	30A	.47
HJM-H	Panel	125 or less	30A	.50
9969	Spring nut for panel mounting in-line holder			.038

LAMP-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HJL	Panel	100 to 250	20A	$2.03

SHIELDED NON-INDICATING FOR 1/4 x 1 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HMS	Panel	250 or less	30A	$5.60

SHIELDED NON-INDICATING FOR 1/4 x 1-1/4 INCH FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HMR	Panel	250 or less	30A	$5.60

SIGNAL ACTIVATING-LAMP INDICATING FOR 1/4 x 1-1/4 inch INDICATING FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HKA	Panel	125 or less	5A	$4.40

LAMP INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HGA	Panel	100 to 250	30A	$4.41
HGA-C	Panel	100 to 250	30A	4.85
HGB	Panel	100 to 250	30A	3.75
HGB-C	Panel	100 to 250	30A	4.13
HKL	Panel	100 to 250	20A	2.03
HKL-X	Panel	100 to 250	20A	2.03
HKR	Panel	24 to 32	20A	3.28
HKT	Panel	10 to 14	20A	3.28
HKU	Panel	4 to 6	20A	3.28
HKX	Panel	24 to 32	20A	3.28

VISUAL INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HLD	Panel	125 or less	30A	$0.53
5487	Knob assembly for HLD holder			.28

NON-INDICATING FOR 1/4 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HCM	Panel	250 or less	18A	$0.70
HCM-H	Panel	250 or less	18A	.74
HDJ	In-line	250 or less	15A	.19
HHJ	In-line	250 or less	15A	.28
HKP	Panel	250 or less	30A	.47
HKP-CC	Panel	250 or less	30A	.47
HKP-H	Panel	250 or less	30A	.50
HLF	Panel	250 or less	30A	.47
HMB	Panel	250 or less	30A	.47
HMJ	HDJ holder w/SFE 20 fuse & wire leads			.38
HRJ	HHJ holder w/SFE 20 fuse & wire leads			.47
HTA	Panel	250 or less	15A	.47
9969	Spring nut for panel mounting in-line holders			.038

NON-INDICATING FOR 9/32 x 1-1/4 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HCM	Panel	250 or less	18A	$0.70
HCM-H	Panel	250 or less	18A	.74

NON-INDICATING FOR 13/32 x 1-3/8 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC-L	Panel	600 or less	5A	$0.75

NON-INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC	Panel	250 or less	30A	$0.75
HPC-D	Panel	250 or less	30A	1.52

VISUAL INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HPC-C	Panel	250 or less	30A	$0.94

LAMP INDICATING FOR 13/32 x 1-1/2 inch FUSES

Buss No.	Type Mounting	*Fuse Voltage	Current Capacity	Net Each
HGC	Panel	200 to 500	30A	$4.70

OTHER STANDARD AND SPECIAL FUSES, BLOCKS AND HOLDERS

If the fuses, fuse blocks and holders shown do not fit your requirements ask for information on other types. Fuses and fuse mountings to meet JAN and Military specifications also available. If you have a special problem in protection, send description or sketch giving number of circuits, type of fuse, terminals, etc., desired. We welcome such inquiries.

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military fuses and holders

BUSS FUSES LISTED UNDER MIL-F-15160D

Suffix **S** on Military type designation (e.g., F01A250V1/500A-S) indicates silver plating; if silver plating is not required, omit (e.g., F01A250V1/500A).

Military Type Designation	Nearest Buss Equiv.	Price Each
F01A250V1/500A S	AGX1/500	$1.43*
F01A250V1/200A-S	AGX1/200	.62*
F01A250V1/100A-S	AGX1/100	.53*
F01A250V1/32A-S	AGX1/32	.45*
F01A250V1/16A-S	AGX1/16	.30*
F01A250V1/8A-S	AGX1/8	.23*
F01A250V1/4A-S	AGX1/4	.14*
F01A250V3/8A-S	AGX3/8	.096*
F01A250V1/2A-S	AGX1/2	.096*
F01AI25V3/4A-S	AGX3/4	.096*
F01AI25V1A-S	AGX1	.096*
F01AI25V-1/2A-S	AGX1-1/2	.096*
F01AI25V2A-S	AGX2	.096*
F02A250V1/100A-S	AGC1/100	.53*
F02A250V1/32A-S	AGC1/32	.45*
F02A250V1/16A-S	AGC1/16	.23*
F02A250V	AGC1/8	.23*
F02A250V1/4A-S	AGC1/4	.14*
F02A250V3/8A-S	AGC3/8	.14*
F02A250V1/2A-S	AGC1/2	.14*
F02A250V3/4A-S	AGC3/4	.14*
F02A250V1A-S	AGC1	.096*
F02A250V1-1/2A-S	AGC1-1/2	.096*
F02A250V2A-S	AGC2	.096*
F02A250V3A-S	AGC3	.096*
F02A250V4A-S	MTH4	.11*
F02A250V5A-S	MTH5	.11*
F02A250V6A-S	MTH6	.11*
F02AI25V10A-S	GLH10	.17*
F02A32V15A-S	AGC15	.075*
F02A32V20A-S	AGC20	.075*
F02B250V1/100A-S	MDL1/100	.40*
F02B250V1/32A-S	MDL1/32	.40*
F02B250V1/16A-S	MDL1/16	.30*
F02B250V1/8A-S	MDL1/8	.30*
F02B250V1/4A-S	MDL1/4	.30*
F02B250V3/8A-S	MDL3/8	.30*
F02B250V1/2A-S	MDL1/2	.30*
F02B250V3/4A-S	MDL3/4	.30*
F02B250V1A-S	MDL1	.30*
F02B250V1-1/2A-S	MDX1-1/2	.32*
F02B250V2A-S	MDX2	.32*
F02B125V3A-S	MDX3	.23*
F02B125V5A-S	MDX5	.23*
F02B32V8A-S	MDL8	.23*
F02B32V10A-S	MDL10	.23*
F02B32V15A-S	MDL15	.23*
F02B32V20A-S	MDL20	.23*
F03A250V1A-S	ABC1	.19*
F03A250V3A-S	ABC3	.19*
F03A250V5A-S	ABC5	.16*
F03A250V8A-S	ABC8	.16*
F03A250V10A-S	ABC10	.16*
F03A250V12A-S	ABC12	.19*
F03A250V15A-S	ABC15	.19*
F03A125V20A-S	ABC20	.19*
F03AI25V30A-S	ABC30	.25*
F03B250V1/100A-S	MDA1/100	.49*
F03B250V1/32A-S	MDA1/32	.49*
F03B250V1/16A-S	MDA1/16	.41*
F03B250V1/8A-S	MDA1/8	.41*
F03B250V15/100A-S	MDA15/100	.41*
F03B250V3/16A-S	MDA3/16	.41*
F03B250V1/4A-S	MDA1/4	$0.41*
F03B250V3/8A-S	MDA3/8	.41*
F03B250V1/2A-S	MDA1/2	.41*
F03B250V3/4A-S	MDA3/4	.41*
F03B250V1A-S	MDA1	.41*
F03BI25V3A-S	MDA3	.30*
F03BI25V5A-S	MDA5	.30*
F03BI25V8A-S	MDA8	.30*
F03BI25V10A-S	MDA10	.30*
F03R125V12A-S	MDA12	.30*
F03BI25V15A-S	MDA15	.30*
F03B125V20A-S	MDA20	.30*
F03BI25V30A-S	MDA30	.30*
F05A32V10A-S	AGS10	.12*
F05A32V15A-S	AGS15	.12*
F05A32V20A-S	AGS20	.12*
F05A32V25A-S	AGS25	.12*
F05A32V30A-S	AGS30	.12*
F05B32V10A-S	MDM10	.30*
F05B32V15A-S	MDM15	.30*
F05B32V20A-S	MDM20	.30*
F05B32V25A-S	MDM25	.30*
F05B32V30A-S	MDM30	.30*
F06A250V1A-S	ABS1	.30*
F06A250V2A-S	ABS2	.30*
F06A250V3A-S	ABS3	.30*
F06A250V5A-S	ABS5	.28*
F06A250V10A-S	ABS10	.28*
F06A250V15A-S	ABS15	.28*
F07A250V1A-S	AGU1	.17*
F07A250V2A-S	AGU2	.17*
F07A250V3A-S	AGU3	.17*
F07A32V5A-S	AGU5	.17*
F07A32V10A-S	AGU10	.17*
F07A32V15A-S	AGU15	.17*
F07A32V20A-S	AGU20	.17*
F07A32V30A-S	AGU30	.17*
F07B125V1A-S	MDR1	.45*
F07BI25V2A-S	MDR2	.45*
F07BI25V3A-S	MDR3	.38*
F07B32V5A-S	MDR5	.38*
F07B32V10A-S	MDR10	.38*
F07B32V15A-S	MDR15	.38*
F07B32V20A-S	MDR20	.38*
F07B32V30A-S	MDR30	.41*
F09A250V1A-S	BAN1	.17
F09A250V2A-S	BAN2	.17
F09A250V3A-S	BAN3	.17
F09A250V3-1/2A-S	BAN3-1/2	.17
F09A250V5A-S	BAN5	.17
F09A250V6A-S	BAN6	.17
F09A250V6-1/4A-S	BAN6-1/4	.17
F09A250V7A-S	BAN7	.17
F09A250V8A-S	BAN8	.17
F09A250V10A-S	BAN10	.17
F09A250V10A-S	BAN15	.17
F09A250V20A-S	BAN20	.17
F09A250V25A-S	BAN25	.17
F09A250V30A-S	BAN30	.17
F09B250V1/10A-S	FNM1/10	.40
F09B250V15/100A-S	FNM15/100	.40
F09B250V2/10A-S	FNM2/10	.40
F09B250V3/10A-S	FNM3/10	.40
F09B250V4/10A-S	FNM4/10	.40
F09B250V1/2A-S	FNM1/2	.40
F09B250V6/10A-S	FNM6/10	.40
F09B250V8/10A-S	FNM8/10	.40
F09B250V1A-S	FNM1	.40
F09B250V1-1/4A-S	FNM1-1/4	$0.40
F09B250V1-6/10A-S	FNM1-6/10	.40
F09B250V2A-S	FNM2	.40
F09B250V2-1/2A-S	FNM2-1/2	.40
F09B250V3-2/10A-S	FNM3-2/10	.40
F09B250V4A-S	FNM4	.40
F09B250V5A-S	FNM5	.40
F09B250V6-1/4A-S	FNM6-1/4	.40
F09B250V8A-S	FNM8	.40
F09B250V10A-S	FNM10	.40
F09BI25V15A-S	FNM15	.40
F09B32V20A-S	FNM20	.40
F09B32V25A-S	FNM25	.40
F09B32V30A-S	FNM30	.40
F15A250V1A-S	NFA1	.19
F15A250V3A-S	NFA3	.19
F15A250V6A-S	NFA6	.19
F15A250V10A-S	NFA10	.19
F15A250V15A-S	NFA15	.19
F15A250V20A-S	NFA20	.19
F15A250V25A-S	NFA25	.19
F15A250V30A-S	NFA30	.19
F15B250V1A-S	FRN1	.54
F15B250V1-1/10A-S	FRN1-6/10	.54
F15B250V2A-S	FRN2	.54
F15B250V2-1/2A-S	FRN2-1/2	.54
F15B250V1-6/10A-S	FRN3-2/10	.54
F15B250V4A-S	FRN4	.54
F15B250V5A-S	FRN5	.54
F15B250V6-1/4A-S	FRN6-1/4	.54
F15B250V8A-S	FRN8	.54
F15B250V10A-S	FRN10	.51
F15B250V12A-S	FRN12	.51
F15B250V15A-S	FRN15	.51
F15B250V20A-S	FRN20	.51
F15B250V25A-S	FRN25	.51
F15B250V30A-S	FRN30	.51
F60C500V1/8A-S	KLM1/8	.90
F60C500V1/4A-S	KLM1/4	.90
F60C500V3/8A-S	KLM3/8	.90
F60C500V1/2A-S	KLM1/2	.90
F60C500V3/4A-S	KLM3/4	.90
F60C500V1A-S	KLM1	.90
F60C500V3A-S	KLM3	.90
F60C500V6A-S	KLM6	.90
F60C500V8A-S	KLM8	.90
F60C500V10A-S	KLM10	.90
F60C500V15A-S	KLM15	.90
F60C500V20A-S	KLM20	.90
F60C500V25A-S	KLM25	.90
F60C500V30A-S	KLM30	.90

*Add $9.00 Stamping Charge and a minimum $6.00 per thousand Silver Plating Charge per item.

FUSE CLIPS LISTED MIL-F-21346 DATED 24 APRIL 1958

FC2IAN	5682-11	$0.066
FC2IBN	5674-10	.11
FC2ICN	5960-23	.17
FC22AN	5678-05	.11
FC22CN	5623-11	.26

INSTRUMENT TYPE FUSES LISTED UNDER MIL-F-23419A, DATED 19 DEC. 1966

Part No.	Type Designation	Nearest Buss Equivalent	Price Each
M23419/1-001	FM01 1/200A	GMU 1/200A	$0.95
M23419/1-002	FM01 1/100A	GMU 1/100A	.95
M23419/1-003	FM01 1/64A	GBU 1/64A	.95
M23419/1-004	FM01 1/32A	GMU 1/32A	.95
M23419/1-005	FM01 1/16A	GMU 1/16A	.95
M23419 1-006	FM01 1/10A	GMU 1/10A	.73
M23419/1-007	FM01 1/8A	GMU 1/8A	.73
M23419/1-008	FM01 2/10A	GMU 2/10A	.73
M23419/1-009	FM01 1/4A	GMU 1/4A	.73
M23419/1-010	FM01 3/10A	GMU 3/10A	.73
M23419/1-011	FM01 4/10A	GMU 4/10A	.73
M23419/1-012	FM01 1/2A	GMU 1/2A	.73
M23419/1-013	FM01 6/10A	GMU 6/10A	.73
M23419/1-014	FM01 3/4A	GMU 3/4A	.73
M23419/1-015	FM01 1A	GMU 1A	.73
M23419/1-016	FM01 1-1/2A	GMU 1-1/2A	.73
M23419/1-017	FM01 2A	GMU 2A	.73
M23419/1-018	FM01 3A	GMU 3A	.73
M23419/1-019	FM01 4A	GMU 4A	.73
M23419/1-020	FM01 5A	GMU 5A	.73

FM03 listed under **MIL-F-23419A**, 1/100 to 25 amps.

OTHER BUSS MIL FUSES AND BLOCKS

Fuses to MIL-F-15160D also available in styles:

F10A	F16A	F20B	F27A	F36B	F39B	F62C
F11A	F16B	F21A	F28A	F37A	F40A	F63C
F14A	F19A	F21B	F29A	F37B	F40B	F64C
F14B	F19B	F22A	F30A	F38A	F50A	F65C
F15B	F20A	F22B	F36A	F39A	F61C	F66C

Fuse Blocks to MIL-F-21346, Aircraft Limiters to MIL-F-5372C and Aircraft Blocks to MIL-F-5372C are also available.

BUSS FUSEHOLDERS LISTED UNDER MIL-F-19207B, DATED 31 AUG. 1966

Extractor post, blown fuse indicating and non-indicating types.

Buss and Military Type Designation	Electrical Rating	Price Each, Lots of 1-99	100-499	500-999
FHL10U	30A, 90-250V	$4.10	$3.56†	—
FHL11U	30A, 90-250V	3.30	2.75†	—
FHL12U	30A, 90-500V	3.75	3.25†	—
FHL17GI	20A, 90-250V	2.12	1.83	$1.52
FHL18GI-1	20A, 12-22V	3.24	2.79	2.33
FHL18GI-2	20A, 23-33V	3.24	2.79	2.33
FHL18GI-3	20A, 34-45V	3.24	2.79	2.33
FHL18GI-4	20A, 46-60V	3.24	2.79	2.33
FHL18GI-5	20A, 61-80V	3.24	2.79	2.33
FHL18GI-6	20A, 81-90V	3.24	2.79	2.33
FHL18GI-7	20A, 2.5-4V	3.24	2.79	2.33
FHL18GI-8	20A, 5-7V	3.24	2.79	2.33
FHL18GI-9	20A, 8-12V	3.24	2.79	2.33
FHN19G	15A, 250V	1.02	.88	.74
FHL22W	20A, 250V	1.46	1.26	1.06
FHN23W	30A, 250V	1.74	1.49	1.25
FHN26GI	30A, 250V	.80	.69	.57
FHL29G-1	30A, 12-22V	5.38	4.68†	—
FHL29G-2	30A, 23-33V	5.38	4.68†	—
FHL29G-3	30A, 34-45V	5.38	4.68†	—
FHL29G-4	30A, 46-60V	5.38	4.68†	—
FHL29G-5	30A, 61-80V	5.38	4.68†	—
FHL29G-6	30A, 81-90V	5.38	4.68†	—
FHL30G-1	30A, 12-22V	5.55	4.63†	—
FHL30G-2	30A, 23-33V	5.55	4.63†	—
FHL30G-3	30A, 34-45V	5.55	4.63†	—
FHL30G-4	30A, 46-60V	5.55	4.63†	—
FHL30G-5	30A, 61-80V	5.55	4.63†	—
FHL30G-6	30A, 81-90V	5.55	4.63†	—
FHN31GI	5A, 250V	1.00	.85	.68
FHN42W	5A, 125V	1.07	.89	.71

†Lots 100 Up.

CTS CORPORATION ELKHART, INDIANA

Rotary Selector Switches

WHY ENGINEERS SPECIFY CTS ROTARY SWITCHES

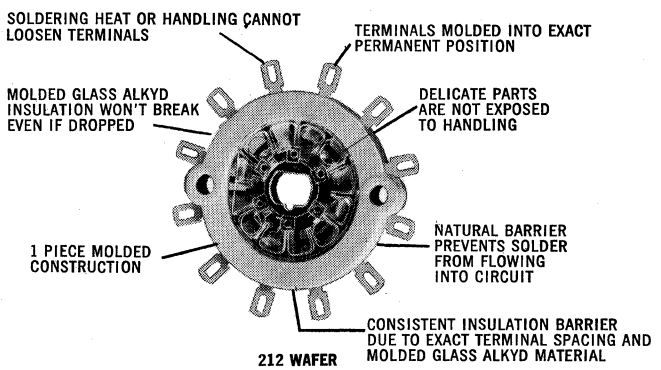
CTS Reliability: The heart of selector switch reliability is the wafer. CTS offers three wafer constructions with uniquely reliable characteristics: The CTS SELECTOR SWITCH 212 WAFER is of a molded, glass alkyd, rivet-free construction which will not break if dropped or jarred. The one-piece molded design eliminates mechanical shifting of stator circuitry and terminals and allows the construction of more compact switches. Automated manufacture provides unprecedented uniformity. In each production run, all switches are identical, terminal placement is exact and permanent — the result is trouble-free assembly into your circuit. The CTS 216 WAFER employs the more conventional "clip" terminals but utilizes unbreakable glass reinforced alkyd for both the rotor and stator. The precision molded stator incorporates strut spacers to evenly space the wafers. An integral molded rib design eliminates radial shifting of contacts and insures increased circuit path insulation. The CTS 223 WAFER features a more compact switch construction. Designed along conventional lines, the 223 wafer can also incorporate back to back clip terminals. The rotor is of a molded Lexan material; the stator is made of molded, glass filled diallyl phthalate. Tight quality control on both wafers and detents from the raw material stage through final assembly and packaging assures you of the fine quality and reliability associated with all CTS products.

CTS Design Flexibility: CTS selector switches provide thousands of variations of shorting and non-shorting circuitry including mixed shorting and non-shorting circuit combinations within the same pole. Design flexibility is further enhanced by a wide selection of index assemblies, three wafer constructions (CTS 212 and 216 wafer constructions can be intermixed on the same switch) and attachable CTS manufactured AC power switches and variable resistors. CTS truly offers a one-source supply for the complete switch package.

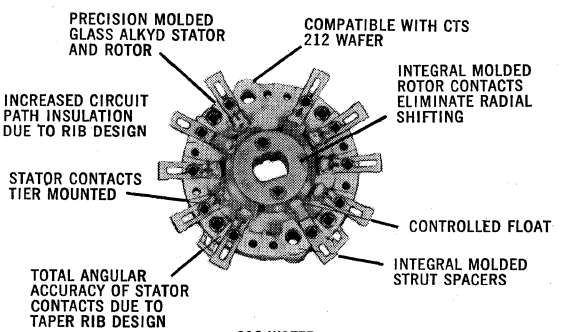
CTS Military Switches: CTS types 211, 212 and 215 are available to meet the requirements of MIL-S-3786C, Style SR03/D. CTS type 223 will meet performance specifications of MIL-S-3786C, Style SR05.

CTS Switches are Made to Your Exact Specifications: All orders received for CTS selector switches are handled individually and are custom manufactured to your exact specifications. The majority of applications can be met with switches which are custom designed from parts shown in this catalog, giving you the advantages of lower cost and faster delivery.
On special applications our engineering staff is at your disposal for designing the best and most economical switch to meet your exact requirements.

WAFERS



212 WAFER

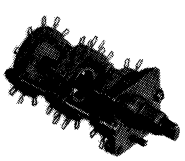


216 WAFER

DETENTS

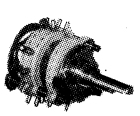
Adjustable stops available on all detents except Types 222 & 227

STAR WHEEL DETENT
Type 211



HIGHEST QUALITY • POSITIVE FEEL • 250,000 CYCLE LIFE • FREE FROM END AND SIDE THRUST • HIGH SWITCHING TORQUE 15—60" OZ.

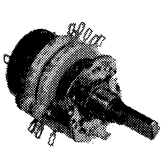
DIE CAST DETENT
Type 222



LOWEST COST OF ALL DETENTS • LOW COST STAKED CONSTRUCTION • AVAILABLE FOR 1 AND 2 WAFER SWITCHES • 20,000 CYCLE LIFE • SWITCHING TORQUE 20"—40" OZ.

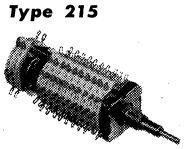
Description	Series	Data Sheet	Order Form
1⅛" diameter rotary wafer switch with star wheel detent	211	4001	Keene
1⅛" diameter rotary wafer switch with hill and valley detent	212	4001	Elkhart*
1⅛" diameter rotary wafer switch with double ball detent	215	4001	Keene
1¼" diameter rotary wafer switch with hill and valley detent	216	4001	Keene
1¼" diameter rotary wafer switch with star wheel index	217	4001	Keene
1¼" diameter rotary wafer switch with double ball detent	218	4001	Keene
1⅛" diameter rotary wafer switch with die cast detent	222	4001	Elkhart
1" diameter rotary wafer switch with double ball detent	223	4223	Keene
1¼" diameter rotary wafer switch with die cast detent	226	4001	Canada
1⅛" diameter rotary wafer switch with new enclosed die cast detent	227	4227	Elkhart

HILL AND VALLEY DETENT
Type 212



LOW COST • DESIGNED FOR HOME ENTERTAINMENT AND LOW COST INSTRUMENT APPLICATIONS • 25,000 CYCLE LIFE • SWITCHING TORQUE 20—48" OZ.

DOUBLE BALL DETENT
Type 215



DESIGNED PRIMARILY FOR INSTRUMENT MARKET • HIGH QUALITY • CRISP FEEL • 25,000 CYCLE LIFE • SWITCHING TORQUE 6 — 36" OZ.

*West of the Mississippi River, excluding Minnesota, order from CTS Keene

ORDERING INFORMATION: Place orders at locations shown above, using the following addresses:

CTS of Elkhart Div., 1142 W. Beardsley Ave., Elkhart, Indiana 46514 • Telephone 219-523-0210 • TWX 810-294-2256
CTS Keene, Inc., P.O. Box 1977, Paso Robles, Calif. 93446 • Telephone 805-238-0350 • TWX 510-842-1085
In Canada, order from:
CTS of Canada, Ltd., 80 Thomas Street, Streetsville, Ontario, Canada • Telephone 416-826-1141

C&K Toggle, Rocker, Pushbutton Switches Paddle Handle Switches

The Switch is on to C & K

C & K produces the widest possible variety of switch combinations to meet every requirement. Toggles, Rockers, Paddle Handle, Pushbutton. Miniature, subminiature and microminiature sizes are available in many circuit/position configurations. This catalog highlights the flexibility possible in switch design with C & K units. Dimensions are given for many popular styles. If you do not find what you are looking for contact the factory or our local reps and distributors. Remember most of the switches listed here are available through our wide network of distributors (DIAL EEM 800-645-9200 for toll-free information on the sales outlet nearest you). Quality, craftsmanship, and care make each C & K switch a precision component. **Most switch models are available with UL listing.** And every switch is made in America. That's why the switch is on to C & K.

UL Listed most models

Price Lists

F.O.B. Watertown, Mass. Prices subject to change without notice.

Toggle, Rocker, Paddle Handle Switches

Model Number	INDUSTRIAL NET PRICE SCHEDULE 1-24 Each	25-99 Each	100-499 Each	UL No.
Switch Units				
7101	$1.50	$1.00	$0.88	U11
7103 to 7109	1.77	1.18	1.06	U13-U19
7201	1.95	1.30	1.18	U21
7203 to 7209	2.32	1.55	1.39	U23-U29
7211	2.60	1.73	1.56	U211
7213	2.87	1.92	1.72	U213
7215	2.87	1.92	1.72	U215
7301	3.50	2.34	2.12	U31
7303 to 7309	3.78	2.52	2.28	U33-U39
7401	4.41	2.88	2.67	U41
7403 to 7409	4.86	3.29	2.93	U43-U49#
7411	6.27	3.92	3.78	U411
7413	6.27	3.92	3.78	U413
7415	6.27	3.92	3.78	U415
OPTIONS — Suffix	**Add Option Prices to Switch Unit Price**		**# U47 not available**	
Toggles				
L1, L2	No Charge	No Charge	No Charge	
M, S, L	No Charge	No Charge	No Charge	
L3	0.10	0.10	0.10	
P, P1	0.50	0.50	0.50	
T	0.75	0.75	0.75	
Lever Lock				
K	1.25	1.00	0.80	
Rocker				
J1	0.35	0.35	0.35	
Paddle				
J2	0.35	0.35	0.35	
Rocker				
J3	0.35	0.35	0.35	
Paddle				
J4	0.35	0.35	0.35	
Large Rocker				
J10	0.35	0.35	0.35	
Snap-In Rocker				
J50	0.35	0.35	0.35	
Snap-In Paddle				
J60	0.35	0.35	0.35	
Bushings				
Y, D ,H, U	No Charge	No Charge	No Charge	
Y1	0.50	0.50	0.50	
CKW	0.35	0.35	0.35	
Pinning				
P	0.50	0.50	0.50	
Terminations				
Z	No Charge	No Charge	No Charge	
C, W, W1, Z3	0.10 Per Pole	0.10 Per Pole	0.10 Per Pole	
R, R-2 or VW (7101 only)	1.20	1.15	——	
R, R-2 or VW (7103 to 7109)	1.33	1.27	——	
A (all SPDT, DPDT)	0.35	0.35	0.35	
AV, AV-2 (all models)	0.35	0.35	0.35	
Materials				
B, Q	No Charge	No Charge	No Charge	
G,	0.25 Per Pole	0.25 Per Pole	0.25 Per Pole	
WG	0.75 Per Pole	0.75 Per Pole	0.75 Per Pole	
WQ	0.50 Per Pole	0.50 Per Pole	0.50 Per Pole	
Seal				
E	0.10 Per Pole	0.10 Per Pole	0.10 Per Pole	
I	0.25 Per Pole	0.25 Per Pole	0.25 Per Pole	
Bezels				
7645 for J1, J2	0.35	0.35	0.35	
7810 for J10	0.50	0.50	0.50	

Pushbutton Switches

Momentary Switches

Model No.	UL No.	Poles & Throw	INDUSTRIAL NET PRICE SCHEDULE 1-24 Each	25-99 Each	100-499 Each
8121	U811	SPDT	$2.55	$1.70	$1.52
8221	U821	DPDT	3.45	2.30	2.06
8121R	None	SPDT	3.05	2.20	2.15
8121R-2	None	SPDT	3.05	2.20	2.15
8121V	None	SPST (N.O.)	3.05	2.20	2.15

Options

Suffix	INDUSTRIAL NET PRICE SCHEDULE 1-999 Each per Pole	1000 or More Each per Pole
C	$.10	$.10
I	.25	.20

Subminiature Switches

Model No.	INDUSTRIAL NET PRICE SCHEDULE 1-24 Each	25-99 Each	100-499 Each
8531	$.90	$.60	$.53
8532	.90	.60	.53
8533	.90	.60	.53
8534	.90	.60	.53

All Models are UL listed

Options

Suffix	INDUSTRIAL NET PRICE SCHEDULE 1-999 Each	1000 or More Each
*B	No Charge	No Charge
G	$.25	$.20
C	.10	.10
E	.10	.10

* Option B not UL listed

Microminiature Switches

Model No.	INDUSTRIAL NET PRICE SCHEDULE 1-24 Each	25-99 Each	100-499 Each
‡8631	$1.15	$.77	$.67
‡8632	1.30	.86	.77
8633	1.60	1.06	.94

‡ Models 8631 and 8632 are UL listed

Options

Suffix	INDUSTRIAL NET PRICE SCHEDULE 1-999 Each	1000 or More Each
†B	No Charge	No Charge
G	$.25	$.20
E	.10	.10

† Option B not UL listed

C & K COMPONENTS, INC. FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

103 MORSE STREET / WATERTOWN, MASS. 02172 / (617) 926-0800 / TWX: 710-327-0460

C&K Toggle, Rocker, Paddle Handle Switches

UL Listed most models

How to select the right switch

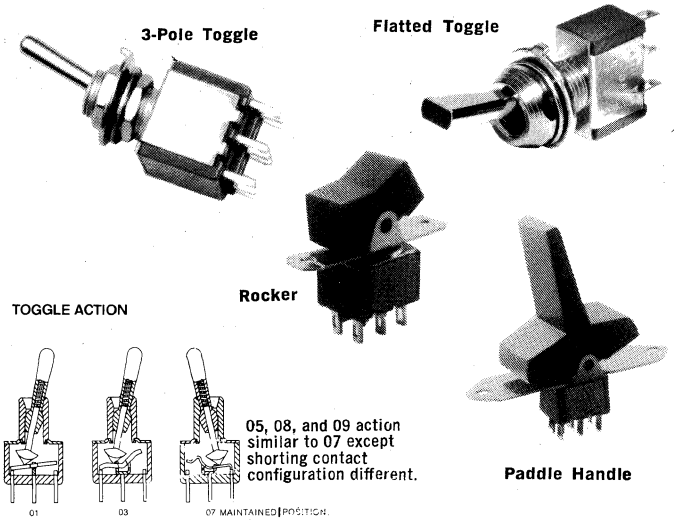
Because there are so many combinations possible with the switches offered by C & K this catalog has been designed to enable you to identify the best one for your application. The table below is constructed so that you can generate the correct order number based on the essential characteristics of the desired switch.

General Specifications

Contact Ratings: Coin Silver Contacts — 5 amps resistive load @ 120 VAC or 28 VDC, or 2 amps @ 250 VAC.
Brass contacts with gold over nickel plate — 0.4 volt-amps @ 20 V Max. (AC or DC).
Coin Silver Contacts with gold over nickel plate —5 amps resistive load @ 120 VAC or 28 VDC, or 2 amps @ 250 VAC — and 0.4 volt-amps Max. @ 20 V Max. (AC or DC).
Electric Life: 100,000 make-and-break cycles minimum on all models ending in 01 only; all other models 40,000 cycles.
Initial Contact Resistance For Silver: 10 milliohms max. @ 2-4 VDC, 1 amp.
Insulation Resistance: 1,000 megohms minimum.
Dielectric Strength: 1,000 volts rms @ sea level.

Materials and Finishes

Case Material: General purpose phenolic or melamine.
Operating Lever: Bright chrome-plated brass.
Mounting Bushing: Cadmium w/clear chromate over brass.
Housing: Stainless Steel.
Standard Hardware Supplied: 2 hex mounting nuts; 1 internal tooth lockwasher; 1 locking ring.
See page 9 for hardware, panel layouts and mounting information.



05, 08, and 09 action similar to 07 except shorting contact configuration different.

C&K SWITCHES — MADE IN AMERICA

SELECTION GUIDE

SWITCHING FUNCTION

Model No.			KEYWAY	UL No.
SPDT				
7101	ON	NONE	ON	U11
7103	ON	OFF	ON	U13
7105	(ON)	OFF	(ON)	U15
7107	ON	OFF	(ON)	U17
7108	ON	NONE	(ON)	U18
7109	NONE	ON	(ON)	U19
DPDT				
7201	ON	NONE	ON	U21
7203	ON	OFF	ON	U23
7205	(ON)	OFF	(ON)	U25
7207	ON	OFF	(ON)	U27
7208	ON	NONE	(ON)	U28
7209	NONE	ON	(ON)	U29
*7211	ON	ON	ON	U211
*7213	ON	ON	(ON)	U213
*7215	(ON)	ON	(ON)	U215
Terminals Connected	2-3 5-6	2-3 4-5	1-2 4-5	

* To obtain 3 position switch see Wiring Diagram for external wiring.

3PDT				
7301	ON	NONE	ON	U31
7303	ON	OFF	ON	U33
7305	(ON)	OFF	(ON)	U35
7307	ON	OFF	(ON)	U37
7308	ON	NONE	(ON)	U38
7309	NONE	ON	(ON)	U39
4PDT				
7401	ON	NONE	ON	U41
7403	ON	OFF	ON	U43
7405	(ON)	OFF	(ON)	U45
7407	ON	OFF	(ON)	N/A
7408	ON	NONE	(ON)	U48
7409	NONE	ON	(ON)	U49
*7411	ON	ON	ON	U411
*7413	ON	ON	(ON)	U413
*7415	(ON)	ON	(ON)	U415
Terminals Connected	2-3 5-6 8-9 11-12	2-3 4-5 8-9 10-11	1-2 4-5 7-8 10-11	

* To obtain 3 position switch see Wiring Diagram for external wiring, page 3.
( ) Indicates Momentary Contact

Ordering Number Construction

Select alpha numeric identifiers from selection guide and fill in the assigned boxes.

Switching function	Actuator	Bushing	Pinning	Termi-nations	Terminal material	Sealing	Handle color	Mounting hardware

Example 7101 L3 Y P C B E -1

This is a SPDT switch with a long plastic toggle, a standard bushing, a pinned toggle, with Printed Circuit terminals of gold plated brass, epoxy sealing, a white plastic sleeve on the toggle, and equipped with standard mounting hardware.

ACTUATORS

		See Page
L	Long Toggle (.840)	6
L1	Long Toggle (.642)	6
L2	Long Toggle (.550)	6
L3	Long Toggle (.840)	6
M	Short Toggle (.200)	6
P	Flatted Toggle (.450)	6
P1	Flatted Toggle (.840)	6
S	Standard Toggle (.410)	6
T	Large Toggle	6
K	Locking Lever	6
J1	Rocker	4
J2	Paddle Handle	4
J3	Rocker	4
J4	Paddle Handle	5
J10	Rocker	5
J50	Snap-In Rocker	5
J60	Snap-In Paddle Handle	5

For **L3, J1, J2, J3, J4, J10, J50, J60,** and **K** specify color after order no.

BUSHINGS

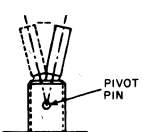
		See Page
D	Short Bushing	6
H	High Torque	6
U	Special Bushing	6
Y	Standard Bushing	6
Y1	Long Bushing	6
CKW	Splashproof Bushing	3

If option **J1, J2, J3, J4, J10, J50, J60, K** or **T** has been specified the bushing options are **not** applicable and this space should be left blank.

PINNING

Option P Pinning

Pinning option for anti-rotation of toggle is available for all toggle-bushing combinations by adding suffix P.

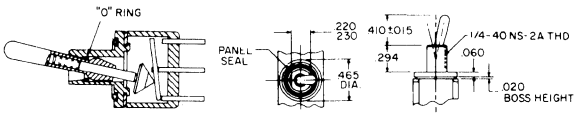


If option **J1, J2, J3, J4, J10, J50, J60, K,** or **CKW** has been specified the Pinning option is not applicable and this space should be left blank.

UL Listed most models

Toggle, Rocker, Paddle Handle Switches C&K

Option CKW Splashproof

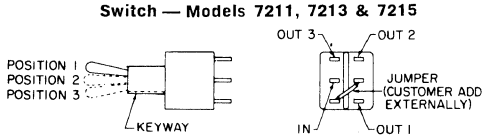


Special seal around toggle and bushing.

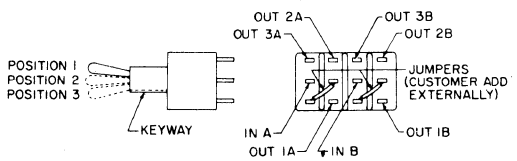
Gives splashproof model tight panel seal. To order, add prefix **CKW.**

Wiring Diagram

Wiring for Single Pole 3 Position Switch — Models 7211, 7213 & 7215



Wiring for 2 Pole 3 Position Switch — Models 7411, 7413, 7415



Color Chart, plastic handles/bezels

Color No.	Color
-1	White
-2	Black
-3	Red
-4	Orange
-5	Yellow
-6	Green
-7	Blue
-8	Brown
-9	Gray

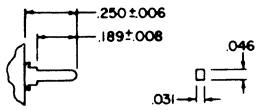
For **J50 - J60** Bezel specify P/N 7890 and Color No.
For Rocker, Paddle Handle or L-3 Specify Color No.

Panel Seals

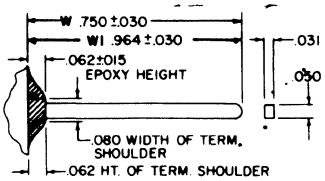
Flexible Rubber Seal Boots are available from APM-Hexseal Corp. 41 Honeck St., Englewood, New Jersey, and Multi-Flex Seals, Inc., 1170 Commerce Ave., Bronx, N. Y.
These boots come in various styles and meet a number of MIL Specs for front panel switch seals.

Terminal Options

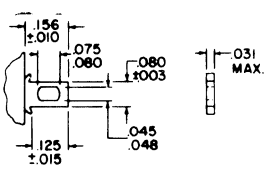
Option C Printed Circuit



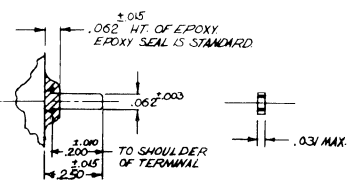
Options W, W1 Wirewrap



Option Z Standard



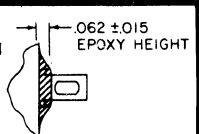
Option Z-3 Quick Connect



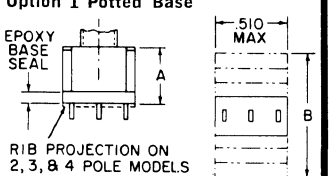
MATING "FASTON" RECEPTACLE FROM AMP INC. HARRISBURG, PA., AMP P/N SINGLE PIECES 61454 SERIES; STRIP FORM 60900 SERIES.

SEALING

Option E Terminal Seal



Option I Potted Base



Notes:
1. Min. length of surface path between exposed terminal and metal housing equals .118 inch (3mm). REF. International Electrotechnical Commission (I.E.C.) Specification 131-1.

	A Max.	B Max.
SPDT	.395	.290
DPDT	.395	.470
3PDT	.460	.670
4PDT	.460	.870

If options **A, AV, AV-2, R, R-2,** or **VW** has been specified, option **I** is not applicable and this space should be left blank.

HANDLE COLOR

Plastic toggle for **L-3** option See Color Chart
Anodized cap for **K** option See Page 6
Rocker and Paddle Handle See Color Chart this page

Specify color required. Unless otherwise specified, L-3 is black, K is natural aluminum and J options are black.

MOUNTING HARDWARE

	See Page
J1, J2, and J10 metal bezels specify P/N	6
J50, and **J60** plastic bezels specify P/N	6
Standard mounting hardware no P/N required	9
Optional mounting hardware	9

TERMINATIONS

		See Page
A	Right Angle Mounting	4
AV	Vertical Mounting	5
AV-2	Vertical Mounting	5
R	Right Angle Mounting	4
R-2	Right Angle Mounting	4
VW	Right Angle Mounting P.C.	5
Z	Standard	3
C	Printed Circuit	3
W	Wirewrap	3
W-1	Wirewrap	3
Z3	Quick Connect	3

If option **Y1, H, U, J1, J2, J3, J4, J10, J50, J60, K, T,** or **CKW** has been specified, options **A, AV, AV-2, R, R-2,** and **VW** are not applicable and this space should be left blank.

TERMINAL MATERIAL

Option B ½ hd. brass with 50 millionths min. Gold plate over 200 millionths min. Nickel. Rating: 0.4 VA max. @ 20 V max. (AC or DC).

Option G Coin Silver (90% Ag-10% Cu) with 50 millionths min. gold plate over 50 millionths min. nickel. Rating: 5 amps resistive load @ 120 VAC or 28 VDC or 2 amps @ 250 VAC — and 0.4 VA max. @ 20 V max. (AC or DC).

Note: The only advantage of coin silver with gold plating is that it may be used for either of preceding ratings. However, when dry circuit rating is exceeded, gold plating is effectively removed from contact interfaces and switch cannot then be used for dry circuit.

Option Q Coin Silver (90% Ag-10% Cu). Rating: 5 amps resistive load @ 120 VAC or 28 VDC or 2 amps @ 250 VAC.

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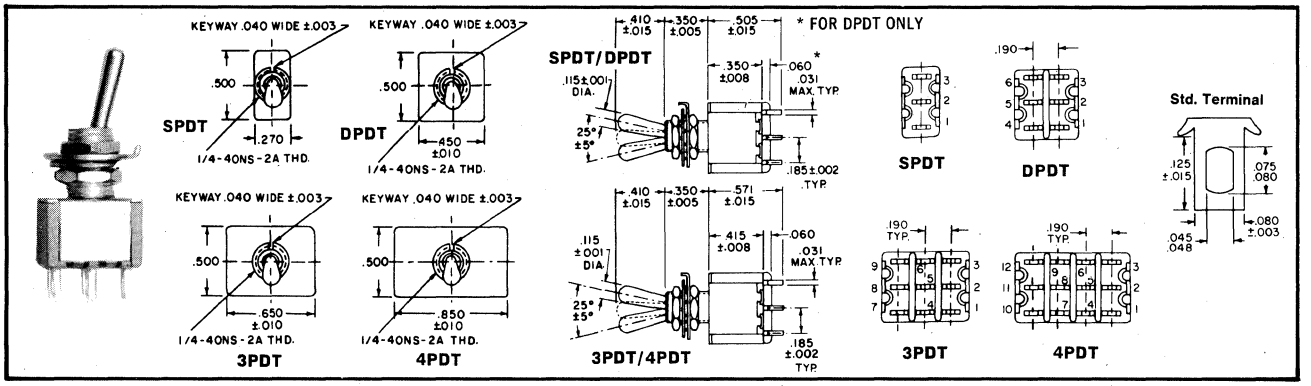
103 MORSE STREET / WATERTOWN, MASS. 02172 / (617) 926-0800 / TWX: 710-327-0460

C&K Toggle, Rocker, Paddle Handle Switches

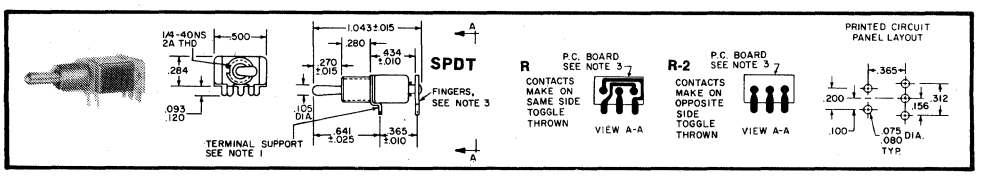
UL Listed most models

Standard Toggle Switches with standard terminal (Z)

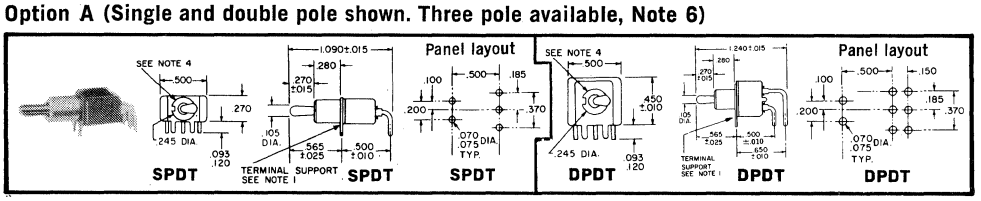


Right Angle Mounting Horizontal Style

Option R or R-2 (Single pole only)



Option A (Single and double pole shown. Three pole available, Note 6)



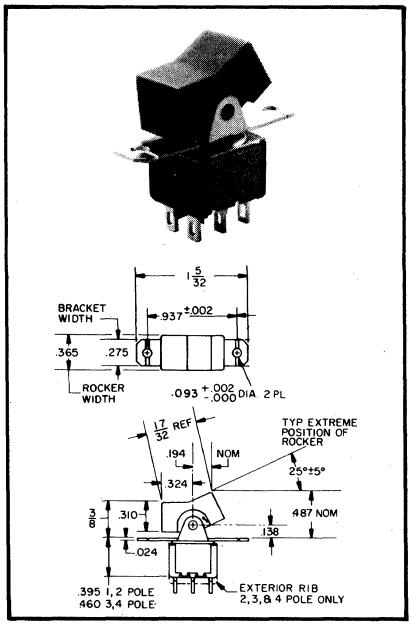
NOTES: For A and R options

1. Terminal support is ½ hd. brass Electrotin plated.
2. Contacts and terminals normally supplied are brass w/50 millionths gold plate.
3. For **R** only — P.C. Board is G10 epoxy with 1 oz. Electrotin plated copper. Projecting fingers only have copper both sides. Circuit on P.C. Board has copper outside only.
4. For **A** only — non-threaded bushing is standard.
5. All terminals are .031″ thick by .050″ wide. (Terminal width is shown in side view.)
6. 3 pole A option also available. For details contact factory.

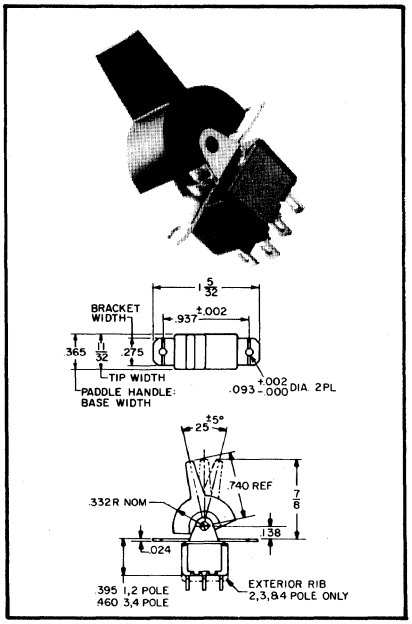
Rocker and Panel Handle Switches

All switching functions available.

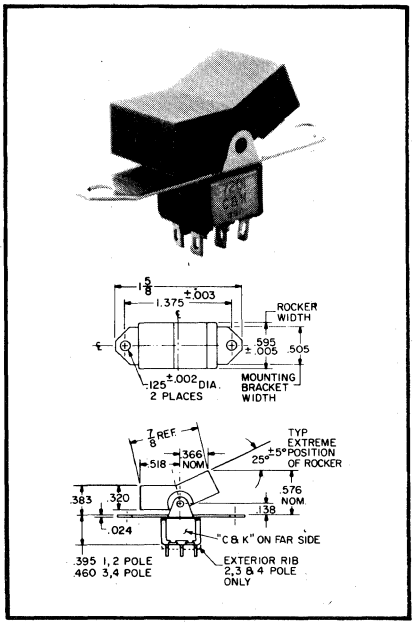
Option J-1 Rocker



Option J-2 Paddle Handle



Option J-3 Rocker

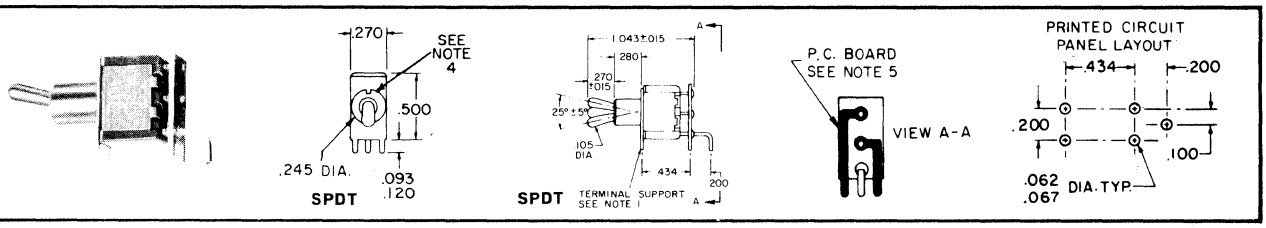


UL Listed most models

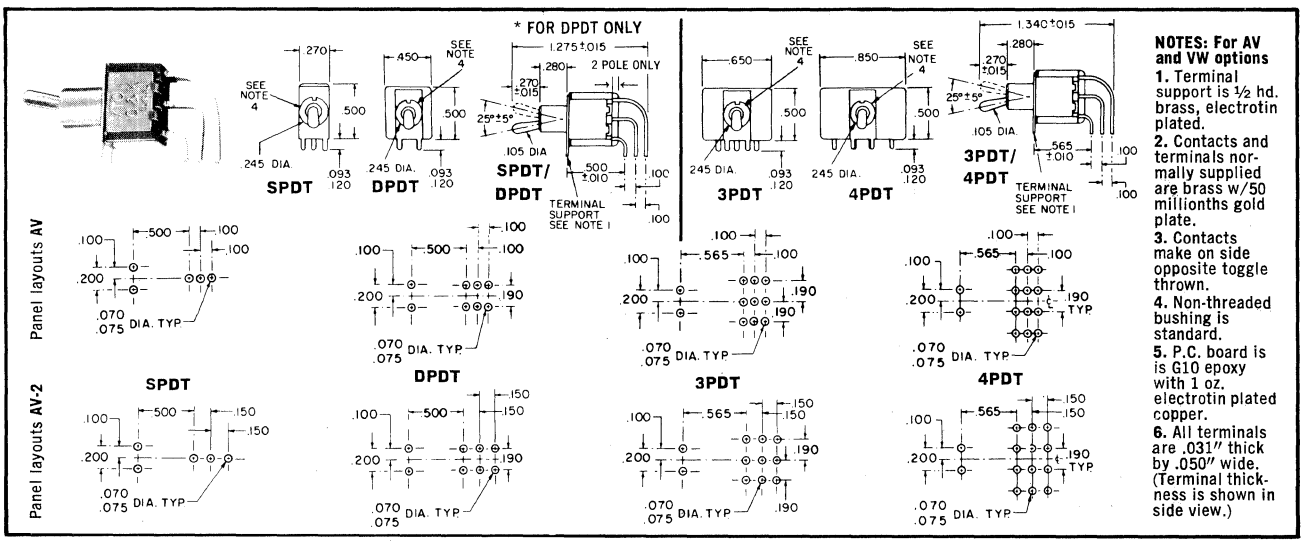
Toggle, Rocker, Paddle Handle Switches C&K

Right Angle Mounting Vertical Style

Option VW (Single pole only)



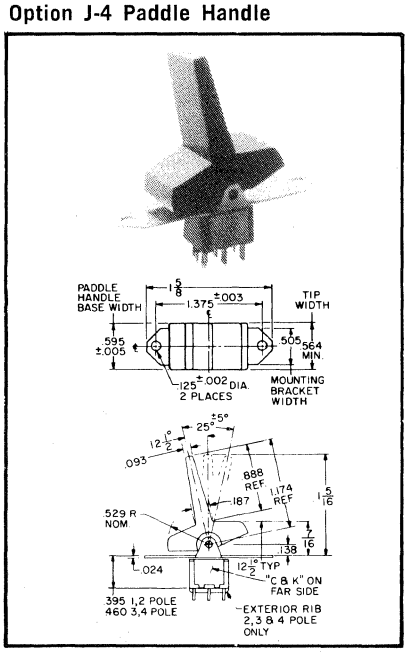
Option AV and AV-2 Terminal spacing AV, 0.100"; AV-2, 0.150"



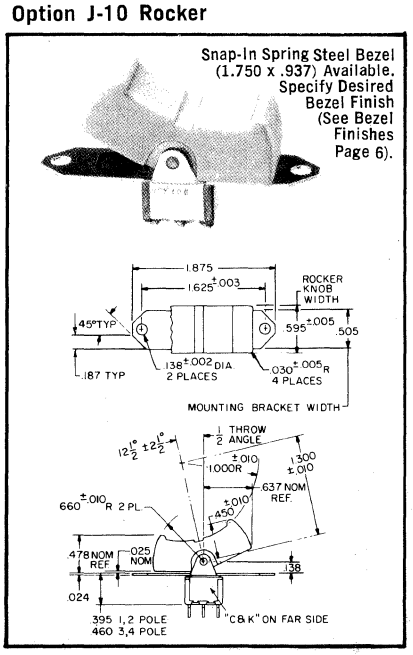
NOTES: For AV and VW options

1. Terminal support is ½ hd. brass, electrotin plated.
2. Contacts and terminals normally supplied are brass w/50 millionths gold plate.
3. Contacts make on side opposite toggle thrown.
4. Non-threaded bushing is standard.
5. P.C. board is is G10 epoxy with 1 oz. electrotin plated copper.
6. All terminals are .031" thick by .050" wide. (Terminal thickness is shown in side view.)

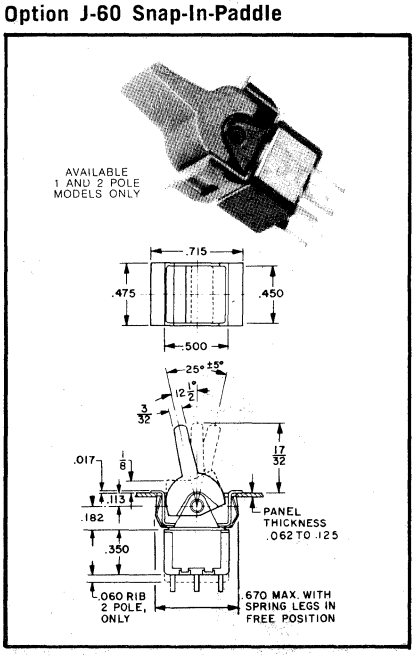
Option J-4 Paddle Handle



Option J-10 Rocker



Option J-50 Snap-In-Rocker
Option J-60 Snap-In-Paddle



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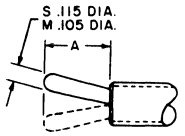
C&K Toggle, Rocker, Paddle Handle Switches

UL Listed most models

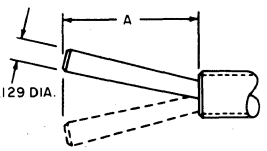
Toggle / Bushing Options

Toggle Switch Options

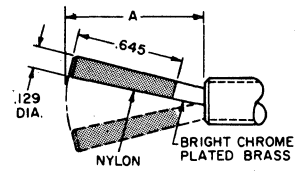
TOGGLES — **S** STANDARD
M SHORT



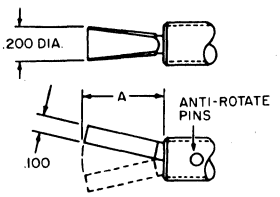
L, L1, L2 LONG



L3, LONG PLASTIC



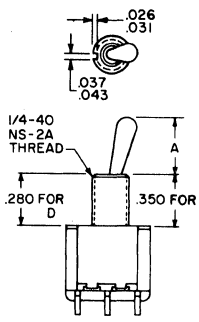
P, P1 FLATTED



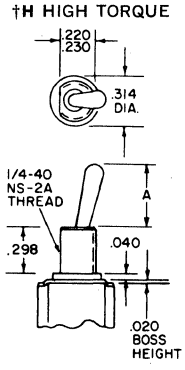
For color option see color chart p. 3

Toggle pinning is available for all toggle/bushing combinations (except **CKW, J** and is designated a **P**). (Toggle pinning is standard on flatted toggles, **Y1** and **K** options.)

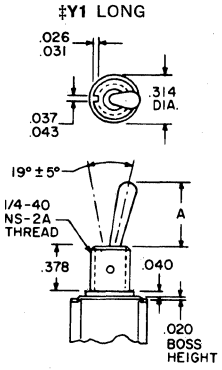
BUSHINGS — ***D** SHORT
***Y** STANDARD



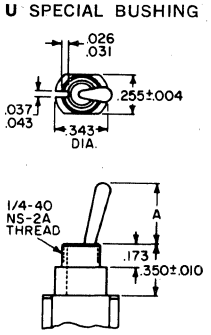
†H HIGH TORQUE



‡Y1 LONG



U SPECIAL BUSHING



For Toggle Lengths used with Specific Bushings

"A" Dim.	*Y (.350)	‡Y1 (.378)	*D (.280)	†H (.298)	U (.350)
S	.410	.410	.480	.410	.410
M	.200	.200	.270	.200	.200
L	.840	.840	.910	.840	.840
L1	.642	.642	.712	.642	.642
L2	.550	.550	.620	.550	.550
L3	.840	.840	.910	.840	.840
P	.450	.450	.520	.450	.450
P1	.840	.840	.920	.840	.840

* A tolerance of .010 is required on standard Y and D bushing.
† All high torque bushings will withstand torque of 12 in/lb. with no distortion.
‡ Offered only with pinning option.

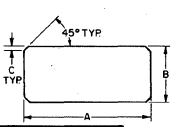
Bezel Options

Specify desired bezel finish by placing the Bezel P/N after the order number (see page 3). Unless otherwise specified a black finish bezel (P/N 7645-2 or P/N 7810-2) will be supplied.

J-1 and J-2 Bezel P/N	Finish	J-10 Bezel P/N
7645-1	Bright Chrome Plate	7810-1
7645-2	Black	7810-2
7645-3	Satin Chrome Plate	7810-3

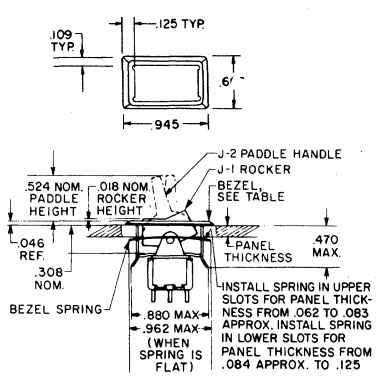
Materials: Bezel - Spring Steel. Bezel Spring - Beryllium Copper, Bright Dipped

RECOMMENDED BEZEL PANEL LAYOUT



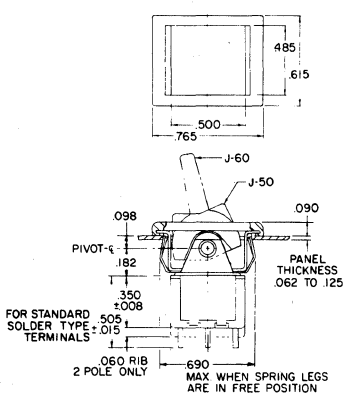
SWITCH TYPE	'A'	'B'	'C'
J1 & J2	.746 .751	.408 .413	.033
J10	1.522 1.528	.645 .651	.037
J50 & J60	.595 .605	.495 .505	NONE

Bezel 7645 for J1 or J2



INSTALLATION SEQUENCE
1. INSERT BEZEL INTO PANEL OPENING FROM FRONT OF PANEL.
2. ASSEMBLE SPRING ON BEZEL FROM BEHIND PANEL.
3. SNAP SWITCH IN PLACE FROM BEHIND PANEL.

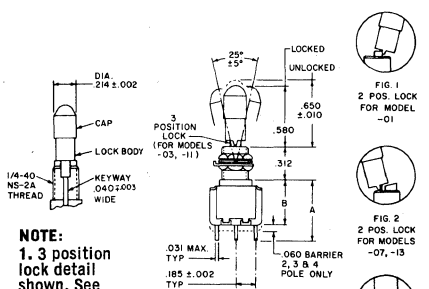
Bezel 7890 for J-50 and J-60



NOTE:
SPECIFY BEZEL P/N 7890 AND COLOR. USE COLOR CHART ON PAGE 3 FOR COLOR NUMBER. EXAMPLE A RED BEZEL IS P/N 7890-3.

NOTE: BEZEL SPRING ASSEMBLY WILL ACCOMMODATE ALL PANEL THICKNESSES FROM .062" TO .125"

Option K Locking Lever



NOTE:
1. 3 position lock detail shown. See fig's 1 thru 4 for other lock details.
2. Caps are normally supplied natural aluminum. Anodized red, blue, or black caps are available on request — specify color if desired after order no.
3. Lock body is nickel plated brass.

	A ±.015	B ±.015
SPDT	.580	.425
DPDT	.580	.425
3PDT	.645	.490
4PDT	.645	.490

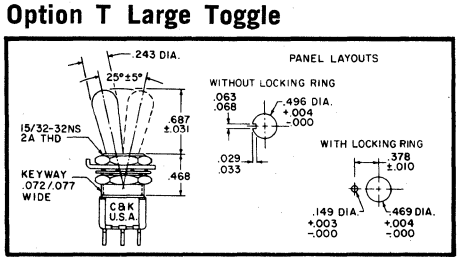
FIG. 1
2 POS. LOCK FOR MODEL -01

FIG. 2
2 POS. LOCK FOR MODELS -07, -13

FIG. 3
1 POS. LOCK FOR MODELS -05, -09, -15

FIG. 4
1 POS. LOCK FOR MODEL -08

Option T Large Toggle



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103 MORSE STREET / WATERTOWN, MASS. 02172 / (617) 926-0800 / TWX: 710-327-0460

UL Listed most models

Pushbutton Switches C&K

Momentary Pushbutton Switches / Available 1 and 2 poles

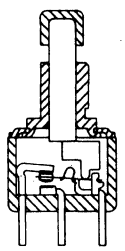
General Specifications

Contact Ratings: Gold contact surfaces on copper alloy terminals (epoxy sealed terminals are standard). 1 ampere resistive load @ 120 VAC — 28 VDC. Designed for use in dry (very low energy) circuits.
Insulation Resistance: 1000 megohms minimum.
Dielectric Strength: 1000 volts rms at sea level.
Electric Life: 60,000 cycles minimum at full load.
Mechanical Life: 100,000 make-and-break cycles minimum.
Max. Allowable Force on Plunger: 10 lb.
UL Listing: All models except 8121R, 8121R-2 and 8121V available with UL Listing.

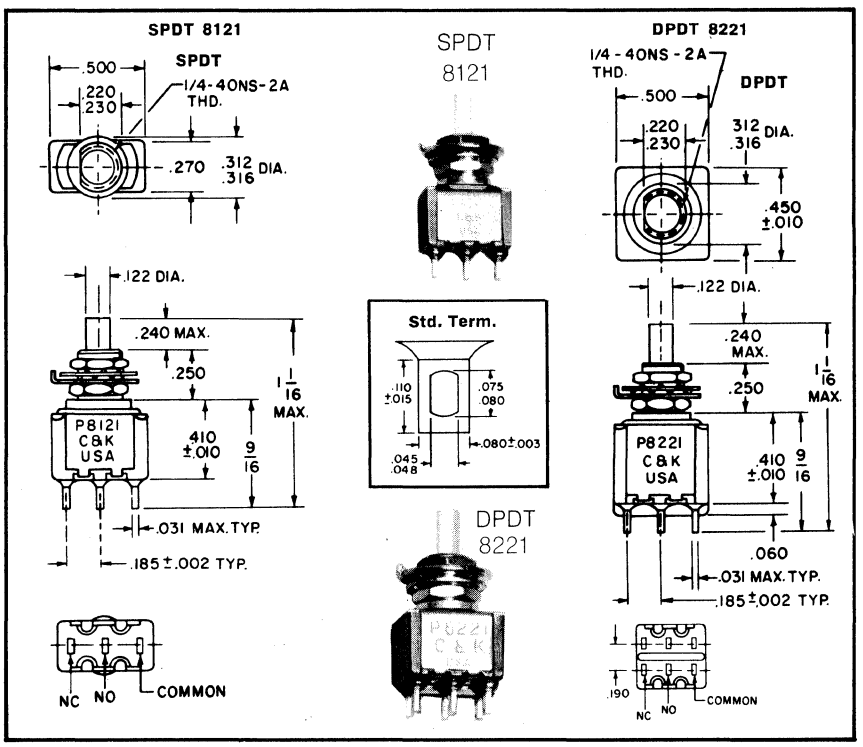
Materials and Finishes

Plunger: Nylon plunger and cap.
Mounting Bushing: Cadmium w/clear chromate over brass. High torque to withstand 12 in.-lbs. with no distortion or loosening of parts.
Housing: Stainless Steel.
Case Material: General purpose phenolic or melamine.
Standard Hardware Supplied: 2 Hex mounting nuts, 1 Internal lockwasher, 1 Locking ring. On request 1 hex nut, and 1 special nut may be substituted at no charge.
Standard locking ring is normally supplied — on request small locking ring may be substituted at no charge.

Cross Section Momentary PB Action

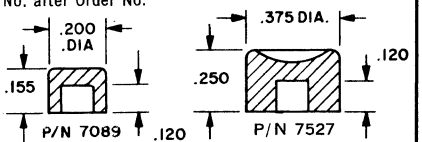


Standard Configurations



Caps for 8121, and 8221

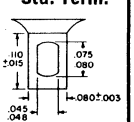
Cap supplied unassembled. Specify Cap No. and Color No. after Order No.



Color Chart

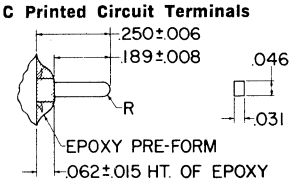
Cap No. 7089 or 7527	Color	Cap No. 7089 or 7527	Color
-1	White	-6	Green
-2	Black	-7	Blue
-3	Red	-8	Brown
-4	Orange	-9	Gray
-5	Yellow		

Std. Term.

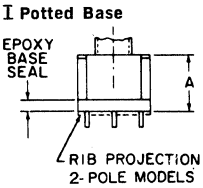


Options

C Printed Circuit Terminals



I Potted Base

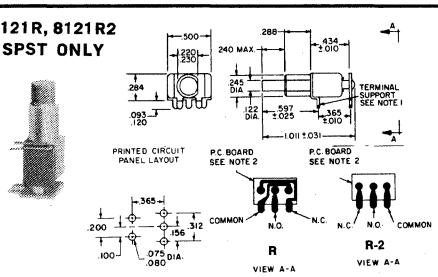


	A MAX.	B MAX.
SPDT	.395	.290
DPDT	.395	.470

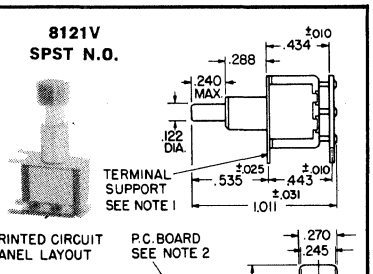
Notes:
1. Min. length of surface path between exposed terminal and metal housing equals .118 inch (3mm). REF. International Electrotechnical Commission (I.E.C.) Specification 131-1.

Right Angle Mounting

8121R, 8121R2 SPST ONLY



8121V SPST N.O.



NOTES:
1. Terminal Support is ½ hd. brass, electrotin plated.
2. P.C. Board is GIO epoxy with 1 oz. electrotin plated copper. Projecting Fingers, only have copper both sides. Circuit on P.C. Board has copper outside only.

How to Order: Use switch model numbers followed by option letter (EXAMPLE: 8121C)

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C&K Pushbutton Switches

UL Listed most models

Momentary Pushbutton Switches SPST Butt Contact

General Specifications

Subminiature — 8500 Series

Contact Ratings: Coin Silver Contacts — 1 amp resistive load @ 120 VAC or 28 VDC or 0.5 amps @ 250 VAC, or Brass Contacts with gold over nickel plate — 0.4 volt-amps max. @ 20 V max. (AC or DC).
Insulation Resistance: 10,000 Megohms, min.
Dielectric Strength: 1,000 VOLTS rms at sea level.
Electric Life: 1,000,000 make-and-break cycles.
Initial Contact Resistance: 10 Milliohms, max.
Terminal Type: Solder.
Mounting Hole: ¼" Dia.
UL Listing: All models are UL listed except Option B.

Materials and Finishes

Bushing: Brass, Cadmium Plated with Clear Chromate Finish.
Mounting Nut: Brass, Bright Nickel Plated. Hex nut is standard. On request, panel dress nut may be substituted at no extra charge.
Lockwasher, Internal Tooth: Bright Nickel Plated CRS.
Base: Diallyl Phthalate (DAP). Color, Green.
Plunger: General Purpose Phenolic. Black supplied unless otherwise specified. Red is available.
Contacts and Terminals: Coin Silver Standard.

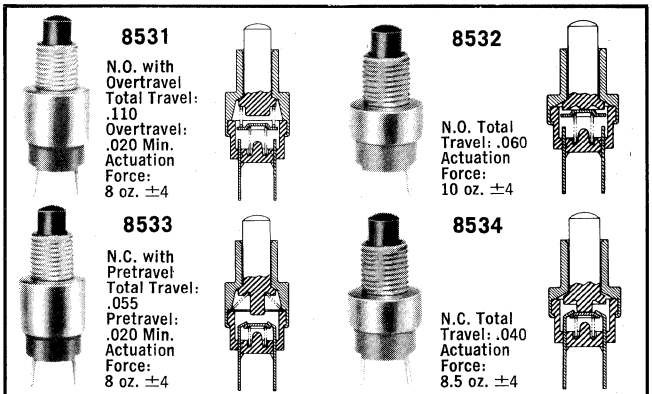
Microminiature — 8600 Series

Contact Ratings: See individual models.
Insulation Resistance: 10,000 Megohms Min.
Dielectric Strength: 500 VOLTS Min. at sea level.
Electric Life: 1,000,000 make-and-break cycles (8631)
100,000 make-and-break cycles (8632)
250,000 make-and-break-cycles (8633)
Initial Contact Resistance: 10 Milliohms Max.
Terminal Type: Solder
Mounting Hole: 11/64" Dia.
UL Listing: Models 8631 and 8632 are UL Listed except for Option B.

Materials and Finishes

Bushing: Brass, Cadmium Plated with Clear Chromate Finish.
Mounting Nut: Brass, Bright Nickel Finish.
Base: General Purpose Phenolic (Red) or Melamine (Red).
Plunger: General Purpose Phenolic. Black supplied unless otherwise specified. Red is available.
Contacts and Terminals: Coin Silver Standard.

Subminiature 8500 Series

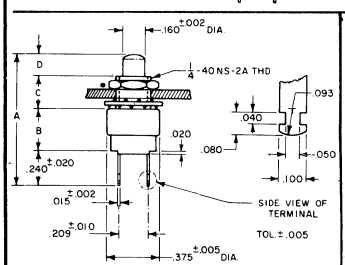


8531
N.O. with Overtravel
Total Travel: .110
Overtravel: .020 Min.
Actuation Force: 8 oz. ±4

8532
N.O. Total Travel: .060
Actuation Force: 10 oz. ±4

8533
N.C. with Pretravel
Total Travel: .055
Pretravel: .020 Min.
Actuation Force: 8 oz. ±4

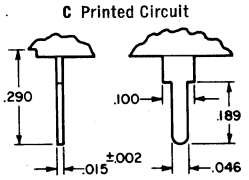
8534
N.C. Total Travel: .040
Actuation Force: 8.5 oz. ±4



Model No.	A (Ref. Only)	B ±0.015	C ±0.010	D ±0.015
8531	1.047	0.407	0.227	0.173
8532	0.935	0.295	0.250	0.150
8533	1.047	0.407	0.250	0.150
8534	0.935	0.295	0.250	0.150

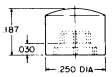
OPTIONS
TERMINATION

C Printed Circuit



MATERIALS (TERMINALS)
B For ½ hd. brass with 50 millionths min. Gold over 200 millionths min. Nickel, add "B" suffix.
G For Coin Silver (90% Ag-10% Cu) with 50 millionths min. Gold over 50 millionths min. Nickel, add "G" suffix.

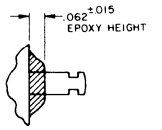
CAP FOR 8500 SERIES — Supplied on request. Specify Cap. No. and Color No. after Order No.



Color Chart

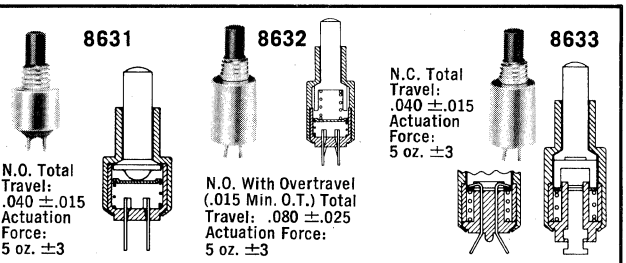
Cap No. A7795	Color
-1	White
-2	Black
-3	Red
-5	Yellow
-6	Green

SEALING
E Terminal Seal



How to Order: Use switch model numbers followed by option letter (EXAMPLE: 8531BE)

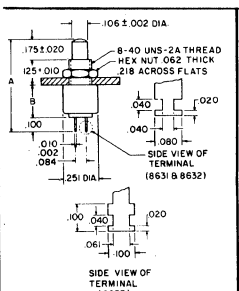
Microminiature 8600 Series



8631
N.O. Total Travel: .040 ±.015
Actuation Force: 5 oz. ±3
Contact Ratings: Coin Silver Contacts ½ amp resistive load @ 120 VAC or 28 VDC; or ¼ amp @ 250 VAC.

8632
N.O. With Overtravel (.015 Min. O.T.) Total Travel: .080 ±.025
Actuation Force: 5 oz. ±3
Contact Ratings: Coin Silver Contacts ½ amp resistive load @ 120 VAC or 28 VDC; or ¼ amp @ 250 VAC.

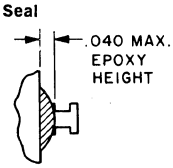
8633
N.C. Total Travel: .040 ±.015
Actuation Force: 5 oz. ±3
Contact Ratings: Coin Silver Contacts ¼ amp resistive load @ 120 VAC or 28 VDC; or ⅛ amp @ 250 VAC.



Model No.	A (Ref. Only)	B ±0.015
8631	0.635	0.235
8632	0.755	0.355
8633	0.745	0.345

Options
MATERIALS (TERMINALS)
B For ½ hd. brass with 50 millionths min. gold over 200 millionths min. nickel, add "B" suffix.
G For coin silver (90%Ag-10% Cu) with 50 millionths min. gold over 50 millionths min. nickel, add "G" suffix.

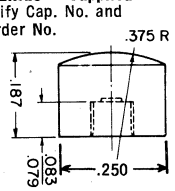
TERMINATIONS
E Terminal Seal



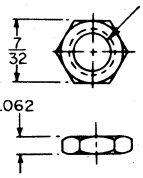
CAP FOR 8600 SERIES — Supplied on request. Specify Cap. No. and Color No. after Order No.

Color Chart

Cap No. A7851	Color
-1	White
-2	Black
-3	Red
-5	Yellow
-6	Green



Hex Nut (std)



How to Order: Use switch model numbers followed by option letter (EXAMPLE: 8631BE)

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UL Listed most models

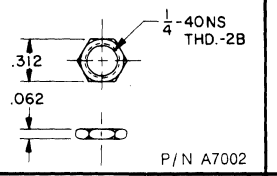
Mounting Hardware For All Switches

C&K

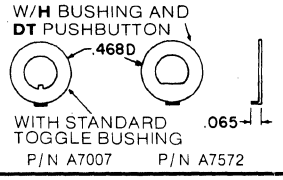
Mounting Hardware for Toggle and Double Throw (DT) Pushbutton Switches

Standard

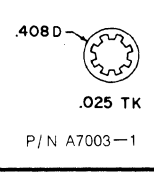
Nuts Hex Nut (std)



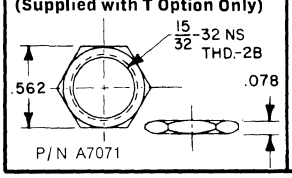
Locking Rings (Std) W/H BUSHING AND DT PUSHBUTTON



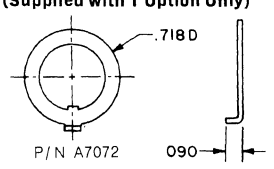
Lockwashers (Std)



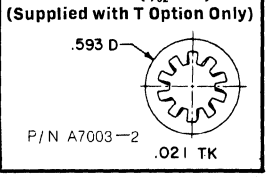
Nuts Hex Nut (15/32 thd) (Supplied with T Option Only)



Locking Ring (15/32 thd) (Supplied with T Option Only)

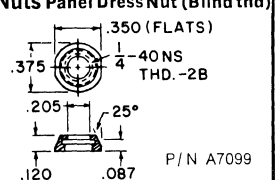


Lockwashers (15/32 thd) (Supplied with T Option Only)

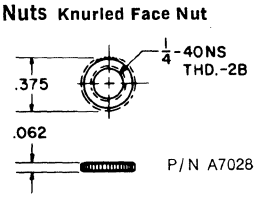


Options

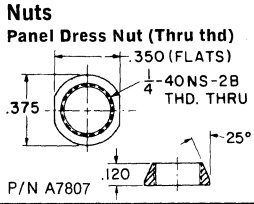
Nuts Panel Dress Nut (Blind thd)



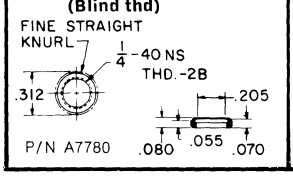
Nuts Knurled Face Nut



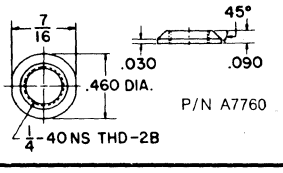
Nuts Panel Dress Nut (Thru thd)



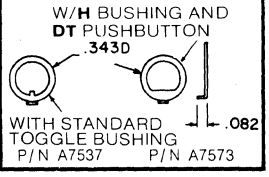
Nuts Decorative Knurled Nut (Blind thd)



Nuts Decorative Dress Nut



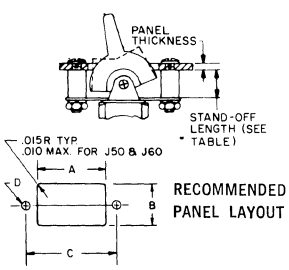
Locking Rings — Small W/H BUSHING AND DT PUSHBUTTON



MATERIALS

1. NUTS — Bright nickel plated brass — 2 hex nuts supplied — on request, 1 hex nut and 1 special nut may be substituted.
2. LOCKING RINGS — Bright nickel plated brass. Standard locking ring normally supplied — on request small locking ring may be substituted.
3. LOCKWASHER — Bright nickel plated CRS. 1 normally supplied.

Mounting Hardware for Rocker and Paddle Handle Switches



Switch Type	'A'	'B'	'C'	'D'
J1 & J2	.705 .710	.416 .421	.932 .942	.093 .096
J3 & J4	1.093 1.098	.646 .651	1.370 1.380	.120 .123
J3 & J4 ALT.	1.093 1.098	.646 .651	1.620 1.630	.147 .150
J10	1.375 1.380	.646 .651	1.620 1.630	.147 .150
J50 & J60	.595 .605	.495 .505	NONE	NONE

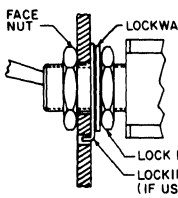
STAND-OFF CHART

Panel Thickness	Switch Style	Stand-Off P/N	Stand-Off Length	Stand-Off Dia.	Binder Head Screw Size	Binder Head Screw Length
1/16"	J1 & J2	7611-1	.295	3/16	2	1/2
	J3	7706-1	.295	7/32	4	5/16
	J4	7750-1	.375	7/32	4	5/8
	J3 ALT., J10	7707-1	.295	1/4	6	5/16
	J4 ALT.	7751-1	.375	1/4	6	5/8
3/32"	J1 & J2	7611-2	.264	3/16	2	1/2
	J3	7706-2	.264	7/32	4	5/16
	J4	7750-2	.344	7/32	4	5/8
	J3 ALT., J10	7707-2	.264	1/4	6	5/16
	J4 ALT.	7751-2	.344	1/4	6	5/8
1/8" STD	J1 & J2	7611-3	.233	3/16	2	1/2
	J3	7760-3	.233	7/32	4	5/16
	J4	7750-3	.312	7/32	4	5/8
	J3 ALT., J10	7707-3	.233	1/4	6	5/16
	J4 ALT.	7751-3	.312	1/4	6	5/8

Specify desired stand-off by placing the stand-off P/N after the order number (see page 3). Unless otherwise specified stand-offs for 1/8 inch thick panel will be supplied.

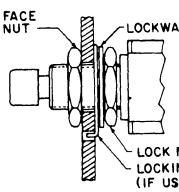
Standard hardware (except for bezel mounting) 2 al. alloy stand-offs, 2 stainless steel binder head screws, 2 stainless steel hex nuts, and 2 stainless steel split lock washers.

Mounting Information



Normal panel asembly when using locking ring.

WARNING:
Do not torque face nut when lock nut is not in place. (Except for high-torque bushing.)

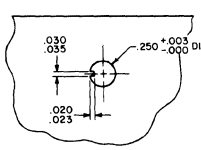


Normal panel assembly when using locking ring, and lock nut.

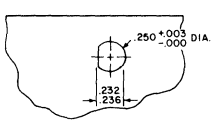
Bushing will withstand torque of 12 IN-Lbs with no distortion or loosening of parts.

Panel Layouts

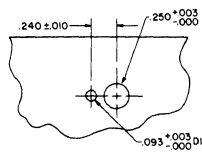
TOGGLE W/O LOCKING RING



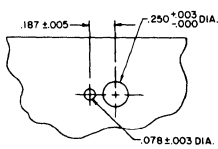
W/H BUSHING AND DT PUSHBUTTON W/O LOCKING RING



TOGGLE AND DT PUSHBUTTON W/STD. LOCKING RING



TOGGLE AND DT PUSHBUTTON W/SMALL LOCKING RING



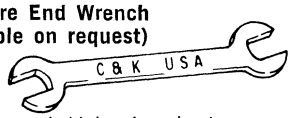
Cap Options (Toggle)

Color Caps

Color-Caps (Vinyl Plastisol) available for standard and long toggles.

A7062 or A7637	Color	A7062 or A7637	Color
-1	Black	-6	Green
-2	Brown	-7	Blue
-3	Red	-9	Gray
-4	Orange	-10	White
-5	Yellow		

Hardware End Wrench (Available on request)



Switches are held in place by two mounting nuts — one front-of-panel, one back-of-panel. Tighten the back-of-panel nut to avoid stratching or damaging the panel's front. This thin, C & K wrench is designed to facilitate back-of-panel tightening. The wrench fits a standard 1/4-40 hex nut and the panel dress nuts.

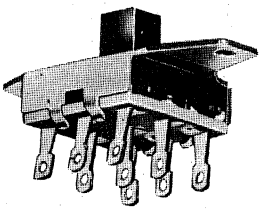
CW INDUSTRIES

SLIDE SWITCHES

QUALITY PRODUCTS THROUGH CREATIVE ENGINEERING

STANDARD SLIDE SWITCHES

Wide Range of Basic Types Available

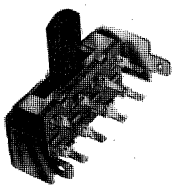


TOP ACTUATED SLIDE SWITCHES

Available from current rating of 3.0 amps AC 0.5 amps DC at 125 volts to 11.0 amps AC at 125 volts, and 8.0 amps DC at 12 volts.

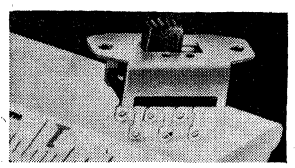
Types include 1 pole, 2 pole, 3 pole and 4 pole in two positions, three positions and four positions. Detent or spring return action.

Variety of mounting options, terminal choice and supplemental features available. Request bulletin 2096.



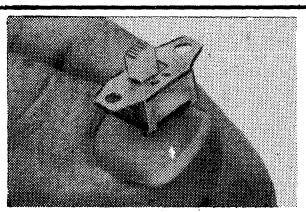
"SYDEWYNDER®" SIDE-ACTUATED SLIDE SWITCHES

Available as single and double pole in 2 positions or 3 positions. Current rating 3.0 amps AC 0.5 amp DC at 125 volts. Mount with two mounting holes on 1⅛" centers or snap into printed circuit board. Variety of knob lengths and colors available. Particularly suitable for applications where switch actuation from side of switch saves extra mechanical assembly. Request bulletin 2096.



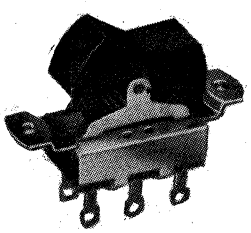
SWIDGET® MINIATURE SLIDE SWITCHES

Available in types having up to 3 poles and 4 positions. 2-position switches mount on .812" centers; other switches have slightly longer mounting centers. Side or top actuated. Detent or spring return. Variety of terminals and knob sizes. Rated at 0.5 amp AC/DC at 125 volts. Request bulletin 2096.



"SWIDGET® JR." SUB-MINIATURE SLIDE SWITCHES

Available as SPDT and DPDT. Mount on 0.562" centers. Overall length .762". Rated 0.5 amp AC/DC at 125 volts. Request bulletin 2096.



ROCKER SWITCHES

Dress up your unit with handsome CW rocker switches. Four basic rocker superstructures can be added to most CW models. Types include 2-position switches with one, two, three or four poles, in a variety of mountings, rocker knobs and features. Rated from 3.0 amps AC 0.5 amp DC at 125 volts, to 11.0 amps AC at 125 volts and 8.0 amps DC at 12 volts. Request bulletin 2085-68.

Additional types of components manufactured by CW Industries include Precision Film Resistors, Wirewound Potentiometers and Automotive Spark Suppressors. Commercial and military type Precision Resistors qualified to MIL-R-10509 are available in 1/10 through 1 watt (RN55 through RN75) and are fully described in Bulletin 2094.

Wirewound Potentiometers described in Bulletin 2080 (¾" diameter) are designed for commercial applications requiring exacting electrical characteristics at competitive cost. They feature simplicity of design and construction aimed at trouble-free operation.

Automotive Spark Suppressors effective in suppressing ignition noises on automotive and marine radio equipment are detailed in Bulletin 2095.

CW Research and Engineering facilities are always at your service, to consult with you on any development or engineering problem. Engineering bulletins describing in detail our products are also readily available on request. Call or write at any time for consultation.

CW INDUSTRIES

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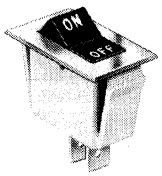
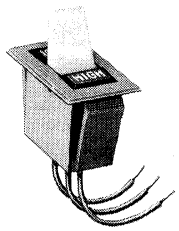
CARLINGSWITCH

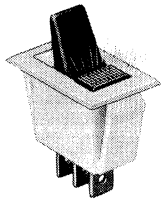
THE BIGGEST SINGLE NAME IN SWITCHES



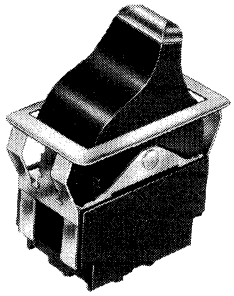
MINI TIPPETTE SERIES



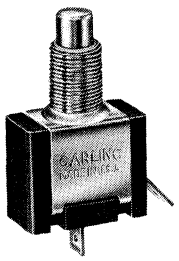
MINI TIPPETTE SERIES



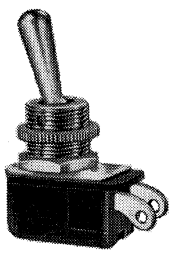
LIGHTED MINI TIPPETTE SERIES



SPECIAL LIGHTED TIPPETTE

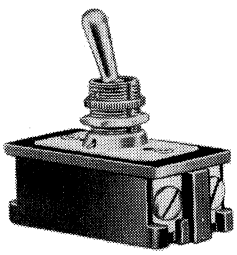


300 SERIES

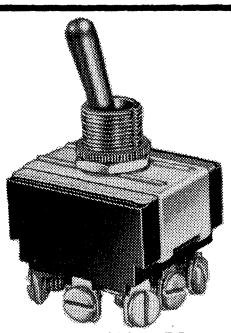


110 SERIES

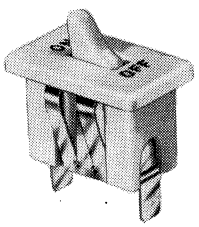
F SERIES



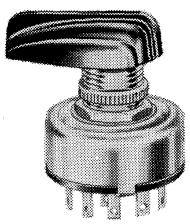
D & F SERIES



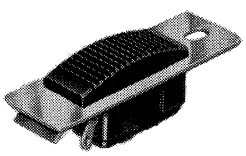
H SERIES



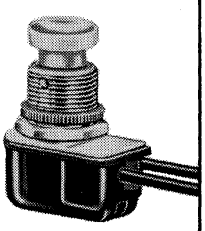
215 SERIES



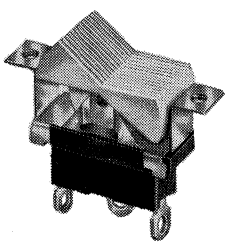
800 SERIES



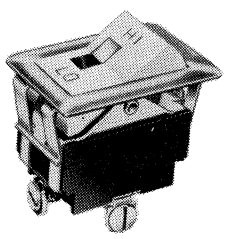
SL-110 SERIES



P-27 SERIES



TIPPETTE SERIES



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for Appliance, Aircraft, Automotive, Electronic, Marine, Military, Motor Control, Special Applications

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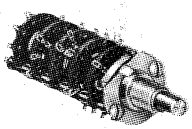
Dallas, Texas 75220

CENTRALAB ROTARY SWITCHES . . .

The table below depicts the standard Rotary Switch products and available standard options. Many custom variations are offered to meet your industrial, commercial, and military applications.

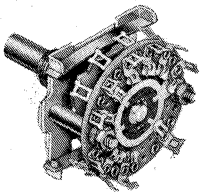


Envelope Diameter Maximum

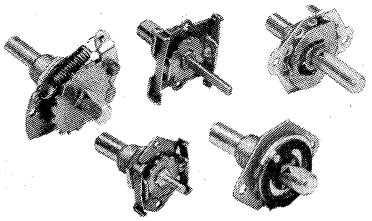
	Strut Size	Maximum Positions and Throw in Degrees										Insulation					Index Type								
		4 x 90°	6 x 60°	8 x 45°	9 x 40°	10 x 36°	12 x 30°	16 x 22.5°	18 x 20°	20 x 18°	24 x 15°	Ceramic	Phenolic	Glass	Kel-F	Diallyl Phthalate	Side Thrust	Hill and Valley	Formed Spring	Flat Spring	Single Ball	Double Ball	Coil Spring and Star Wheel	Spring Return
1" SERIES 100	13/16"	●	●				●					●	●	●		●		●		●	●			
1" SERIES 160	13/16"		●	●		●	●				●	30° & 60°	●	●		30° & 60°	●					●		
1" SERIES 800	13/16"						●					●	●	●		●	●					●		
1 9/32" SERIES 500	1 1/32"		●	●		●	●					30° & 60°	●	●			●					●		
1 9/32" SERIES 600	1 1/32"	●	●	●			●					30° 60° 90°	●	●				●		●	●			
1 1/2" SERIES 020-040	13/16" 1 1/4"	●	●	●			●					●	●	●				●		●	●			
1 1/2" SERIES 050	13/16" 1 1/4"						5 pos. max.					●	●	●									●	●
1 1/2" SERIES 070-090	13/16" 1 1/4"						●					●	●	●				●	●					080
1 1/2" SERIES 550	13/16" 1 1/4"		●	●		●	●					30° & 60°	●	●			●					●		
1 7/16" SERIES 140	1 1/4"								●				●	●									●	
1 7/8" SERIES 300	1 5/16"	●	●	●			●					30° 60° 90°	●	Double Eyelet	Double Eyelet			●		●		●		
1 7/8" SERIES 710	1 5/16"							●					●					●		●		●		
2 5/16" SERIES 650	2"								●				●					●		●		●		
2 5/16" SERIES 670	2"										●		●	●				●		●		●		
2 5/16" SERIES 720	2"									●			●					●		●		●		
2 13/16" SERIES 230	2 7/16"				●				●			●				Durez		●		●		●		
3 1/2" SERIES 236	3"		●				●				●	●						●		●		●		

SERIES 200 & 214	Economy switches for limited switching applications. One piece die cast index frame or conventional stamped steel front plate with staked bushing.
SLIDE SWITCHES	Linear actuation. Available without detent, with positive detent, or spring return, in several sizes.
LEVER SWITCHES	Coil spring/cam and roller or formed spring detents available; available as single units or ganged.

VERSATILITY IS . . .

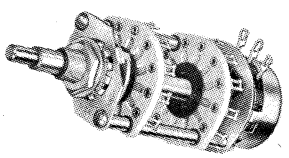


Design freedom to select the best insulation materials. Phenolic, ceramic, glass epoxy, glass silicone, Kel F and diallyl phthalate.



Standard index styles — Single and double ball hill and valley flat spring and dual ball side thrust to provide variable torque, positive detent and operation to satisfy your switching and human factor requirements.

. . . OUR SPECIALTY



Switch design versatility to accommodate add on features such as: A/C line switches, potentiometers and push button actuation.

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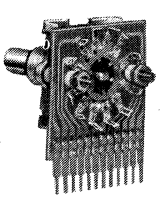
Construction		Shaft Type & Dia.			Rear Mounted Options		Other Features		QPL	P.C. Application			Loc. Lug Radius	Resistive Load Ratings
Bolted	Staked	Single	Dual Concentric	Waterseal	Potentiometers	A-C Switch	Push to Turn	Adj. Stops	MIL-S-3786 SR #	P.C. Clips	P.C. Board	Tube Pins		
●		.125 / .250		●					SR05		●		3/8	Brass Silver Plate — .170 Amp @ 115 VAC — .550 Amp @ 28 VDC Coin Silver — .335 Amp @ 115 VAC — 1.100 Amp @ 28 VDC
●		.125 & .250	.078 / .250	●	●		●	●			●		3/8	Brass Silver Plate — .170 Amp @ 115 VAC — .550 Amp @ 28 VDC Coin Silver — .335 Amp @ 115 VAC — 1.100 Amp @ 28 VDC
●		.250	.078 / .250	●	●				SR05		●		3/8	Brass Silver Plate — .170 Amp @ 115 VAC — .550 Amp @ 28 VDC Coin Silver — .335 Amp @ 115 VAC — 1.100 Amp @ 28 VDC
●		.250	.125 / .250	●	●			●		●			17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250 / .187 / .265	●	●			●	SR03	●			3/8 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●	●	.250	.125 / .250 / .187 / .265	●	●	●	●	●	SR02	●	●		3/8 7/16 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●				●	●		3/8 7/16 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●	●	.250	.125 / .250		●	●				●	●		3/8 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●		●		●	●		7/16 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●							3/8 7/16 17/32	Brass Silver Plate — .170 Amp @ 115 VAC — .550 Amp @ 28 VDC Coin Silver — .335 Amp @ 115 VAC — 1.100 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●		●				●	3/8 17/32	Brass Silver Plate — .350 Amp @ 115 VAC — 2.25 Amp @ 28 VDC Coin Silver — .675 Amp @ 115 VAC — 3.9 Amp @ 28 VDC
●		.250	.125 / .250	●	●					●			3/8 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●		●				●	5/8 17/32	Brass Silver Plate — .350 Amp @ 115 VAC — 2.25 Amp @ 28 VDC Coin Silver — .675 Amp @ 115 VAC — 3.9 Amp @ 28 VDC
●		.250	.125 / .250	●	●	●		●		●			3/8 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250	.125 / .250	●	●					●			3/8 17/32	Brass Silver Plate — .230 Amp @ 115 VAC — 1.5 Amp @ 28 VDC Coin Silver — .450 Amp @ 115 VAC — 2.6 Amp @ 28 VDC
●		.250		●				●					1/2	Coin Silver Only — 9 Amp @ 115 VAC — 11 Amp @ 28 VDC 231 Series — 5 Amp @ 115 VAC — 6 Amp @ 28 VAC
●		.250		●										Coin Silver Only — 9 Amp @ 115 VAC — 11 Amp @ 28 VDC

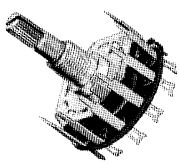
Centralab also offers a complete line of pushbutton switches for industrial and commercial applications. See EEM pages Vol.2•1026 and Vol.2•1027.

You have an OEM sales representative in your area. Contact him for assistance with your switch applications.

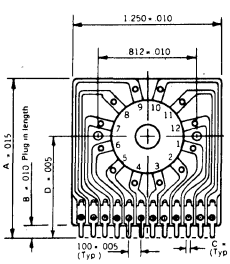
Availability? There's flexibility there too. You can get immediate delivery on custom assembled switches from your Centralab Selectashaft™ Distributor or standard types from any Centralab Industrial Distributor. For design application help, write for Centralab Bulletin 1101S.

For immediate factory assistance call 414/228-2963.





Printed circuit and plug in mount — Various printed circuit board and plug in clip designs available in 1", 1½" and 2 5/16" diameter switch types.

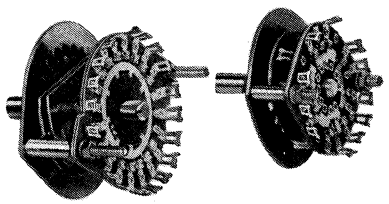


1" printed circuit board now available in three terminations.

TERMINATIONS AVAILABLE

A	B	C	D
1.335	.117	.040	.859
1.335	.117	.025	.859
1.538	.181	.025	1.062

NEW OPTIONS FOR YOU



16 and 20 position switches now available. See Series 710 and 720 in above chart.

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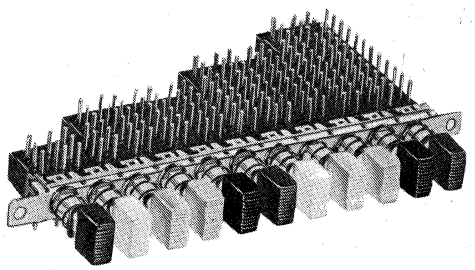
CENTRALAB PUSH BUTTON SWITCHES

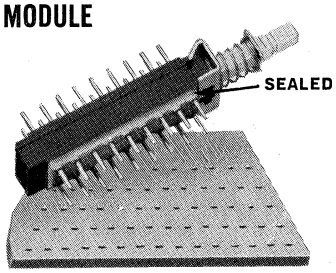
CENTRALAB'S COMPLETE LINE OF PUSH BUTTON SWITCHES* ARE DESIGNED TO MEET INDUSTRIAL & COMMERCIAL APPLICATIONS

- RELIABLE
- LONG LIFE
- LOW COST
- INTERLOCK AND LOCKOUTS
- SEALED OR UNSEALED MODULES
- INDIVIDUAL OR GANG ASSEMBLED
- LIGHTED OR NON-LIGHTED
- LINE AND FUNCTION SWITCHES
- PRINTED CIRCUIT OR SOLDER LUG PINS
- SELECTIVE PIN CUTTING
- LARGE SELECTION OF BUTTON STYLES

Custom assembled standard push button switches are available from Centralab Push Button Switch Field Assembly Distributors.

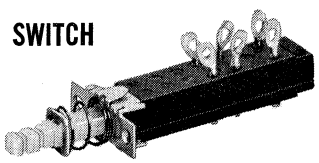


BASIC MODULE



Printed Circuit Mounting

LINE SWITCH



Switches are double throw, non-shorting slide switches available in 2, 4, 6 or 8 pole designs. Basic modules may be mounted by plugging into a printed circuit board, or panel mounted by use of a standard mounting bracket. Modules may be furnished into assemblies of up to 29 stations. Terminal lengths up to .236" on top, to .472" on bottom are standard. Stator materials of **phenolic or diallyl phthalate,** may be selected. Gold plate, of 50 millionths is offered for longer life and low level circuit applications. A few of the buttons available to fit the basic module are listed in the table. Many other button options are offered — consult the factory for entire selection. The epoxy seal option provides a conformal protective coat around the terminals to prevent flux or other contamination within the contact area.

MOMENTARY CONTACT

In this type of operation the button remains in only as long as it is pressed, and it returns to its original position as soon as pressure is released. The switching function is maintained by pressure on the button.

PUSH-PUSH

In this type of operation the button remains in when pressed and must be pressed again to return to its original position. The switching function continues as long as the button is engaged.

PUSH-PULL

In this type of operation the button remains in when pressed and must be pulled out to return to its original position. The switching function continues as long as the button is engaged.

INTERLOCKING AND LOCKOUTS

Standard Interlocking enables the connection of a group of modules so that when any button of the interlock group is pressed, it automatically disengages any other button of the group that was engaged.

Type A — With one button depressed, no other button can be depressed until the first one has been "cleared," or released, by a clearing module.

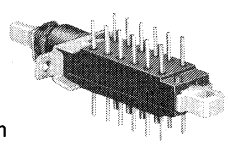
Type C — For a group (2 or more) of PUSH-PUSH switches. Any button depressed has to be released by pushing this same button again before any other button can be depressed.

Type D — An "Interlocking Lockout," used in conjunction with the standard interlock, prevents depressing any two buttons at one time (applicable to a maximum of 8 adjacent positions).

Type D_1 — Uses "Interlocking Lockout." Same as Type D except two row interlock with lockout. Available only with interlocking modules. Lockout will function in any row but not row to row.

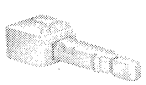
NOTE: Also use Type C for "momentary" switches. Will lock out or prevent depressing any two adjacent modules.

REAR COUPLING



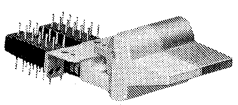
When desired, a coupling can be provided that will permit the switch to perform additional functions. This consists of an adapter ring which is attached to the rear end of the slider bar and may be used to provide an alternate source of activation.

CLEARING MODULES

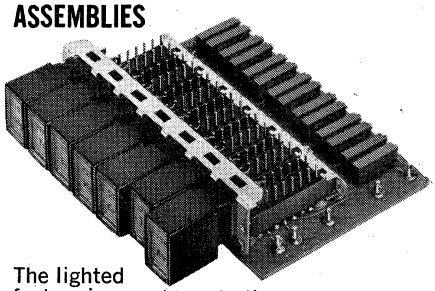


A clearing module can be provided for releasing an engaged switch when interlocking switching is used. This module has no contacts but it provides a mechanical means of activating the interlocking mechanism. It is available with either momentary or interlocking action.

KEY SWITCH

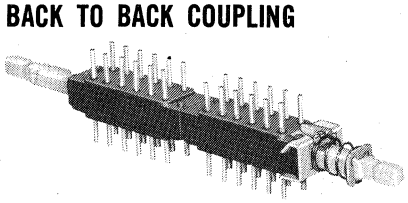


LIGHTED ASSEMBLIES



The lighted feature is an add-on to the basic module. All standard specifications and functions of the non-lighted switch apply. Detailed light assembly specs and features are available at your Centralab distributor and factory. **Ask for latest catalog.**

BACK TO BACK COUPLING



When desired, two modules may be connected back-to-back, to permit a maximum of sixteen poles to be operated by a single button. This is accomplished by connecting the slider bars with a slide bar coupler.

*Isostat licensed — Available from Centralab in North and Central America.

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CENTRALAB PUSH BUTTON SWITCHES

MECHANICAL, ELECTRICAL & ENVIRONMENTAL SPECIFICATIONS

MECHANICAL

Stator Block:
Function Switch: Phenolic or Diallyl Phthalate
Line Switch: Phenolic

Slider Bar: Thermoplastic

Fixed Contacts:* Silver Plated Copper Wire

Moving Contacts:* Nickel Silver Alloy with Silver Overlay

Lubrication: During assembly; no further required

Standard Activating Force

2 pole	12 to 22 oz.
4 pole	17 to 27 oz.
6 pole	24 to 36 oz.
8 pole	30 to 46 oz.
Line Switch	32 to 48 oz.

CONSULT FACTORY FOR OTHER RATINGS

*Optional gold plate 50 or 200 millionths.

ELECTRICAL

Contact Resistance: 4 milliohms, initial
10 milliohms after 25,000 cycles
Current and Voltage Ratings (at 25,000 cycles): 0.45 Amp at 115 VAC
1.00 Amp at 28 VDC

Dielectric Strength (VAC, R.M.S.)
(Ratings for factory new condition)

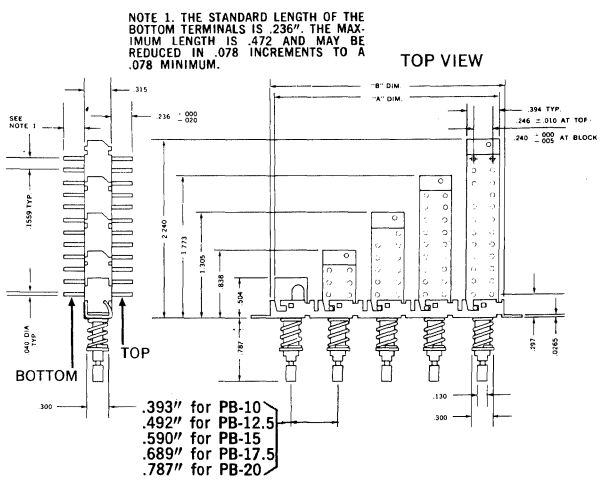
Measured Between	Phenolic	Diallyl Phthalate
Bracket & Pins	1000	1000
Pin-to-Pin	1000	1500

	INSULATION RESISTANCE — MEGOHMS		
Condition	Measured Between	General Purpose Material	Diallyl Phthalate Material
70% Relative Humidity @ 70°F.	Bracket & Pin Pole-to-Pole Pin-to-Pin	6,000 Megohms 65,000 Megohms 50,000 Megohms	Over 1000K Megohms
After 96 Hours at 95-100% Relative Humidity @ 70°F.	Bracket & Pin Pole-to-Pole Pin-to-Pin	100 Megohms 185 Megohms 210 Megohms	100K Megohms 500K Megohms 500K Megohms

ENVIRONMENTAL

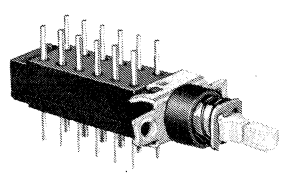
Temperature: The switches withstand temperatures up to 180°F in continuous operation. The slider bar will tolerate a maximum of 550°F for a maximum of 9 seconds. This is well within the standard dwell time for soldering terminals by either conventional hand methods or wave soldering techniques.

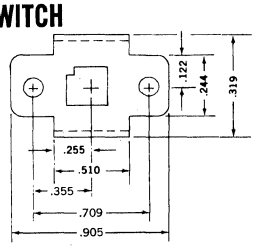
ASSEMBLY DIMENSIONS



Consult Factory for Detailed Information or ask for latest Catalog.

BRACKET MOUNTING SINGLE SWITCH





BUTTON DIMENSIONS

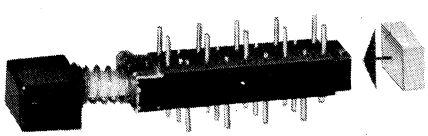
Style	Max. A	B	C
	.221	.395	.395
	.332	.551	.784
	.298	.434	.466
	.229	.547	.472
	.293	.435	.580
	.221	.425	.394

Style	Max. A	B	C
	.295	.677	.580
	.405	.476	.583
	.399	.476	.780
	.223	.433	.472
	.403	.475	.583
	.479	.471	

PUSH BUTTON SPECIFIER

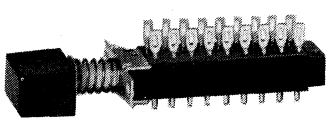
Helps you select from twenty-six button styles and eighteen colors. Write for catalog 42-DO-1532 PBS.

NEW FEATURES

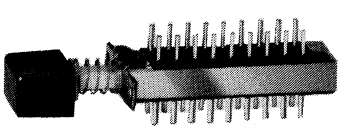


Dust Cover: Provides additional protection from airborne contaminants.

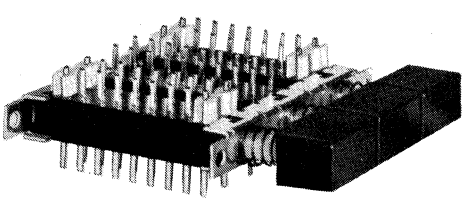
Selective Pin Cutting: Invaluable for applications using top and bottom PC boards because only active terminals need enter PC board.



Solder Lug Terminals: Available for hand soldering applications.



Wrap-Around Support Bracket: Provides additional support for single module applications.



Dog-Bone Spacer: Allows for adequate module-to-PC-board spacing when using automated solder methods.

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NO ONE CUSTOMIZES SWITCHES LIKE CDI- and no one matches our complete line

C•D•I

SEE ALL THE BONUSES YOU GET IN CDI PRECISION THUMBWHEEL, ROTARY & PUSHBUTTON SWITCHES

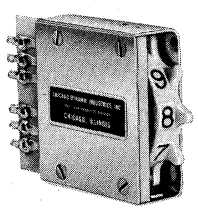
Our Complete Line covers the switch spectrum. If we don't have the switch you need, contact our Custom Design Department.

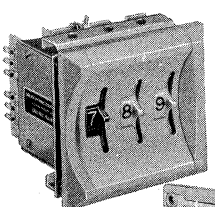
Exceptional design flexibility gives you many Bonus Features not available elsewhere.

1,000,000 DETENTS

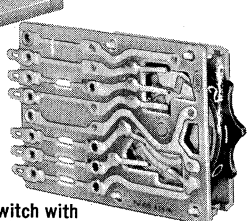
THUMBWHEEL SWITCHES

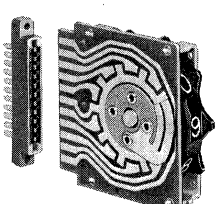
YOUR BONUS FEATURES: (1) Up to 17 poles or more if required. (2) Reset, lock, unlock, with or without remote control. (3) Special engravings, special wheel colors. (4) Double width wheels for increased data readout.





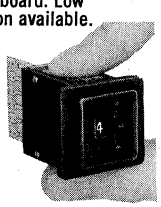
Completely sealed against hostile environments. Also panel sealed only, or unsealed.





Miniature binary or decimal switch with extended circuit board. Low cost utility version available.

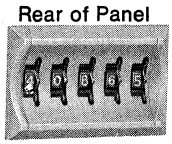
Tab-type decimal or binary switch. Removable wafer for quick replacement from front of panel.



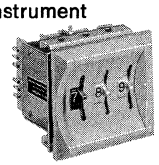
Retrofits most miniature thumbwheel switch panel openings. Only .900"x.980" front panel size for single module assembly. Mounts on ½" centers.

Other CDI Thumbwheel Switch Features: (1) Switch sizes 1", 1½", 2" mount on ½", ⅝" centers. (2) Solder lugs, solder dip pins, pc connectors. (3) Over 100 binary codes. (4) Lighted or unlighted. (5) 8, 10, 12, 16, 17 positions. (6) RFI shielding. (7) Various custom assemblies. (8) Switches are available with these bezel styles in standard black or gray:

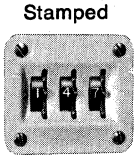
Rear of Panel



Instrument



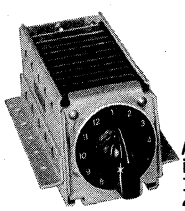
Stamped



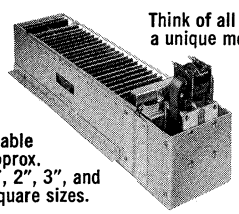
1,000,000 DETENTS VERSATILE

ROTARY SWITCHES

YOUR BONUS FEATURES: (1) With or without motors. (2) 1 to 32 positions per pole; up to 6 poles per wafer; up to 36 wafers in a given switch. (3) Snap-in, snap-out modules in seconds, eliminating downtime. (4) Covered by Tabet Pat. 2841660, 2971066, 3015000, 2956131, 2988607. (5) Binary coded wafers available.



Available in approx. 1½", 2", 3", and 4" square sizes.



Think of all you could do with a unique motor-driven switch with up to 400 circuits.

1,000,000 DETENTS

PUSHBUTTON SWITCHES

FEATURES: (1) Digital or binary codes. (2) Completely sealed, panel sealed, unsealed. (3) Lighted or unlighted.

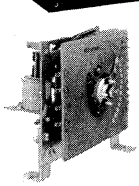
Shorting or non-shorting types available. Uni-directional only. 3" high, mounts on 1" centers.

Available in bi-directional or uni-directional models. Retrofits most miniature thumbwheel switch panel openings.

OTHER COMPONENTS

Counter Switch with decimal or coded electrical readout. Multiple decade models available.

Counter with 2 to 6 digits. Overall size for 2 digits is 2¼" H x 3³⁄₁₆" D x 1⅛" W. Add ¾" to width for each additional digit.



Uni-directional Step-Up Switch. Complete reset or one-step-at-a-time reset. Available in many combinations.

CUSTOM ASSEMBLIES

This modified thumbwheel switch with Geneva movement is just one example of the versatility of CDI's Custom Design Department. Contact them for your special switching applications.

YOUR BONUS FEATURE: Everyday CDI earns anew its reputation for consistently high quality, consistently excellent delivery, consistent preference from engineers and procurement people.

CONTACT CDI—*the Custom Switch House whose Complete Line covers the Switching Spectrum.*

C•D•I

CHICAGO DYNAMIC INDUSTRIES, INC.

PRECISION PRODUCTS DIVISION

1725 Diversey Blvd., Chicago, Illinois 60614 • Phone: 312, 935-4600 Telex 25-4689

CHERRY product/price list

DISCOUNT SCHEDULE FOR ALL SNAP-ACTION SWITCHES

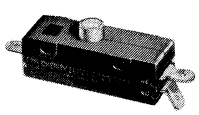
Quantity	Discount	Multiplier
1 to 49	List	1.00
50 to 99	27%	0.73
100 to 499	37%	0.63
500 to 999	43%	0.57
1000 to 1999	48%	0.52
2000 to 4999	54%	0.46

For quantities of 5000 and over consult factory

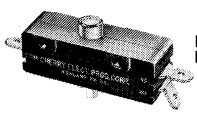
NOTES (apply to all products in this product/price list)

1. Cash Terms — ½% 10 days, net 30 days.
2. Shipments — F.O.B. Shipping Point, Waukegan, Ill.
3. Prices and Discounts — Are subject to change without notice.
4. Multiplier — Net Price can be determined by multiplying list price and multiplier shown in discount schedule.
5. Discounts — Are offered on basis of volume production. To warrant discount each shipment must consist of 2000 pieces minimum, or complete order if less than 2000 pieces.

GENERAL PURPOSE - SINGLE POLE E13 SERIES/E14

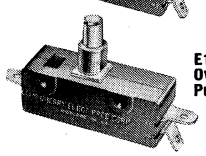


E13-00E
Basic

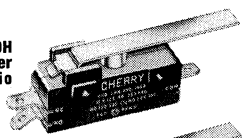


E13-00R
Reset Type

E13-00J
Push Button

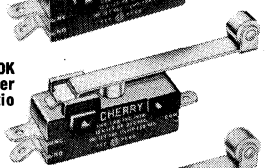


E13-00M
Overtravel
Push Button

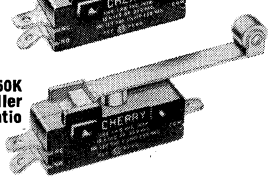


E13-00H
Lever
Std. Ratio

E13-50H
Lever
High Ratio



E13-00K
Roller
Std. Ratio



E13-50K
Roller
High Ratio

A rugged switch with large overtravel, wear resistant nylon button, many integral hinged actuator variations, and choice of two electrical ratings.

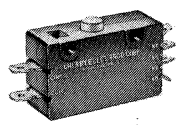
E13 SERIES — 15 AMPS., 125-250 VAC, ¾ H.P., 125 VAC — 1½ H.P., 250 VAC

E14 SERIES — 25 AMPS., 125-250 VAC, 1 H.P., 125 VAC — 2 H.P., 250 VAC

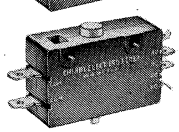
SWITCH BODY — 1 13/16" x 41/64" x 41/64"

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E13-00E	SPDT	$0.75	E13-50K	SPDT	$1.36
E13-01E	SPST NO	.72	E13-51K	SPST NO	1.33
E13-02E	SPST NC	.72	E13-52K	SPST NC	1.33
E13-00R	SPDT	1.67	E14-00A	SPDT	1.04
E13-01R	SPST NO	1.64	E14-01A	SPST NO	1.01
E13-02R	SPST NC	1.64	E14-02A	SPST NC	1.01
E13-00J	SPDT	.85	E14-00H	SPDT	1.37
E13-01J	SPST NO	.82	E14-01H	SPST NO	1.34
E13-02J	SPST NC	.82	E14-02H	SPST NC	1.34
E13-00M	SPDT	1.04	E14-50H	SPDT	1.37
E13-01M	SPST NO	1.01	E14-51H	SPST NO	1.34
E13-02M	SPST NC	1.01	E14-52H	SPST NC	1.34
E13-00H	SPDT	1.08	E14-00K	SPDT	1.65
E13-01H	SPST NO	1.05	E14-01K	SPST NO	1.62
E13-02H	SPST NC	1.05	E14-02K	SPST NC	1.62
E13-50H	SPDT	1.08	E14-50K	SPDT	1.65
E13-51H	SPST NO	1.05	E14-51K	SPST NO	1.62
E13-52H	SPST NC	1.05	E14-52K	SPST NC	1.62
E13-00K	SPDT	1.36			
E13-01K	SPST NO	1.33			
E13-02K	SPST NC	1.33			

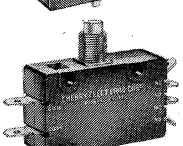
GENERAL PURPOSE - DOUBLE POLE E19 SERIES/E20



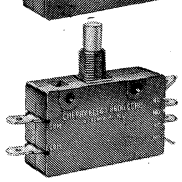
E19-00A
Basic
Double Pole



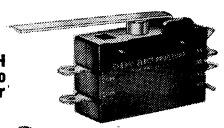
E19-00R
Reset Type



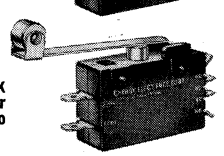
E19-00J
Push Button



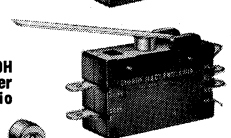
E19-00M
Overtravel
Push Button



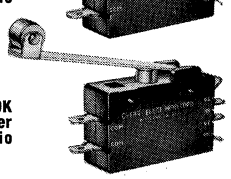
E19-00H
Std. Ratio
Lever



E19-50K
Roller
High Ratio



E19-50H
Lever
High Ratio



E19-00K
Roller
Std. Ratio

A compact switch with double pole electrical control, large overtravel, sturdy construction and wide range of actuators in two electrical ratings.

E19 SERIES — 15 AMPS., 125-250 VAC, ¾ H.P., 125 VAC — 1½ H. P., 250 VAC

E20 SERIES — 20 AMPS., 125-250 VAC, 1 H.P., 125 VAC — 2 H.P., 250 VAC

SWITCH BODY — 1 13/16" x 1⅛" x 41/64"

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E19-00A	DPDT	$1.80	E19-00M	DPDT	$2.10
E19-01A	DPST NO	1.75	E19-01M	DPST NO	2.05
E19-02A	DPST NC	1.75	E19-02M	DPST NC	2.05
E19-00R	DPDT	2.64	E20-00A	DPDT	2.67
E19-01R	DPST NO	2.59	E20-01A	DPST NO	2.62
E19-02R	DPST NC	2.59	E20-02A	DPST NC	2.62
E19-00H	DPDT	2.00	E20-00H	DPDT	2.87
E19-01H	DPST NO	1.95	E20-01H	DPST NO	2.82
E19-02H	DPST NC	1.95	E20-02H	DPST NC	2.82
E19-50H	DPDT	2.00	E20-50H	DPDT	2.87
E19-51H	DPST NO	1.95	E20-51H	DPST NO	2.82
E19-52H	DPST NC	1.95	E20-52H	DPST NC	2.82
E19-00K	DPDT	2.13	E20-00K	DPDT	3.00
E19-01K	DPST NO	2.08	E20-01K	DPST NO	2.95
E19-02K	DPST NC	2.08	E20-02K	DPST NC	2.95
E19-50K	DPDT	2.13	E20-50K	DPDT	3.00
E19-51K	DPST NO	2.08	E20-51K	DPST NO	2.95
E19-52K	DPST NC	2.08	E20-52K	DPST NC	2.95
E19-00J	DPDT	1.90	E20-00J	DPDT	2.77
E19-01J	DPST NO	1.85	E20-01J	DPST NO	2.72
E19-02J	DPST NC	1.85	E20-02J	DPST NC	2.72

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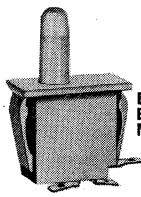
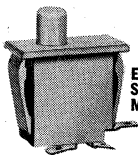
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

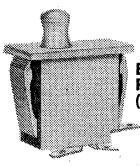
CHERRY

PANEL MOUNT PUSHBUTTON-SINGLE POLE/E69 SERIES

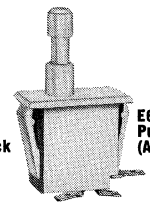

E69-00A
Basic
Momentary


E69-40A
Short Button
Momentary

E69-50A
For Auxiliary
Pushbutton


E69-20A
Push-Pull
(Reset)

E69-30A
Momentary
Cheat Interlock


E69-60A
Push-Push
(Alt. Atcion)

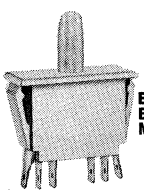
ELECTRICAL RATING: 10 AMP., ⅓ H.P. 125/250 VAC

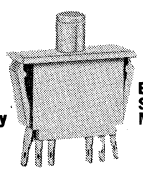
SWITCH BODY — 1¼" x 1" x 11/16"

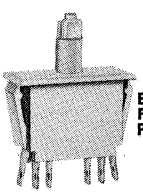
Exclusive stainless steel coil spring, long-life mechanism. Snap-in mounting in choice of momentary contact action, push-pull (reset), momentary "cheat" interlock, push-push (alternate action).

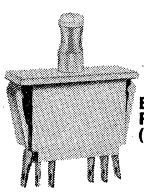
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E69-00A	SPDT	$0.95	E69-40A	SPDT	$1.00
E69-01A	SPST NO	.95	E69-41A	SPST NO	1.00
E69-02A	SPST NC	.95	E69-42A	SPST NC	1.00
E69-20A	SPDT	.92	E69-50A	SPDT	.95
E69-21A	SPST NO	.92	E69-51A	SPST NO	.95
E69-22A	SPST NC	.92	E69-52A	SPST NC	.95
E69-30A	SPDT	1.25	E69-60A	SPDT	2.20
E69-31A	SPST NO	1.25	E69-61A	SPST NO	2.20
E69-32A	SPST NC	1.25	E69-62A	SPST NC	2.20

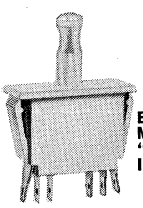
PANEL MOUNT PUSHBUTTON - DOUBLE POLE/E79 SERIES

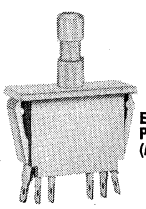

E79-00A
Basic
Momentary


E79-40A
Short Button
Momentary


E79-50A
For Auxiliary
Pushbutton


E79-20A
Push-Pull
(Reset)


E79-30A
Momentary
"Cheat"
Interlock


E79-60A
Push-Push
(Alt. Action)

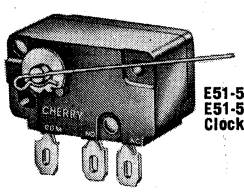
ELECTRICAL RATING — 10 AMP., 125/250 VAC ⅓ H.P., 125/250 VAC

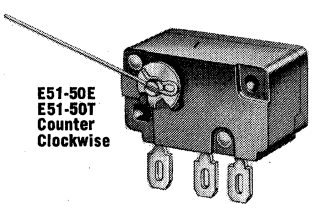
SWITCH BODY — 1½" x 1" x 11/16"

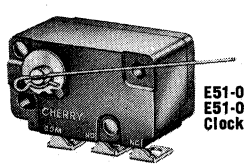
Two circuit controls from a single actuator is contained in this snap-in panel mount switch. White nylon switch case, rock-wipe contact action, large overtravel, white acetal actuating button and long-life coil spring mechanism.

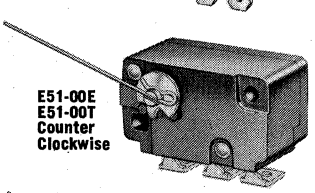
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E79-00A	DPDT	$1.55	E79-40A	DPDT	$1.60
E79-01A	DPST NO	1.55	E79-41A	DPST NO	1.60
E79-02A	DPST NC	1.55	E79-42A	DPST NC	1.60
E79-20A	DPDT	1.52	E79-50A	DPDT	1.55
E79-21A	DPST NO	1.52	E79-51A	DPST NO	1.55
E79-22A	DPST NC	1.52	E79-52A	DPST NC	1.55
E79-30A	DPDT	2.25	E79-60A	DPDT	2.80
E79-31A	DPST NO	2.25	E79-61A	DPST NO	2.80
E79-32A	DPST NC	2.25	E79-62A	DPST NC	2.80

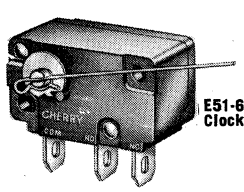
LOW TORQUE/E51 SERIES

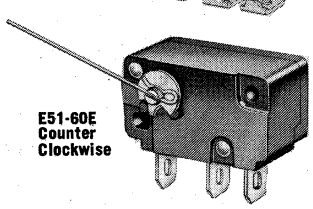

E51-50B
E51-50R
Clockwise


E51-50E
E51-50T
Counter
Clockwise


E51-00B
E51-00R
Clockwise


E51-00E
E51-00T
Counter
Clockwise


E51-60B
Clockwise


E51-60E
Counter
Clockwise

ELECTRICAL RATING — 5 AMP., 125/250 VAC ⅓ H.P. 125/250 VAC

SWITCH BODY — 1½" x 1" x 11/16"

Rotary action, coin switch with sensitive feather light operation. Same coil spring, long-life Cherry mechanism. Available in clockwise or counter clockwise actuation and a wide choice of terminal configurations.

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E51-00B	SPDT	$2.12	E51-50E	SPDT	$2.12
E51-01B	SPST NO	2.12	E51-51E	SPST NO	2.12
E51-02B	SPST NC	2.12	E51-52E	SPST NC	2.12
E51-00E	SPDT	2.12	E51-50R	SPDT	2.12
E51-01E	SPST NO	2.12	E51-51R	SPST NO	2.12
E51-02E	SPST NC	2.12	E51-52R	SPST NC	2.12
E51-00R	SPDT	2.12	E51-50T	SPDT	2.12
E51-01R	SPST NO	2.12	E51-51T	SPST NO	2.12
E51-02R	SPST NC	2.12	E51-52T	SPST NC	2.12
E51-00T	SPDT	2.12	E51-60B	SPDT	2.12
E51-01T	SPST NO	2.12	E51-61B	SPST NO	2.12
E51-02T	SPST NC	2.12	E51-62B	SPST NC	2.12
E51-50B	SPDT	2.12	E51-60E	SPDT	2.12
E51-51B	SPST NO	2.12	E51-61E	SPST NO	2.12
E51-52B	SPST NC	2.12	E51-62E	SPST NC	2.12

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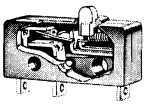
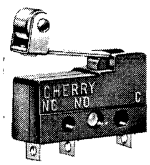
CHERRY

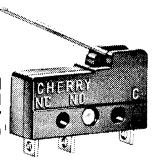
SUBMINIATURE SERIES E61-LIGHT FORCE/SERIES E62-STANDARD FORCE



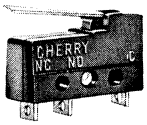
E61-00A
E62-00A
Basic



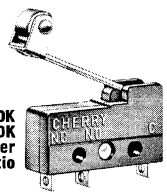
E61-00K
E62-00K
Roller
Std. Ratio



E61-50H
E62-50H
Lever
High Ratio



E61-00H
E62-00H
Lever
Std. Ratio



E61-50K
E62-50K
Roller
High Ratio

E61 SERIES — 5 AMPS., 125/250 VAC
SWITCH BODY — 25/32" x 23/64" x 1/4"
E62 SERIES — 10.1 AMPS., 125/250 VAC., 1/4 H.P., 125 VAC
SWITCH BODY — 25/32" x 23/64" x 1/4"

A switch with large overtravel, integral hinged actuators, and choice of .093" QC, .110" QC, or solder terminals with two force and rating ranges.

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E61-00A	SPDT	QC .093"	$1.22	E61-30K	SPDT	.110" QC	$1.50
E61-01A	SPST NO	QC .093"	1.22	E61-31K	SPST NO	.110" QC	1.50
E61-02A	SPST NC	QC .093"	1.22	E61-32K	SPSA NC	.110" QC	1.50
E61-00H	SPDT	QC .093"	1.32	E61-50H	SPDT	QC .093"	1.32
E61-01H	SPST NO	QC .093"	1.32	E61-51H	SPST NO	QC .093"	1.32
E61-02H	SPST NC	QC .093"	1.32	E61-52H	SPST NC	QC .093"	1.32
E61-00K	SPDT	QC .093"	1.50	E61-50K	SPDT	QC .093"	1.50
E61-01K	SPST NO	QC .093"	1.50	E61-51K	SPST NO	QC .093"	1.50
E61-02K	SPST NC	QC .093"	1.50	E61-52K	SPST NC	QC .093"	1.50
E61-10A	SPDT	Solder	1.22	E61-60H	SPDT	Solder	1.32
E61-11A	SPST NO	Solder	1.22	E61-61H	SPST NO	Solder	1.32
E61-12A	SPST NC	Solder	1.22	E61-62H	SPST NC	Solder	1.32
E61-10H	SPDT	Solder	1.32	E61-60K	SPDT	Solder	1.50
E61-11H	SPST NO	Solder	1.32	E61-61K	SPST NO	Solder	1.50
E61-12H	SPST NC	Solder	1.32	E61-62K	SPST NC	Solder	1.50
E61-10K	SPDT	Solder	1.50	E61-80H	SPDT	.110" QC	1.32
E61-11K	SPST NO	Solder	1.50	E61-81H	SPST NO	.110" QC	1.32
E61-12K	SPST NC	Solder	1.50	E61-82H	SPST NC	.110" QC	1.32
E61-30A	SPDT	.110" QC	1.22	E61-80K	SPDT	.110" QC	1.50
E61-31A	SPST NO	.110" QC	1.22	E61-81K	SPST NO	.110" QC	1.50
E61-32A	SPST NC	.110" QC	1.22	E61-82K	SPST NC	.110" QC	1.50
E61-30H	SPDT	.110" QC	1.32				
E61-31H	SPST NO	.110" QC	1.32				
E61-32H	SPST NC	.110" QC	1.32				

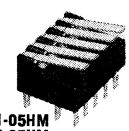
Note: To specify 10 amp change part number prefix from E61 to E62 (example: E61-00A Basic 5 amp becomes E62-00A for 10 amp). Prices are same on both E61 and E62 series.

SUBMINIATURE MODULES/SERIES E61/SERIES E62

E61-02HM
E62-02HM
2PDT

E61-03HM
E62-03HM
3PDT

E61-04HM
E62-04HM
4PDT



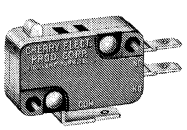
E61-05HM
E62-05HM
5PDT

ELECTRICAL RATING:
E61 SERIES — 5 AMPS., 125/250 VAC
E62 SERIES — 10.1 AMPS., 125/250 VAC 1/4 H.P. 125 VAC

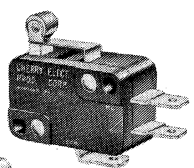
For applications requiring 2, 3, 4, or 5-circuit control in a compact space. The subminiature switch modules have all the features of the regular subminiature switch described above.

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E61-02HM	2PDT	QC .093"	$2.90	E61-52HM	2PDT	QC .093"	$2.90
E61-12HM	2PDT	Solder	2.90	E61-62HM	2PDT	Solder	2.90
E61-32HM	2PDT	.110" QC	2.90	E61-82HM	2PDT	.110" QC	2.90
E61-03HM	3PDT	QC .093"	4.50	E61-53HM	3PDT	QC .093"	4.50
E61-13HM	3PDT	Solder	4.50	E61-63HM	3PDT	Solder	4.50
E61-33HM	3PDT	.110" QC	4.50	E61-83HM	3PDT	.110" QC	4.50
E61-04HM	4PDT	QC .093"	6.23	E61-54HM	4PDT	QC .093"	6.23
E61-14HM	4PDT	Solder	6.23	E61-64HM	4PDT	Solder	6.23
E61-34HM	4PDT	.110" QC	6.23	E61-84HM	4PDT	.110" QC	6.23
E61-05HM	5PDT	QC .093"	7.96	E61-55HM	5PDT	QC .093"	7.96
E61-15HM	5PDT	Solder	7.96	E61-65HM	5PDT	Solder	7.96
E61-35HM	5PDT	.110" QC	7.96	E61-85HM	5PDT	.110" QC	7.96

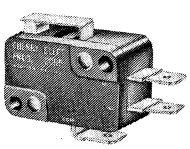
STANDARD FORCE-MINIATURE SERIES E22/E23/E33/E34



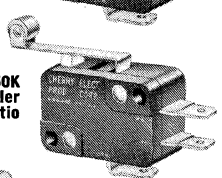
-00A
Basic



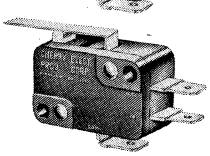
-00K
Short Roller



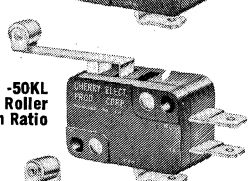
-00H
Short Lever



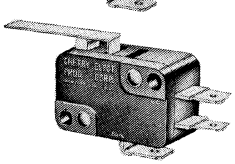
-50K
Roller
Std. Ratio



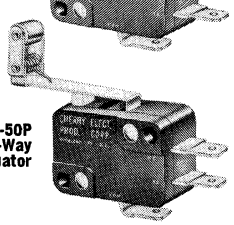
-50H
Lever
Std. Ratio



-50KL
Roller
High Ratio



-50HL
Lever
High Ratio



-50P
One-Way
Actuator

E22 — 3 AMPS., 125 VAC
E23 — 5 AMPS., 1/4 H.P., 125/250 VAC
E33 — 10 AMPS., 1/2 H.P., 125/250 VAC
E34 — 15 AMPS., 1/2 H.P., 125/250 VAC
SWITCH BODY — 13/32" x 5/8" x 13/32"

Compact miniature switch with long-life coil spring mechanism, integral hinged actuators, choice of three terminal types and four force rating ranges.

(E22 series switches are 20 cents higher than those shown in the table below for E23 series)

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E23-00A	SPDT	QC	$0.85	E23-00K	SPDT	QC	$1.20
E23-01A	SPST NO	QC	.82	E23-01K	SPST NO	QC	1.17
E23-02A	SPST NC	QC	.82	E23-02K	SPST NC	QC	1.17
E23-10A	SPDT	Screw	1.36	E23-10K	SPDT	Screw	1.71
E23-11A	SPST NO	Screw	1.19	E23-11K	SPST NO	Screw	1.54
E23-12A	SPST NC	Screw	1.19	E23-12K	SPST NC	Screw	1.54
E23-20A	SPDT	Solder	.85	E23-20K	SPDT	Solder	1.20
E23-21A	SPST NO	Solder	.82	E23-21K	SPST NO	Solder	1.17
E23-22A	SPST NC	Solder	.82	E23-22K	SPST NC	Solder	1.17
E23-00H	SPDT	QC	1.00	E23-50K	SPDT	QC	1.20
E23-01H	SPST NO	QC	.97	E23-51K	SPST NO	QC	1.17
E23-02H	SPST NC	QC	.97	E23-52K	SPST NC	QC	1.17
E23-10H	SPDT	Screw	1.51	E23-60K	SPDT	Screw	1.71
E23-11H	SPST NO	Screw	1.34	E23-61K	SPST NO	Screw	1.54
E23-12H	SPST NC	Screw	1.34	E23-62K	SPST NC	Screw	1.54
E23-20H	SPDT	Solder	1.00	E23-70K	SPDT	Solder	1.20
E23-21H	SPST NO	Solder	.97	E23-71K	SPST NO	Solder	1.17
E23-22H	SPST NC	Solder	.97	E23-72K	SPST NC	Solder	1.17
E23-50H	SPDT	QC	1.00	E23-50KL	SPDT	QC	1.20
E23-51H	SPST NO	QC	.97	E23-51KL	SPST NO	QC	1.17
E23-52H	SPST NC	QC	.97	E23-52KL	SPST NC	QC	1.17
E23-60H	SPDT	Screw	1.51	E23-60KL	SPDT	Screw	1.71
E23-61H	SPST NO	Screw	1.34	E23-61KL	SPST NO	Screw	1.54
E23-62H	SPST NC	Screw	1.34	E23-62KL	SPST NC	Screw	1.54
E23-70H	SPDT	Solder	1.00	E23-70KL	SPDT	Solder	1.20
E23-71H	SPST NO	Solder	.97	E23-71KL	SPST NO	Solder	1.17
E23-72H	SPST NC	Solder	.97	E23-72KL	SPST NC	Solder	1.17
E23-50HL	SPDT	QC	1.00	E23-50P	SPDT	QC	1.55
E23-51HL	SPST NO	QC	.97	E23-51P	SPST NO	QC	1.52
E23-52HL	SPST NC	QC	.97	E23-52P	SPST NC	QC	1.52
E23-60HL	SPDT	Screw	1.51	E23-60P	SPDT	Screw	2.06
E23-61HL	SPST NO	Screw	1.34	E23-61P	SPST NO	Screw	1.89
E23-62HL	SPST NC	Screw	1.34	E23-62P	SPST NC	Screw	1.89
E23-70HL	SPDT	Solder	1.00	E23-70P	SPDT	Solder	1.55
E23-71HL	SPST NO	Solder	.97	E23-71P	SPST NO	Solder	1.52
E23-72HL	SPST NC	Solder	.97	E23-72P	SPST NC	Solder	1.52

Note: To specify E33, 10 amp. series, E34, 15 amp. series or E22, 3 amp. series, merely change the E23 series prefix to the desired series (i.e. E22, E33, E34). Prices on E33 and E34 are the same as the E23 series. The E22 series list prices are 20 cents higher on every switch.

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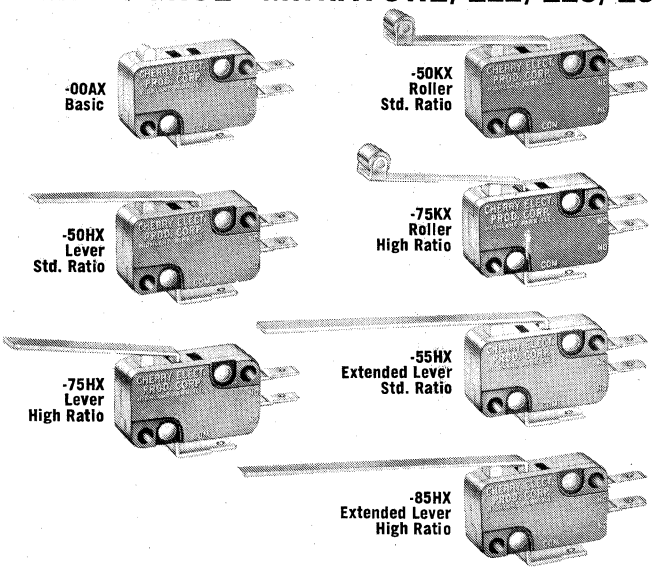
CHERRY

LIGHT FORCE - MINIATURE/E22/E23/E33/E34 SERIES



Added internal actuator increases life range, reduces operating force while maintaining high contact pressure.

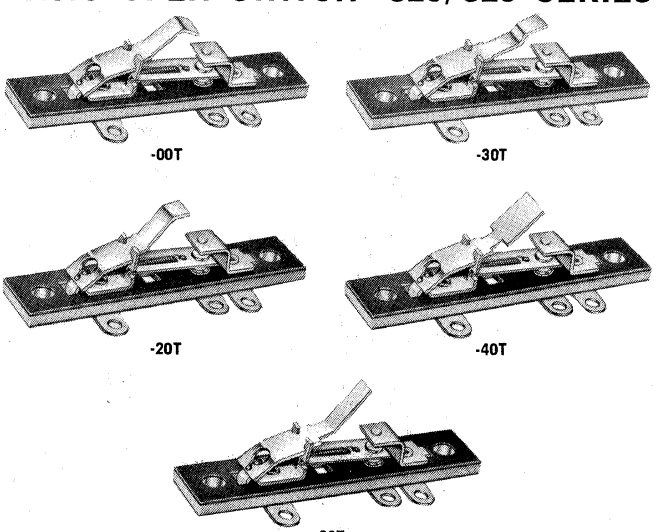
ELECTRICAL RATINGS
3 AMP., 125 VAC
5 AMP., ¼ H.P., 125/250 VAC
10 AMP., ½ H.P., 125/250 VAC
15 AMP., ½ H.P., 125/250 VAC
SWITCH BODY — 13/32" x 5/8" x 13/32"

SERIES	OPERATING FORCE
E22	15 GRAMS, MAX.
E23	45 GRAMS, MAX.
E33	75 GRAMS, MAX.
E34	100 GRAMS, MAX.

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E33-00AX	SPDT	QC	$0.88	E33-75HX	SPDT	QC	$1.03
E33-01AX	SPST NO	QC	.85	E33-76HX	SPST NO	QC	1.00
E33-02AX	SPST NC	QC	.85	E33-77HX	SPST NC	QC	1.00
E33-10AX	SPDT	Screw	1.39	E33-85HX	SPDT	QC	1.08
E33-11AX	SPST NO	Screw	1.22	E33-86HX	SPST NO	QC	1.05
E33-12AX	SPST NC	Screw	1.22	E33-87HX	SPST NC	QC	1.05
E33-20AX	SPDT	Solder	.88	E33-50KX	SPDT	QC	1.23
E33-21AX	SPST NO	Solder	.85	E33-51KX	SPST NO	QC	1.20
E33-22AX	SPST NC	Solder	.85	E33-52KX	SPST NC	QC	1.20
E33-50HX	SPDT	QC	1.03	E33-60KX	SPDT	Screw	1.74
E33-51HX	SPST NO	QC	1.00	E33-61KX	SPST NO	Screw	1.57
E33-52HX	SPST NC	QC	1.00	E33-62KX	SPST NC	Screw	1.57
E33-60HX	SPDT	Screw	1.54	E33-70KX	SPDT	Solder	1.23
E33-61HX	SPST NO	Screw	1.37	E33-71KX	SPST NO	Solder	1.20
E33-62HX	SPST NC	Screw	1.37	E33-72KX	SPST NC	Solder	1.20
E33-70HX	SPDT	Solder	1.03	E33-75KX	SPDT	QC	1.23
E33-71HX	SPST NO	Solder	1.00	E33-76KX	SPST NO	QC	1.20
E33-72HX	SPST NC	Solder	1.00	E33-77KX	SPST NC	QC	1.20
E33-55HX	SPDT	QC	1.08				
E33-56HX	SPST NO	QC	1.05				
E33-57HX	SPST NC	QC	1.05				

Note: To specify 3 amp E22 series, 5 amp E23 series, or 15 amp E34 series merely change the E33 series prefix to the desired series (i.e. E22, E23, E34.) The E23 series is 5¢ more, the E34 series is 12¢ more and the E22 is 20¢ more than the E33 series on every switch.

BASIC OPEN SWITCH - S23/S25 SERIES



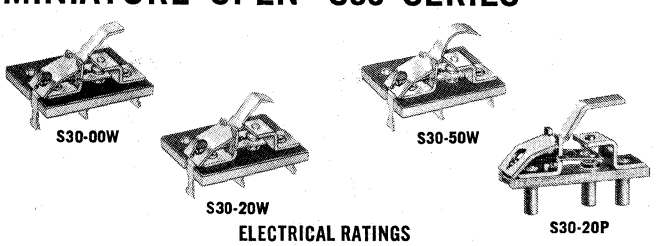
Many variations in actuators, terminals, and panels.

LIGHT FORCE - S23 SERIES — 5 AMPS., 125 VAC
SWITCH PANEL — 2⅛" x 7/16" x 3/32"
STANDARD FORCE - S25 SERIES — 10 AMPS., 125 VAC — 5 AMPS., 250 VAC — ¼ H.P., 125/250 VAC
SWITCH PANEL — 2⅛" x 7/16" x 3/32"

Part No.	Circuitry	Descrip-tion	List Price	Part No.	Circuitry	Descrip-tion	List Price
S23-00T	SPDT	Flat solder	$1.02	S23-30W	SPDT	Int. solder	$1.02
S23-01T	SPST NO	Flat solder	1.02	S23-31W	SPST NO	Int. solder	1.02
S23-02T	SPST NC	Flat solder	1.02	S23-32W	SPST NC	Int. solder	1.02
S23-00Z	SPDT	QC	1.02	S23-40T	SPDT	Flat solder	1.02
S23-01Z	SPST NO	QC	1.02	S23-41T	SPST NO	Flat solder	1.02
S23-02Z	SPST NC	QC	1.02	S23-42T	SPST NC	Flat solder	1.02
S23-00W	SPDT	Int. solder	1.02	S23-40Z	SPDT	QC	1.02
S23-01W	SPST NO	Int. solder	1.02	S23-41Z	SPST NO	QC	1.02
S23-02W	SPST NC	Int. solder	1.02	S23-42Z	SPST NC	QC	1.02
S23-20T	SPDT	Flat solder	1.02	S23-40W	SPDT	Int. solder	1.02
S23-21T	SPST NO	Flat solder	1.02	S23-41W	SPST NO	Int. solder	1.02
S23-22T	SPST NC	Flat solder	1.02	S23-42W	SPST NC	Int. solder	1.02
S23-20Z	SPDT	QC	1.02	S23-60T	SPDT	Flat solder	1.02
S23-21Z	SPST NO	QC	1.02	S23-61T	SPST NO	Flat solder	1.02
S23-22Z	SPST NC	QC	1.02	S23-62T	SPST NC	Flat solder	1.02
S23-20W	SPDT	Int. solder	1.02	S23-60Z	SPDT	QC	1.02
S23-21W	SPST NO	Int. solder	1.02	S23-61Z	SPST NO	QC	1.02
S23-22W	SPST NC	Int. solder	1.02	S23-62Z	SPST NC	QC	1.02
S23-30T	SPDT	Flat solder	1.02	S23-60W	SPDT	Int. solder	1.02
S23-31T	SPST NO	Flat solder	1.02	S23-61W	SPST NO	Int. solder	1.02
S23-32T	SPST NC	Flat solder	1.02	S23-62W	SPST NC	Int. solder	1.02
S23-30Z	SPDT	QC	1.02				
S23-31Z	SPST NO	QC	1.02				
S23-32Z	SPST NC	QC	1.02				

Note: To specify 10 amp. S25 series merely change the S23 prefix to S25. For example, S23-01T SPST NO 5 amp becomes S25-01T SPST NO 10 amp. Prices are the same on S23 and S25 series.

MINIATURE OPEN - S30 SERIES



ELECTRICAL RATINGS
10 AMPS., 125 VAC — 5 AMPS. 250 VAC — ⅛ HP 125/250 VAC
SWITCH PANEL — 1 1/16" x ¾" x 3/32"
Many variations in actuators, terminals, and panels.

Part No.	Circuitry	Descrip-tion	List Price	Part No.	Circuitry	Descrip-tion	List Price
S30-00W	SPDT	Int. solder	$1.02	S30-50W	SPDT	Int. solder	$1.02
S30-01W	SPST NO	Int. solder	1.02	S30-51W	SPST NO	Int. solder	1.02
S30-02W	SPST NC	Int. solder	1.02	S30-52W	SPST NC	Int. solder	1.02
S30-00T	SPDT	Flat solder	1.02	S30-50T	SPDT	Flat solder	1.02
S30-01T	SPST NO	Flat solder	1.02	S30-51T	SPST NO	Flat solder	1.02
S30-02T	SPST NC	Flat solder	1.02	S30-52T	SPST NC	Flat solder	1.02
S30-00Z	SPDT	QC	1.02	S30-50Z	SPDT	QC	1.02
S30-01Z	SPST NO	QC	1.02	S30-51Z	SPST NO	QC	1.02
S30-02Z	SPST NC	QC	1.02	S30-52Z	SPST NC	QC	1.02
S30-20W	SPDT	Int. solder	1.02	S30-20P	SPDT	PC Term.	1.14
S30-21W	SPST NO	Int. solder	1.02	S30-21P	SPST NO	PC Term.	1.14
S30-22W	SPST NC	Int. solder	1.02	S30-22P	SPST NC	PC Term.	1.14
S30-20T	SPDT	Flat solder	1.02	S30-20T	SPDT	Flat solder	1.02
S30-21T	SPST NO	Flat solder	1.02	S30-21T	SPST NO	Flat solder	1.02
S30-22T	SPST NC	Flat solder	1.02	S30-22T	SPST NC	Flat solder	1.02
S30-20Z	SPDT	QC	1.02	S30-50Z	SPDT	QC	1.02
S30-21Z	SPST NO	QC	1.02	S30-51Z	SPST NO	QC	1.02
S30-22Z	SPST NC	QC	1.02	S30-52Z	SPST NC	QC	1.02

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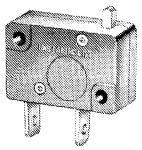
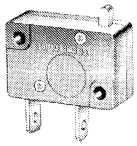
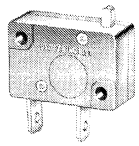
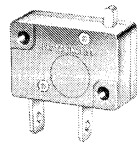
CHERRY

ENCLOSED-SINGLE THROW/E10/E15/E16/E18 SERIES


E10-00M


E15-00M


E16-00M

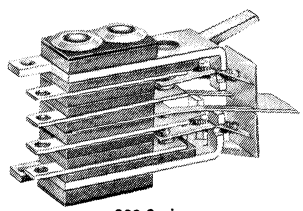

E18-00M

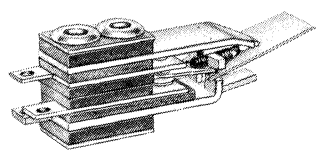
A single pole, single throw switch with light force and large overtravel. Solderable QC ¼" terminals. Switch body: 1⅛" x 47/64" x 7/16".

E10-00M—NC, 10 AMPS., ⅓ H.P., 125 VAC— 5 AMPS., 250 VAC
E15-00M—NC, 6 AMPS., 125 VAC — 3 AMPS., 250 VAC
E16-00M—NO, 2 AMPS., 125 VAC — 1 AMP., 250 VAC
E18-00M—NO, 3¼ AMPS., 125 VAC

Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
E10-00M	SPST NC	$0.91	E16-00M	SPST NO	$0.91
E15-00M	SPST NC	.91	E18-00M	SPST NO	.91

STACK SWITCHES/S36/S37 SERIES


S36 Series
Double Pole


S37 Series
Single Pole

ELECTRICAL RATING:
7½ AMPS., 125 VAC
5 AMPS., 250 VAC

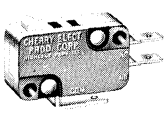
Available in single or double pole with momentary or reset (maintained) contact action.

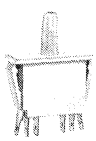
SWITCH BODY: 1 41/64" x 37/64" x 5/16"

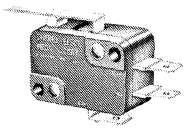
Part No.	Circuitry	List Price	Part No.	Circuitry	List Price
S36-20E	DPDT (R)	$2.40	S37-10E	SPDT (R)	$1.53
S36-21E	DPST NO (R)	2.35	S37-11E	SPST NO (R)	1.50
S36-22E	DPST NC (R)	2.35	S37-12E	SPST NC (R)	1.50
S36-40E	DPDT (M)	2.40	S37-20E	SPDT (M)	1.53
S36-41E	DPST NO (M)	2.35	S37-21E	SPST NO (M)	1.50
S36-42E	DPST NC (M)	2.35	S37-22E	SPST NC (M)	1.50

Note: (R) Denotes reset (maintained) contact action.
(M) Denotes momentary contact action.

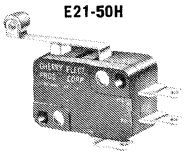
CHERRY GOLD "CROSSPOINT" CONTACT SWITCHES

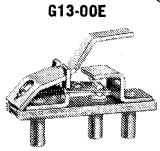

E21-00A

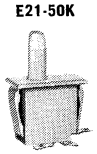

E78-00A

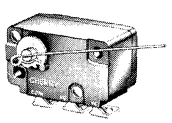

E21-50H

G13-00E

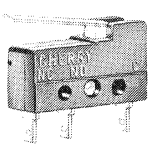

E21-50K

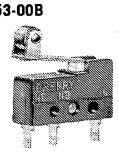

S31-20P


E68-00A

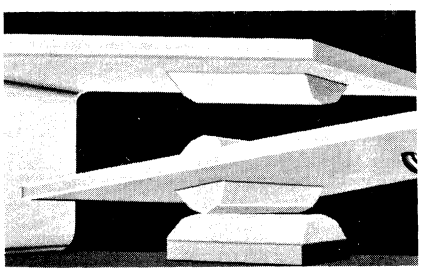

E53-00B

E63-00A


E63-00H


E63-00K

Cherry Gold "Crosspoint" Contact switches are available in a wide variety of switch types and mountings as shown above. These provide extremely low insertion resistance and long life . . . measured in millions of operations. The contact material is W/E Alloy #1 . . . 69% Gold, 25% Silver, 6% Platinum.



For positive switching of low energy solid state circuits.

The Cherry "Crosspoint" contact configuration . . . (two gold contact prisms at right angles to each other) provide maximum contact pressure and minimum hazard of contact closure interference.

Part No.	Circuitry	Terminal	List Price	Part No.	Circuitry	Terminal	List Price
E21-00A	SPDT	QC	$1.57	S31-20P	SPDT	PC	$1.50
E21-01A	SPST NO	QC	1.25	S31-21P	SPST NO	PC	1.18
E21-02A	SPST NC	QC	1.25	S31-22P	SPST NC	PC	1.18
E21-10A	SPDT	Screw	2.08	E53-00B	SPDT		2.76
E21-11A	SPST NO	Screw	1.59	E53-01B	SPST NO		2.76
E21-12A	SPST NC	Screw	1.59	E53-02B	SPST NC		2.76
E21-20A	SPDT	Solder	1.57	E63-00A	SPDT	QC .093"	1.86
E21-21A	SPST NO	Solder	1.25	E63-01A	SPST NO	QC .093"	1.86
E21-22A	SPST NC	Solder	1.25	E63-02A	SPST NC	QC .093"	1.86
E21-50H	SPDT	QC	1.72	E63-10A	SPDT	Solder	1.86
E21-51H	SPST NO	QC	1.40	E63-11A	SPST NO	Solder	1.86
E21-52H	SPST NC	QC	1.40	E63-12A	SPST NC	Solder	1.86
E21-60H	SPDT	Screw	2.23	E63-30A	SPDT	QC .110"	1.86
E21-61H	SPST NO	Screw	1.74	E63-31A	SPST NO	QC .110"	1.86
E21-62H	SPST NC	Screw	1.74	E63-32A	SPST NC	QC .110"	1.86
E21-70H	SPDT	Solder	1.72	E63-00H	SPDT	QC .093"	1.96
E21-71H	SPST NO	Solder	1.40	E63-01H	SPST NO	QC .093"	1.96
E21-72H	SPST NC	Solder	1.40	E63-02H	SPST NC	QC .093"	1.96
E21-50K	SPDT	QC	1.92	E63-10H	SPDT	Solder	1.96
E21-51K	SPST NO	QC	1.60	E63-11H	SPST NO	Solder	1.96
E21-52K	SPST NC	QC	1.60	E63-12H	SPST NC	Solder	1.96
E21-60K	SPDT	Screw	2.43	E63-30H	SPDT	QC .110"	1.96
E21-61K	SPST NO	Screw	1.94	E63-31H	SPST NO	QC .110"	1.96
E21-62K	SPST NC	Screw	1.94	E63-32H	SPST NC	QC .110"	1.96
E21-70K	SPDT	Solder	1.92	E63-00K	SPDT	QC .093"	2.14
E21-71K	SPST NO	Solder	1.60	E63-01K	SPST NO	QC .093"	2.14
E21-72K	SPST NC	Solder	1.60	E63-02K	SPST NC	QC .093"	2.14
E68-00A	SPDT	QC	1.59	E63-10K	SPDT	Solder	2.14
E68-01A	SPST NO	QC	1.59	E63-11K	SPST NO	Solder	2.14
E68-02A	SPST NC	QC	1.59	E63-12K	SPST NC	Solder	2.14
E78-00A	DPDT	QC	2.83	E63-30K	SPDT	QC .110"	2.14
E78-01A	DPST NO	QC	2.83	E63-31K	SPST NO	QC .110"	2.14
E78-02A	DPST NC	QC	2.83	E63-32K	SPST NC	QC .110"	2.14
G13-00E	SPDT	QC	1.39				
G13-01E	SPST NO	QC	1.07				
G13-02E	SPST NC	QC	1.07				

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CHERRY

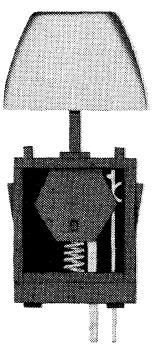
B80-3766
Keyboard enclosure available at nominal extra cost.

KEYBOARD SWITCHES

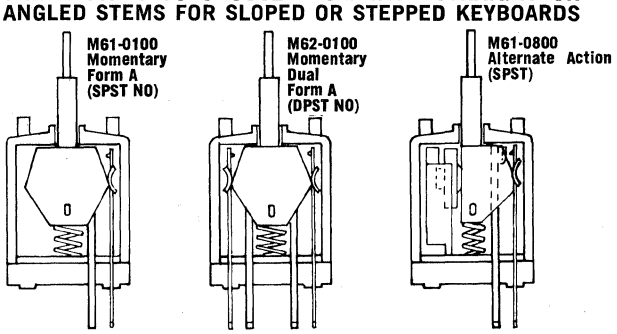
for modern electronic desk top calculators . . . computer terminals . . . credit card validators. NEW Gold "Crosspoint" contact key.

This proven design concept (crossed knife edge contact configuration) provides high force per unit of contact area, and virtually eliminates contact closure interference by contaminates. Contacts are normally held apart for greater shock resistance. No microphonics or bounce during turn-off or at rest.

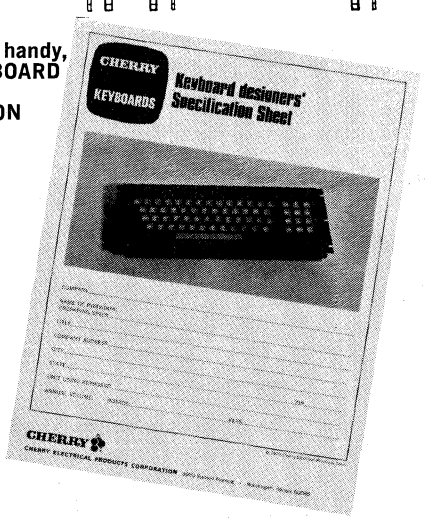
Three types with straight or angled stems for sloped or stepped keyboards.



THREE TYPES TO CHOOSE FROM WITH STRAIGHT OR ANGLED STEMS FOR SLOPED OR STEPPED KEYBOARDS



Write for this handy, six-page KEYBOARD DESIGNERS' SPECIFICATION SHEET



ELECTRONIC DATA ENTRY KEYBOARDS

Straightforward electronics adapt readily to customer specifications. Custom design in mono, dual, tri and quad mode operation are available in volume application with modest engineering, tooling, and art work charges.

Standard units include:

B80-3766, 66 Key Tri Mode ASCII negative logic with provision to add 4 extra keys.

B70-4753, 53 Key Quad Mode ASCII (ASR 33) positive logic.

B65-1712, 12 Key Numeric straight output.

KEYBOARD PRICE LIST

Net Price For Quantity	B80-3766 66-Key ASCII Tri-Mode	B70-4753 53-Key ASCII Quad-Mode	B65-1712 12-Key Numeric Non-Encoded
1 - 9	$228.00 each	$214.00 each	$32.50 each
10 - 24	209.00 each	196.00 each	29.75 each
25 - 49	190.00 each	178.00 each	27.10 each
50 - 99	158.00 each	148.00 each	22.60 each
100 - 249	127.00 each	119.00 each	18.05 each
250 - 499	95.50 each	89.10 each	13.60 each
500 - 999	82.50 each	77.25 each	11.75 each

For prices on quantities greater than shown in price list, consult factory.

KEYBOARD SWITCH PRICE LIST

Net Price For Quantity	M61-0100 Single Form A (SPST NO)	M62-0100 Dual Form A (DPST NO)	M61-0800 Alternate Action (SPST)
1 - 49	$1.27 each	$1.97 each	$1.88 each
50 - 99	0.90 each	1.44 each	1.37 each
100 - 499	0.78 each	1.24 each	1.18 each
500 - 999	0.70 each	1.12 each	1.07 each
1000 - 1999	0.65 each	1.03 each	0.98 each
2000 - 4999	0.57 each	0.91 each	0.87 each
5000 - 9999	0.50 each	0.81 each	0.77 each

8 REASONS YOU SPECIFY CHERRY WITH CONFIDENCE:

1. Cherry keyboard and key switch components as well as assembled keyboards are made under one roof. 2. We make our own printed circuit board. 3. We make our own two-shot molded key caps. 4. We have a large assortment of tooled key cap legends in two type faces and a variety of sizes. 5. We offer a wide choice of standard key cap colors. 6. We install and wave solder the electronics to the pc board. 7. We provide a choice of MOS or TTL. 8. Cherry Keyboards are backed by 20 years experience in the design and manufacture of precision snap-action switches, matrix selector switches, gold "crosspoint" contact switches and leverwheel/thumbwheel switches.

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CHERRY

THUMBWHEEL AND LEVERWHEEL SWITCHES

DISCOUNT SCHEDULE

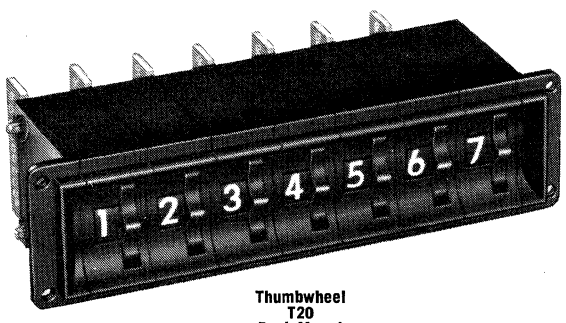
Quantity	Discount	Multiplier
1-49	List	1.00
50-99	20%	.80
100-199	25%	.73
200-499	27%	.73
500-999	30%	.70
1000-1999	32%	.68
2000-4999	34%	.66

For prices on quantities of 5000 pieces and over, consult factory or contact nearest representative.

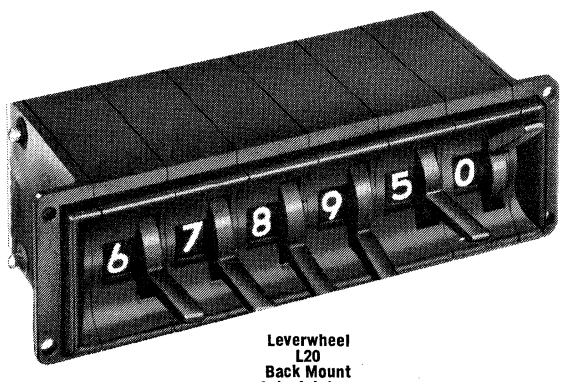
LIST PRICE ADDERS FOR OPTIONS AND SPECIAL FEATURES

Two Sided Printed Circuit Board	$1.25
Special Code	1.00
Extended PC Board (one side)	1.00
Spacers ¼" or ½" (blank, gloss or matte)	0.50
Adding Symbol to Spacer	0.50
Adding Stops (per switch)	0.75
Matte Finish (per switch)	0.30
End Caps (per set)	0.80
Assembly of Modules labor only, no parts) for first switch — $0.30 each additional switch or spacer in the Module ($3.00 maximum)	$0.50
Assembly Hardware (per set-unassembled)	0.50

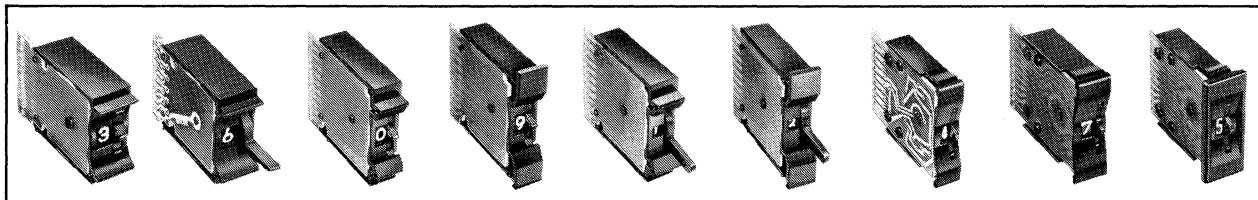
Thumbwheel and Leverwheel switches are available in nine basic configurations — in a broad range of coded outputs — in individual digits — in assemblies of several digits mounted side-by-side complete with end caps — in gloss or matte finish. T71 Series Decimal Point switch for calculators not listed in table below is available in all the same output codes shown for T60 and T70 except Hexadecimal. For complete information and prices on T71, consult factory.



Thumbwheel
T20
Back Mount
Subminiature
7 Gang Assembly



Leverwheel
L20
Back Mount
Subminiature
6 Gang Assembly



T20 L20 T10 T11 L10 L11 T60 T70 T71

Note: All list prices shown in the following table are subject to discount schedule shown above.

Suffix No.	Position	Description	Readout	T20	L20	T10	T11	L10	L11	T60	T70
-94A	2	Single pole, repeating	(−,+)	$4.00	$5.00	$4.50	$4.50	$5.00	$5.00	$3.50	$3.50
-95A	2	Single pole, repeating	(0-1)	4.00	5.00	4.50	4.50	5.00	5.00	3.50	3.50
-96A	2	Single pole, repeating	(0-5)	4.00	5.00	4.50	4.50	5.00	5.00	3.50	3.50
-97A	2	Double Pole, Repeating	(+, 1)							4.50	4.50
-07A	8	Binary Coded Octal	(0-7)	4.00	5.00	5.00	5.00	5.50	5.50	3.50	3.50
-47A	8	BCO with separate common To not true bits	(0-7)	7.50	8.50						
-17A	8	Decimal	(0-7)	4.00	5.00						
-57A	8	BCO with diode provision	(0-7)	5.00	6.00						
-77A	8	BCO complement only	(0-7)	4.50	5.50					4.00	4.00
-01A	10	Decimal	(0-9)	4.00	5.00	4.50	4.50	5.10	5.10	3.00	3.00
-11A	10	Double pole decimal	(0-9)	8.60	9.20	8.60	8.60	9.20	9.20		
-69A	10	Decimal	(0-9)	4.00	5.00						
-02A	10	Binary Coded Decimal	(0-9)	4.00	5.00	4.50	4.50	5.10	5.10	3.00	3.00
-04A	10	BCD plus complement, 1 common	(0-9)	5.00	6.00	6.80	6.80	7.80	7.80	4.00	4.00
-05A	10	BCD plus complement, 2 commons	(0-9)					9.50	9.50		
-06A	10	BCD plus odd parity	(0-9)	5.15	6.10					5.00	5.00

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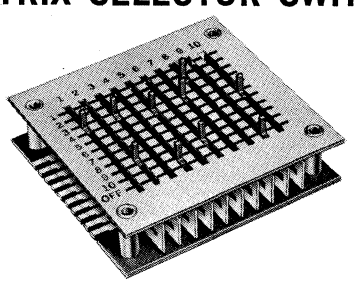
CHERRY

THUMBWHEEL AND LEVERWHEEL SWITCHES (Cont'd.)

Suffix No.	Position	Description	Readout	T20	L20	T10	T11	L10	L11	T60	T70
-10A	10	BCD plus even parity	(0-9)	$5.15	$6.10			$7.10	$7.10	$5.00	$5.00
-12A	10	BCD complement only	(0-9)	4.50	5.50					4.00	4.00
-15A	10	BCD with separate common To not true bits	(0-9)	7.50	8.50						
-14A	10	9's complement of BCD	(0-9)	5.00	6.00						
-52A	10	BCD with diode provisions	(0-0)	5.00	6.00	$5.50	$5.50			4.00	4.00
-54A	10	BCD plus complement, 1 common with diode provision	(0-9)	6.00	7.00	7.80	7.80				
-68A	10	Two out of five code with diode provision	(0-9)	6.00	7.00						
-72A	10	Complement of 9's complement with diode provision	(0-9)	6.00	7.00						
-65A	10	Kelvin-Varley voltage divider	(0-9)	8.50	9.50						
-67A	10	1-2-2-2-2 resistive decade	(0-9)	8.00	9.00						
-20A	12	Decimal	(0-11)		5.00						
-03A	16	Hexadecimal	(0-15)	6.50		7.50	7.50			5.50	5.50
-08A	16	Hexadecimal plus complement, 1 common	(0-15)	7.50		8.50	8.50				
-09A	16	Hexadecimal plus complement, 2 commons	(0-15)	8.50		9.50	9.50				
-13A	16	Hexadecimal	(0-9,A-F)	6.50		7.50	7.50			5.50	5.50
-53A	16	Hexadecimal with diode provision	(0-15)	7.50							
-19A	16	Hexadecimal plus complement, 2 commons	(0-9,A-F)			9.50	9.50				
-63	16	Hexadecimal with diode provision	(0-9,A-F)	7.50							
-88A	16	Hexadecimal plus complement, 1 common	(0-9,A-F)	7.50							
-89A	16	Hexadecimal plus complement, 2 commons	(0-9,A-F)	8.50							
-50A	10	Excess 3 gray code positive	(0-9)							5.00	5.00
-49A	10	Excess 3 gray code negative	(0-9)							5.00	5.00
-70A	10	Aiken code 1-2-4-2	(0-9)							5.00	5.00
-71A	10	Aiken code modern 1-2-4-2	(0-9)							5.00	5.00

(Note: T71 Integral Bezel Decimal Point Set Thumbwheel is available in output codes same as all T60 and T70 except it is not available in Hexadecimal.)

MATRIX SELECTOR SWITCH



Manual programming and switching for complex control equipment. Each of two standard types is expandable up to five modules, providing 500 to 1,000 crosspoints. Custom design available up to 2,784 crosspoints.

Electrical capacity:

1. Make and break 48 volts DC at 0.50 Amp. 125 Volts AC at 0.15 Amp.
2. Current carrying only (no make and break) 2 Amp. AC or DC.

Insertion Resistances:

50 milliohms plus 6 milliohms per inch of printed circuit.

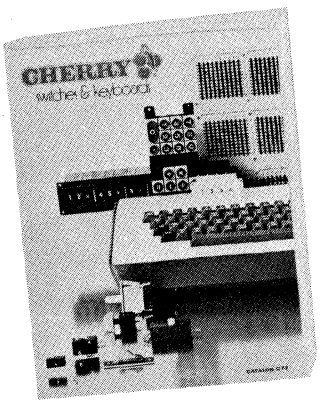
Note: Overall width of basic 10 x 10 and 20 x 10 Selector Switch is 3½ inches. For each 10 sliders added to the basic unit add 3 inches to overall width. A 20 slider unit measures 6½ inches wide; a 30 slider unit measures 9½ inches wide; a 40 slider unit measures 12½ inches wide and a 50 slider unit measures 15½ inches wide.

DISCOUNT SCHEDULE

Quantity	Discount	Multiplier
1-9	List	1.00
10-24	10%	0.90
25-49	15%	0.85
50-99	20%	0.80
100-249	25%	0.75
250-499	30%	0.70

For quantities of 500 and over consult factory or contact nearest representative.

Switch No.	Circuitry	List Price	Switch No.	Circuitry	List Price
C10-01A	20 x 10	$35.00	C10-20A	10 x 10	$25.00
C10-02A	20 x 20	40.00	C10-42A	10 x 20	32.50
C10-03A	20 x 30	60.00	C10-43A	10 x 30	43.00
C10-04A	20 x 40	65.00	C10-44A	10 x 40	55.00
C10-05A	20 x 50	75.00	C10-45A	10 x 50	67.00
			C10-56A	48 x 58	204.00



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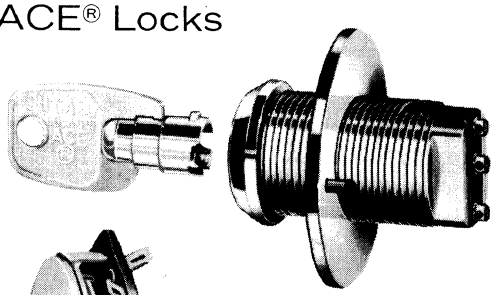
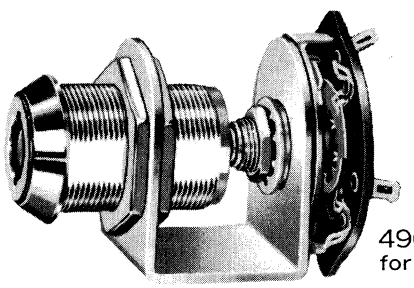
CHICAGO LOCK...
Your Complete Source For Switch Locks

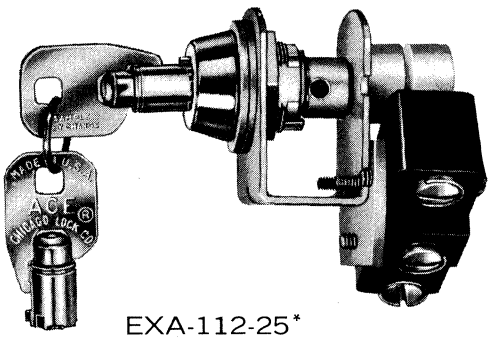
4900 SERIES Underwriters Listed ACE® Locks

No. 4901
SPDT Switch Lock



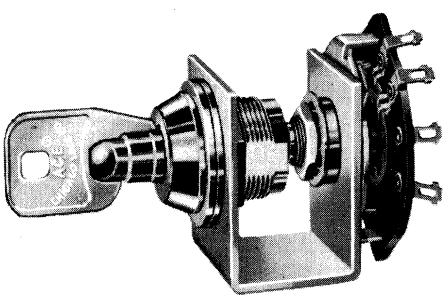


4903 Wafer switch lock for complex circuits



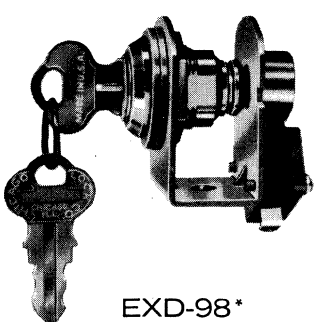
EXA-112-25*
Heavy duty switch lock
Switch SPDT; 25 amps; 125, 250 or 480 VAC; UL and CSA listed.
Multi-pole also available.

Chicago ACE® Locks provide maximum security with registered key series if desired.

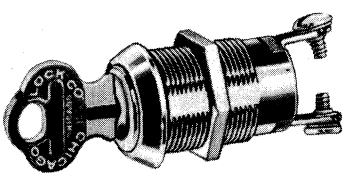


*4188 ACE® lock and wafer switch, can be furnished with double bitted lock Spec. 2242

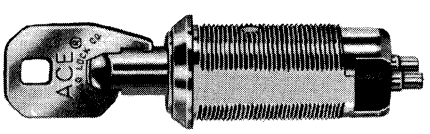
*Wafer switches will permit various circuit combinations



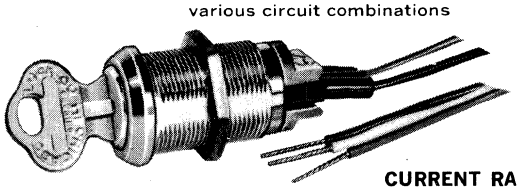
EXD-98*
Heavy duty switch lock
Multi-pole available.
UL listed switch.



2174 (SPST)
Double bitted lock with screw terminals
For momentary contact, spring return, specify 2174-70



4073 Basic ACE® (SPST) switch lock



3535 Double bitted lock with UL listed SPDT switch
Also furnish with ACE LOCK—Part No. 4235

SWITCH CONTACT RATINGS

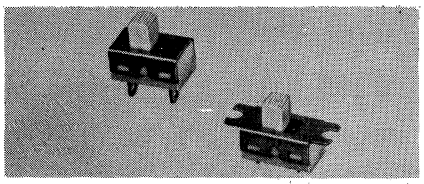
CURRENT RATINGS	LOCK NUMBER
125-250V AC— 5 AMP 30V DC— 3 AMP	4901—4902 Silver Plated Contacts
125-250V AC— 7 AMP 28V DC— 7 AMP	3535—3535A—4235 Silver Plated Contacts
110-120V AC—10 AMP 10V DC—10 AMP	2174—2174-70—3039—4101—4073—4079
125-250V AC—10 AMP 125V DC—½ AMP	EXD-98—EXA-112

*When ordering, specify if for appliance requiring T.V. approved switches. Only available on EXD-98 or EXA-112 series.

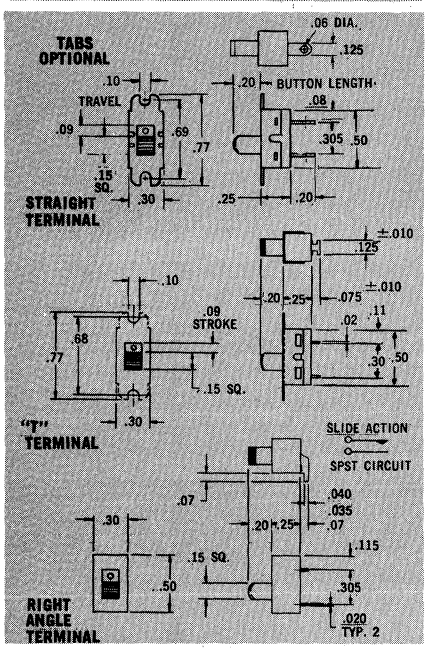
CHICAGO LOCK CO.
4275 W. Belmont Ave. • Chicago, Ill. 60641

For further data on the above locks, write for catalog.

the mini mike line



low bounce spst-slide action switches-maintained



Specifications

Stroke: .085"

Operating Force: 300 - 500 Grams

Mechanical Life: 500,000 Actuations

Contact Rating: 2.5 Amps Inductive at 125 VAC.

Contact Bounce: 0.5 Milliseconds

Contact Resistance: 0.02 ohms Max. Initially

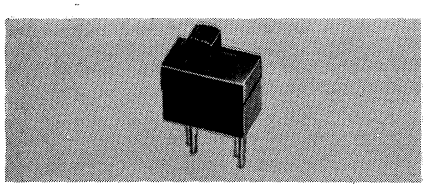
Breakdown Voltage: 1500 V, 60 Hz.

Contact Material: Hard Gold

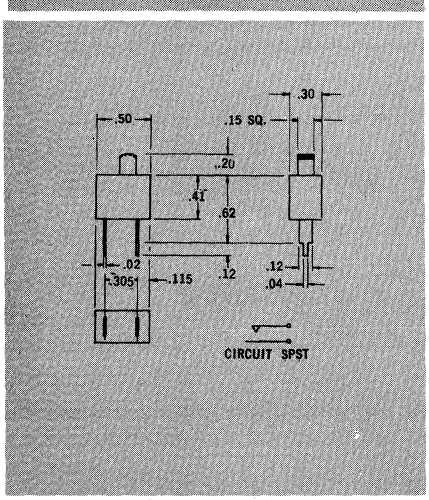
Temperature Range: −40°C to +100°C

Part Number	Terminal Type	Panel Mtg. Tabs	Button Height	Button Color	Terminal Length
23-021-013	Straight	No	.20	Black	.20
23-021-017	Straight	Yes	.20	Black	.20
23-021-019	Straight	Yes	.20	White	.20
23-021-020	Straight	No	.20	White	.20
23-021-023	"T"	Yes	.20	White	.08
23-021-024	"T"	No	.20	White	.08
23-021-025	"T"	Yes	.20	Black	.08
23-021-026	"T"	No	.20	Black	.08
23-021-031	Rt. Angle	No	.20	Black	.07
23-021-032	Rt. Angle	Yes	.20	Black	.07
23-021-033	Rt. Angle	No	.20	White	.07
23-021-034	Rt. Angle	Yes	.20	White	.07
23-021-040	P.C.	No	.20	Black	.12

Consult factory for other versions.



low bounce spst slide action switches for p-c applications momentary (spring return) or maintained



Specifications

Stroke: .085"

Operating Force: 150 - 300 Grams

Mechanical Life: 500,000 Actuations

Contact Material: Hard Gold

Contact Rating: 2.5 Amps Inductive at 125 VAC.

Contact Bounce: 0.5 Milliseconds

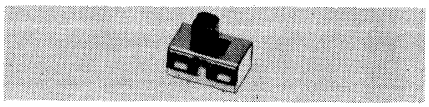
Contact Resistance: 0.02 ohms Max. Initially

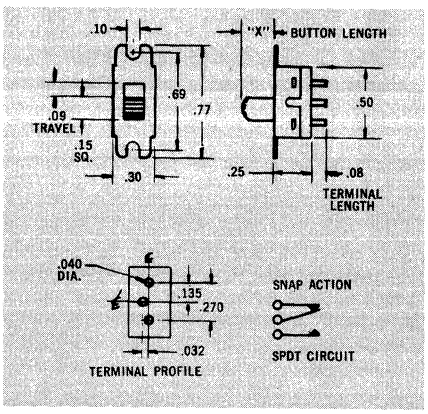
Breakdown Voltage: 1500 V, 60 Hz.

Temperature Range: −40°C to +100°C

Part Number	Type	Button Height	Button Color	Terminal Length
23-021-601	Momentary	.20	Black	.12
23-021-602	Maintained	.20	Black	.12

the mini mike line



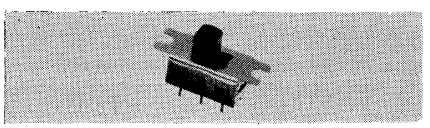


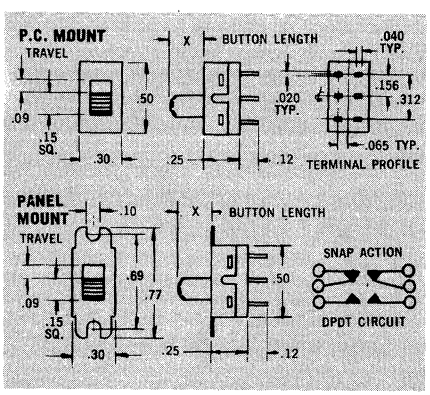
spdt-slide switches with snap action contacts

Specifications

Stroke: .085"
Operating Force: 300 - 500 Grams
Mechanical Life: 1,000,000 Actuations
Contact Material: Hard Gold
Contact Rating: 0.5 Amps Resistive at 125 VAC
Contact Bounce: 1 Millisecond Max.
Contact Resistance: 0.02 ohms Max. Initially
Breakdown Voltage: 1500 V, 60 Hz.
Temperature Range: −40°C to +100°C

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length	Contacts
23-021-103	Panel	.20	Black	.08	Gold
23-021-105	P.C.	.20	Black	.12	Gold
23-021-106	P.C.	.20	Black	.08	Gold
23-021-109	Panel	.25	Black	.12	Gold
23-021-112	Panel	.20	Black	.12	Gold
23-021-126	P.C.	.20	White	.12	Gold
23-021-127	Panel	.20	White	.12	Gold





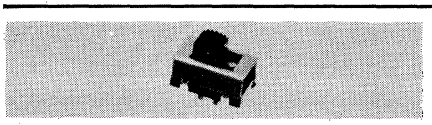
dpdt slide switches with snap action contacts

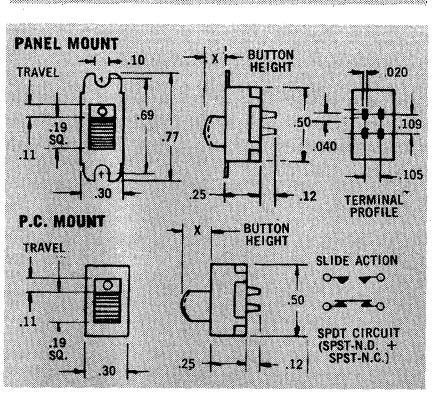
Specifications

Stroke: .085"
Operating Force: 300 - 500 Grams
Mechanical Life: 1,000,000 Actuations
Contact Material: Hard Gold
Contact Rating: 0.5 Amps Resistive at 125 VAC
Contact Bounce: 2 Milliseconds Max.
Contact Resistance: 0.02 ohms Max. Initially
Breakdown Voltage: 1000 V, 60 Hz.
Temperature Range: −40°C to +100°C

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length
23-021-113	Panel	.20	Black	.12
23-021-114	P.C.	.20	Black	.12
23-021-117	P.C.	.20	Black	.12
23-021-118*	Panel	.25	Black	.12
23-021-124	Panel	.20	White	.12
23-021-125	P.C.	.20	White	.12
23-021-303**	P.C.	.20	White	.12

*White Dot
** Insert molded pins. Consult factory for details.





spdt 4 terminal "form z" slide switches spst, no + spst, nc "alternate circuit" slide switches

Specifications

Stroke: .120"
Operating Force: 100 - 500 Grams
Life: 50,000 Actuations at 9 volts DC 10 ma.
Contact Rating: 0.5 Amp Resistive at 125 VAC
Contact Material: Hard Gold
Contact Resistance: 0.02 ohms Max. Initially
Breakdown Voltage: 250 V, 60 Hz.
Temperature Range: −54°C to +177°C

Part Number	Mounting	"X" Button Height	Button Color	Terminal Length	Contacts
23-021-005	P.C.	.20	Black	.12	Gold
23-021-006	Panel	.14	Black	.12	Gold
23-021-008	P.C.	.14	Black	.12	Gold
23-021-009	Panel	.20	Black	.12	Gold
23-021-016	Panel	.14	Black	.12	Heavy Gold
23-021-027*	Panel	.14	Black	.12	Gold

*High Actuation Force

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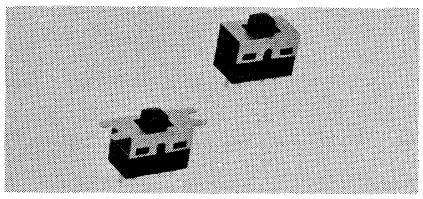
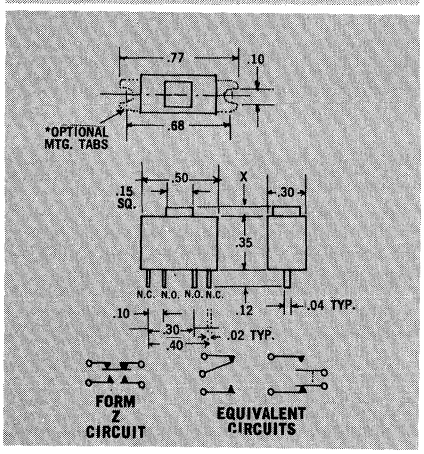
tapit™ keyboard subminiature push-button switch





4 terminal printed circuit mounting momentary switch with bi-furcated contacts for high-reliability

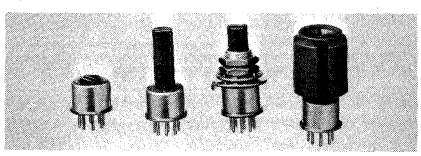
Specifications

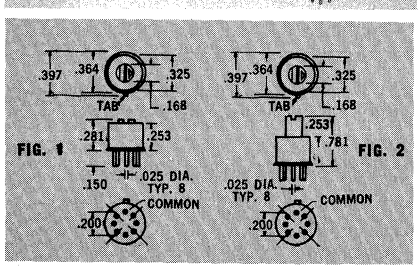
Circuit: SPST-NO +SPST-NC "Form Z" alternate circuits
Stroke: .080"
Operating Force: 3 Oz.
Electrical Life: 10,000,000 actuations
Contact Material: Hard Gold plated over nickel barrier.
Contact Rating: 50 milliamps resistive at 12 VDC
Contact Resistance: 0.05 ohms initially
Temperature Range: −40°C to +100°C

Part Number	Description	"X"* Button Height	Stroke
34-500-001	With Mounting Tabs	.093	.080
34-500-002	P.C. Mount	.093	.080
34-500-003	With Mounting Tabs	.680	.080
34-500-004	P.C. Mount	.680	.080

*Other Button Heights Available Upon Request

TO-5 rotary spasaver™ switch





Specifications

Circuit: SP7T, 8 position max., one position off. Off position indicated by tab on header flange.
Contacts: Hard Gold plated over nickel barrier.
Contact Rating: 100 ma resistive at 5 VDC
Leakage Resistance: 100 Megohms Min.
Breakdown Voltage: 500 Volts RMS.
Contact Resistance: 0.05 ohms Max. Initially
Actuation: Bidirectional, stops available
Leakage Resistance: 100 Megohms Min.

Part Number	Shaft Length	Description
30-000-002	.030	8 position 7 live
30-000-003	.500	8 position 7 live
30-000-006	.180	8 position 7 live
30-400-002	.030	4 position all live
30-400-003	.500	4 position all live
30-400-006	.180	4 position all live
30-500-002	.030	5 position all live
30-500-003	.500	5 position all live
30-500-006	.180	5 position all live
30-900-002	.030	DPDT Rotary
30-900-003	.500	DPDT Rotary
30-900-006	.180	DPDT Rotary

Consult factory for optional:

- Terminal configurations
- Shaft length
- Actuation knobs
- Thumb wheels
- Threaded mounting bushings ¼-40

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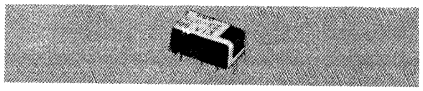
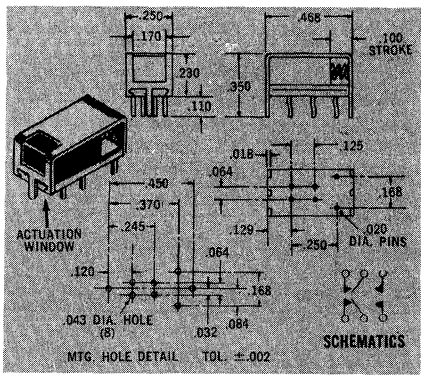
module series



momentary subminiature slide switch-spdt or dpdt



Specifications

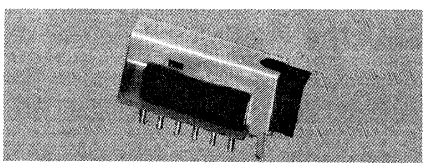
Stroke: .090"
Operating Force: 16 oz.
Life: 150,000 actuations
Contacts*: Solid Silver

Contact Rating: 250 Milliamps resistive at 9 VDC

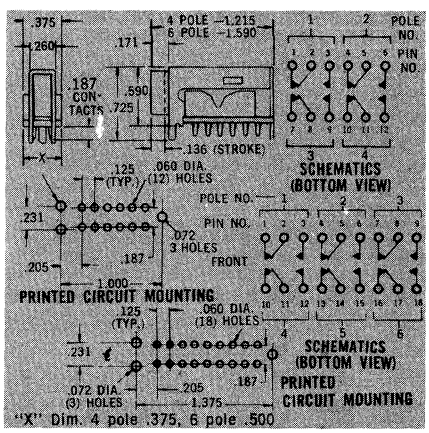
Contact Resistance: 0.01 ohms Max. Initially
Leakage Resistance: 10,000 megohms Min.
Voltage Breakdown: 250 VRMS, 60 Hz.
Temperature Rang:e −30°C to +65°C
Humidity: 200 Hrs. at 90% Relative and 40°C

Part Number	Description
23-020-002	Fine Silver Contacts, DPDT
23-020-003	Fine Silver Contacts, SPDT

* Special contact material available on request.



4 pdt and 6 pdt, p-c mount



Specifications

Stroke: .136"
Mechanical Life: 5,000,000 actuations
Contact Rating: 0.5 Amp Resistive at 50 VDC
Contact Resistance: .025 ohms, Max. Initially

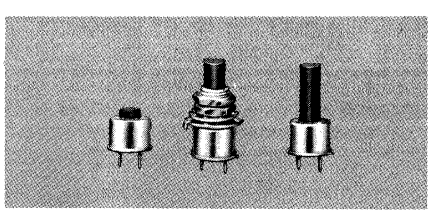
Contacts: Hard Gold
Leakage Resistance: 10,000 megohms Min.
Temperature Range: −30°C to +150°C
Humidity: 96 hrs. at 90% Relative and 35°C

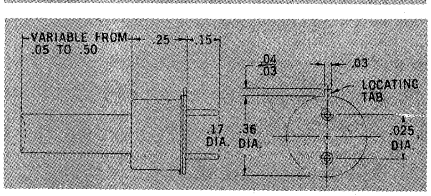
Part No. Identification Chart

Shown below are non-shorting (break before make) variations only. All shorting (make before break) and combinations of shorting and non-shorting are available.

Part Number	Poles	Description
23-004-000	4	Momentary Action, Basic Switch Module, Plug-In
23-006-000	6	Momentary Action, Basic Switch Module, Plug-In
23-010-000	4	Push-On — Push-Off, Alternate Action, Plug-In
23-011-000	6	Push-On — Push-Off, Alternate Action, Plug-In
23-012-000	4	Push Button, Panel Mount, Momentary, Round Button
23-013-000	6	Push Button, Panel Mount, Momentary, Round Button
23-016-000	4	Push-On, Push-Off, Panel Mount, Round Button
23-017-000	6	Push-On, Push-Off, Panel Mount, Round Button
23-024-000	4	Rocker Actuated, Momentary, Plug-In
23-025-000	6	Rocker Actuated, Momentary, Plug-In
23-026-000	4	Rocker Actuated, Push-On, Push-Off, Plug-In
23-027-000	6	Rocker Actuated, Push-On, Push-Off, Plug-In

TO-5 pushbutton spasaver™ switch





Specifications

Circuit: SPST-NO momentary
Contacts: Gold
Contact Rating: 100 ma resistive at 6 VDC
Contact Resistance: 50 milliohms Max. initially
Breakdown Voltage: 1000 Volts RMS, 60 Hz
Leakage Resistance: 100 Megohms, Min.
Actuation Force: 100 grams standard

Part Number	Shaft Length	Description
34-550-001	.060	SPST-NO momentary
34-550-002	.500	SPST-NO momentary

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

CHICAGO SWITCH, INC. / 2035 WABANSIA / CHICAGO, ILLINOIS 60647 / (312) 489-5500

klipsocket™

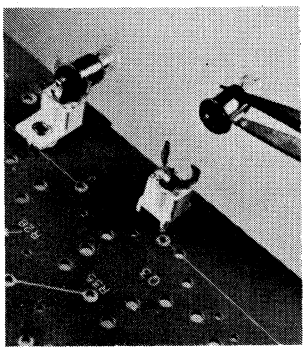
For all T-1¾ Midget Flange Based Incandescent and Neon lamps.

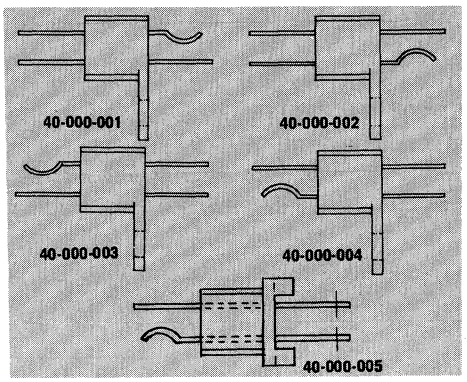
Engage and disengage from the lamp base with a snap. Terminals are designed for soldering or quick-connectors such a: AMP terminal no. 61005-1.

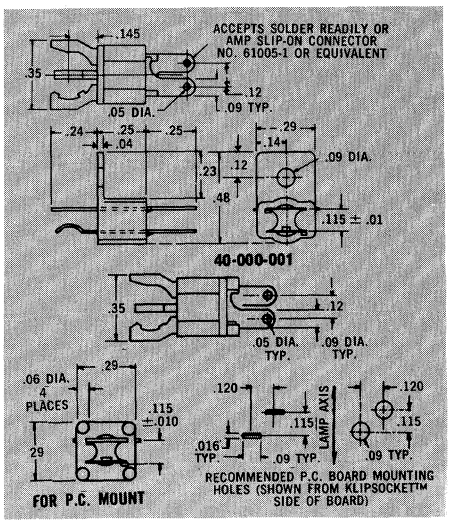
Specifications

Holding Force: 1 lb. Min.

Breakdown Voltage: 2000 V, 60 Hz.







leaf and snap switches

leaf switches

Chicago Switch custom designed leaf switches provide for low-cost, long life switching in phonographs, hi-fi's, radios, tv's, computers, business machines, electronic organs, vending machines, and appliances. Following are just a few "standards" that are available. We would be pleased to custom-design standard switches to fit your application — without costly retooling or special designing. Because of our engineering, production and design facilities — and the versatility of our tooling — you can get the exact leaf switch to meet your requirements.

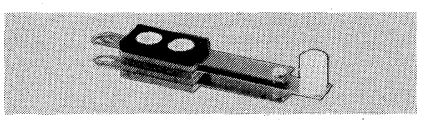
Actuation can be furnished in cam, roller, push button, rotor actuated — or any mechanical situation you require.

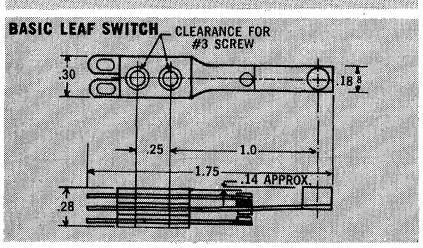
Contacts and lifters can be located on your switch anywhere along the blade length with increments of .001 of an inch, if necessary.

Contacts can be made of palladium, gold, silver, silver cadmium 90-10, silver-plated — whatever material will do the best job.

Blade profile — Most industry standards and many specials are available from stock. Any profile can be made to your specifications. Blade material can be any of either the standard or exotic materials.

No matter what your requirements — Chicago Switch has the experience and facilities to produce leaf switches for you on both large and small orders — switches that are guaranteed to perform and produce to blueprint.





Specifications

Stroke: .125″

Contacts: Fine Silver

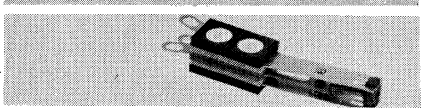
Contact Rating: 3 Amps, 120 V, 60 Hz, 360 watts resistive

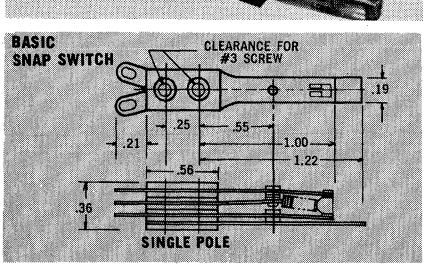
Voltage Breakdown: 1000 VRMS, 60 Hz

Contact Arrangements: May be stacked in any combination

Part No.	Contact Form
20-001-333	SPST-NO (1A)
20-001-334	SPST-NC (1B)
20-001-335	SPDT (1C)

snap switches





Specifications

Contacts: Silver Cad. Oxide

Contact Rating: 5 Amps Inductive at 120 VAC, 60 Hz

Voltage Breakdown: 500 VRMS, 60 Hz

Transfer Time: 4 ms Max.

Actuating Force: 60 grams Max. per pole

Operating differential: .031″ (single pole)

Variations Available:
- Low energy switching
- Maintained
- Low Bounce

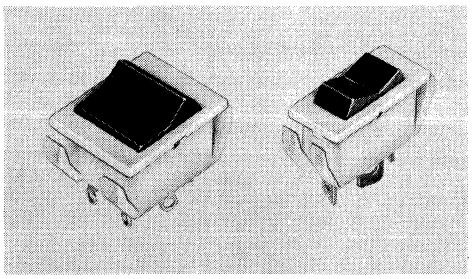
Part No.	Contact Form
20-000-051	SPDT (1C)
20-000-052	DPDT (2C)
20-000-053	3PDT (3C)

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

rocker switches

series 26 — small case
series 27 — large case

- Snap-In Installation
- Attractive Styling
- U/L Listed (26 Series)
- Matching lighted switches and panel lights available.
- Special colors, hot stamping and metal bezels available.
- Compact size, numbered terminals.
- Solder, Screw or slip-on terminals.



Specifications

Contact Rating: 26 Series — 10 Amps inductive at 120 VAC
27 Series—6 Amps inductive at 120 VAC
Breakdown Voltage: 2000V, 60 Hz. Min.
Features: Heavy Duty versions available

Codes common to both 26-Series & 27-Series

TERMINAL CODE	ROCKER COLOR CODE	CASE COLOR CODE
0 — ¼" wide slip-on	0 — White	0 — White
1 — Screw	2 — Red	1 — CHROME BEZEL
2 — Solder	4 — Ivory	2 — Red
6 — 3/16" wide slip-on	5 — Green	3 — GOLD BEZEL
	6 — Light Blue	4 — Ivory
	8 — Gray	5 — Green
	9 — Black	6 — Light Blue
		8 — Gray
		9 — Black

How to order:

Small Case Versions

26-XXX-10X

TERMINAL CODE
ROCKER CODE
CIRCUIT CODE
CASE CODE

26-Series Circuit Code

0 — SPST on-off
1 — SPST N.O. Momentary-on
2 — SPDT Maintained
3 — SPDT Momentary
4 — SPDT 3 Position Center-off
5 — SPST N.C. Momentary-off
6 — SPDT 3-Position Center-off Momentary-both sides
7 — SPST On-Off, terminals in slots #1 and #3
8 — Refer to lighted rocker switch series
9 — SPDT 3-Position Center-off Momentary-one side

Large Case Versions

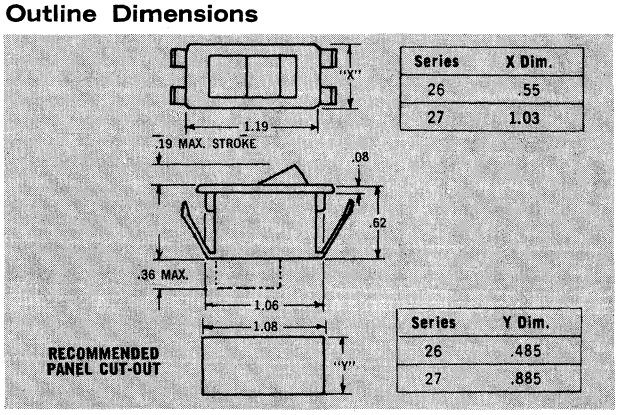
27-1XX-XXX

CIRCUIT CODE
TERMINAL CODE
CASE CODE
ROCKER CODE

27-Series Circuit Code

00 — SPST on-off
01 — SPST N.O. Momentary-on
02 — SPDT Maintained
03 — SPDT Momentary
04 — SPDT 3 Position Center-off
05 — SPST N.C. Momentary-off
06 — SPDT 3-Position Center-off Momentary-both sides
10 — DPST On-Off
11 — DPST N.O. Momentary On
12 — DPDT Maintained
13 — DPDT Momentary
14 — DPDT 3 Position Center-off
15 — DPST N.C. Momentary-Off
16 — DPDT 3 Position Center-off Momentary-both sides

Outline Dimensions



Series	X Dim.
26	.55
27	1.03

Series	Y Dim.
26	.485
27	.885

Panel Thickness: Snaps into panels from .031" to .125" thick.

Also Available:

- Two switches in one case. Specify by two part numbers. Such as "26-290-102 + 26-280-103." Panel cutout 1.08" x .96".
- Switch plus a lens in one case.

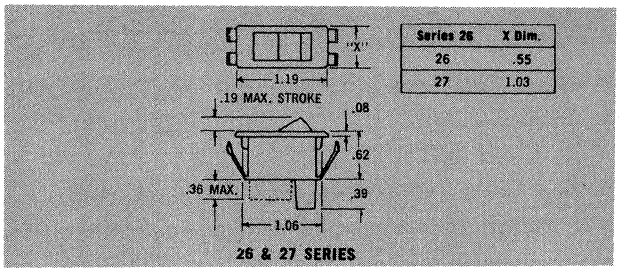
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

lighted rocker switches

series 26 (neon & incandescent) series 27 (incandescent)

- Snap in Installation
- Positive Actuation
- Silver Cadmium Contacts
- Available with slip-on connectors, solder lugs, screw terminals, metal bezels and in heavy duty versions.

Outline Dimensions



Series 26	X Dim.
26	.55
27	1.03

MOUNTING HOLE: Same as Unlighted Switches

HOW to order: 26 Series Small Case Version

26-XXX-XX8

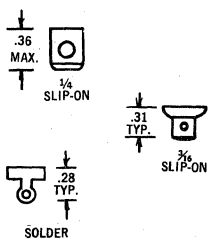
TERMINAL CODE
ROCKER CODE
CASE CODE
LAMP CODE
CIRCUIT CODE

CIRCUIT CODE
1 — SPST on-off
3 — SPST N.O. momentary-on
4 — SPST N.C. momentary-off

ROCKER COLOR CODE
0 — Serrated White
1 — Smooth White
2 — Serrated Red
3 — Smooth Clear
4 — Serrated Amber
5 — Serrated Green
6 — Smooth Amber
7 — Smooth Red
8 — Serrated Clear
9 — Smooth Green

CASE COLOR CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light blue
8 — Gray
9 — Black

TERMINAL CODE
0 — ¼" slip-on
1 — Screw
2 — Solder
6 — 3/16" slip-on
8 — Special small-size on-off switch; see Series No. 26-8



HOW to order: 27 Series Large Case Version

27-XXX-XXX

CIRCUIT CODE
LAMP CODE
CASE CODE
ROCKER CODE
TERMINAL CODE

CIRCUIT CODE
70 — SPST on-off
71 — SPST N.O. momentary-on
72 — SPDT maintained
73 — SPDT momentary
74 — SPDT 3-position center-off
75 — SPST N.C. momentary-off
76 — SPDT 3-position momentary-both sides
80 — DPST on-off
81 — DPST N.O. momentary-on
85 — DPST N.C. momentary-off

LAMP CODE
2 — 4-6V incandescent & standard termination*
3 — 18-28V incandescent & standard termination*
4 — 9-14V incandescent & standard termination*
6 — NE2H neon & 22K resistor, insulated leads on lamp
7 — NE2H neon & 68K resistor, insulated leads on lamp
8 — NE2H neon & 33K resistor, insulated leads on lamp
9 — NO LAMP

* Standard Lamp Terminations: Klipsocket 40-000-001 on incandescents, no lamp leads on "lightable" (no-lamp) versions.

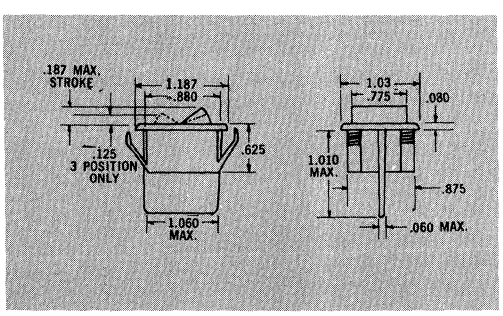
series 27-3-spdt-lighted

With lamp inside case (neon).

How to order:

27-3XX-XXX

CIRCUIT CODE
LAMP CODE
TERMINAL CODE
ROCKER CODE
CASE CODE



CIRCUIT CODE
0 — SPST (on-off)
1 — SPST N.O. momentary-on
2 — SPDT
3 — SPDT momentary
4 — SPDT 3-position center-off
5 — SPST N.C. momentary-off
6 — SPDT 3-position center-off momentary-both sides
7 — SPDT 3-position center-off momentary-one side
8 — DPST
9 — DPST N.O. momentary-on

CASE CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

ROCKER CODE
0 — Serrated White
1 — Smooth White
2 — Serrated Red
3 — Smooth Clear
4 — Serrated Amber
6 — Smooth Amber
7 — Smooth Red
8 — Serrated Clear

TERMINAL CODE
0 — ¼" wide Slip-On
1 — Screw
2 — Solder
6 — 3/16" wide Slip-On

LAMP CODE
0 — 110V Neon
1 — 220V Neon
6 — 380V Neon

series 26-8

Lighted, Shallow Depth. (neon)

- Same features and electrical specs. as standard lighted switches.
- Same outline and mounting dimensions as standard unlighted switches.

How to order:

26-8XX-XXX

CIRCUIT CODE
LAMP CODE
TERMINAL CODE
CASE CODE
ROCKER CODE

CIRCUIT CODE
8 — SPST on-off

ROCKER CODE
0 — Serrated White
1 — Smooth White
2 — Serrated Red
3 — Smooth Clear
4 — Serrated Amber
6 — Smooth Amber
7 — Smooth Red
8 — Serrated Clear

TERMINAL CODE
0 — ¼" wide slip-on
1 — Screw
2 — Solder
6 — 3/16" wide slip-on

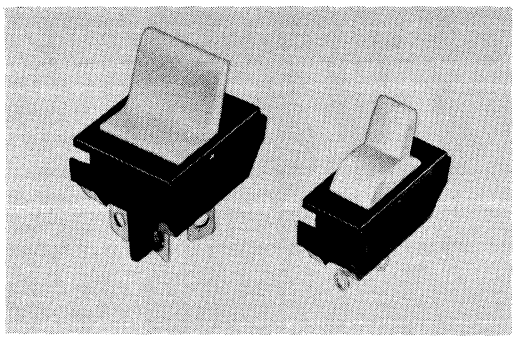
CASE CODE
0 — White
1 — CHROME BEZEL
2 — Red
3 — GOLD BEZEL
4 — Ivory
5 — Green
6 — Light Blue
8 — Gray
9 — Black

LAMP CODE
0 — 110V neon
1 — 220V neon

paddle switches

series P26 — small case
series P27 — large case

- Snap-In Installation
- Modern styling
- Wide range of color combinations
- Special colors, hot stamping and metal bezels available
- Matching panel lights and lighted switches available
- Solder, screw or slip-on terminals
- Low Cost



Specifications

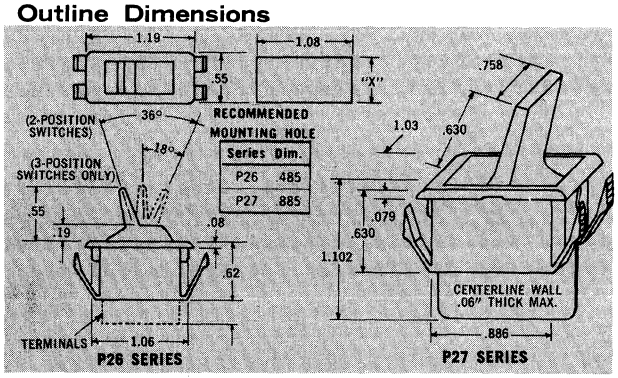
Contacts: Silver-cadmium

Contact rating: P26 series — 10 Amps inductive at 120 VAC
P27 series — 6 Amps inductive at 120 VAC

Mechanical Life: 100,000 Actuations

Breakdown Voltage: 2,000 V, 60 Hz. Min.

Outline Dimensions



Panel Thickness: Snaps into panels from .031" to .125" thick.

How to order: — P26 Series

P26-XXX-10X

TERMINAL CODE, PADDLE CODE — CIRCUIT CODE, CASE CODE

CIRCUIT CODE

0 — SPST on-off
1 — SPST-N.O. momentary-on
2 — SPDT
3 — SPDT momentary
4 — SPDT 3-position center-off
5 — SPST-N.C. momentary-off
6 — SPDT 3-position center-off momentary-both-sides
7 — SPST on-off, terminals in slots #1 and #3
8 — coming soon — lighted versions
9 — SPDT 3-position center-off momentary-one-side

PADDLE COLOR CODE

0 — White 2 — Red 9 — Black

How to order: — P27 Series

P27-1XX-XXX

CIRCUIT CODE, TERMINAL CODE — CASE CODE, PADDLE CODE

CIRCUIT CODE

00 — SPST on-off
02 — SPDT maintained
04 — SPDT 3-position center-off
06 — SPDT 3-position center-off momentary-both-sides
10 — DPST on-off
12 — DPDT maintained
14 — DPDT 3-position center-off
16 — DPDT 3-position center-off momentary-both-sides

PADDLE COLOR CODE

0 — White 4 — Ivory 6 — Light Blue 9 — Black
2 — Red 5 — Green 8 — Gray

How to order: — P27 Series Lighted

P27-3XX-XXX

CIRCUIT CODE, LAMP CODE, TERMINAL CODE — ROCKER CODE, CASE CODE

CIRCUIT CODE

0 — SPST (on-off)
1 — SPST N.O. momentary-on
2 — SPDT
3 — SPDT momentary
4 — SPDT 3-position center-off
5 — SPST N.C. momentary-off
6 — SPDT 3-position center-off momentary-both sides
7 — SPDT 3-position center-off momentary-one side
8 — DPST
9 — DPST N.O. momentary-on

PADDLE COLOR CODE

0 — Serrated White
1 — Smooth White
2 — Serrated Red
3 — Smooth Clear
4 — Serrated Amber
6 — Smooth Amber
7 — Smooth Red
8 — Serrated Clear

LAMP CODE

0 — 110V Neon
1 — 220V Neon
6 — 380V Neon

Codes common to both P26-Series & P27-Series

TERMINAL CODE

0 — 1/4" wide slip-on 1 — Screw 2 — Solder 6 — 3/16" wide slip-on

CASE COLOR CODE

0 — White 2 — Red 4 — Ivory 6 — Light Blue 9 — Black
1 — Chrome Bezel 3 — Gold Bezel 5 — Green 8 — Gray

ALSO AVAILABLE

Two switches in one case. Specify by two part numbers, for example: "P26-020-102 + P26-020-103"

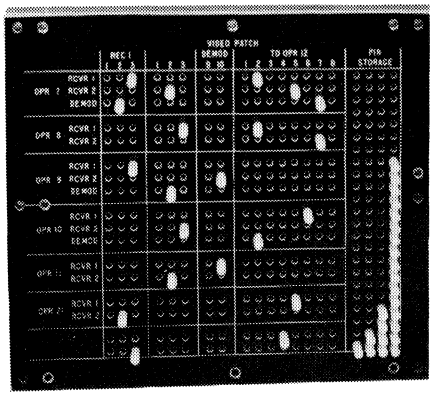
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

CO-ORD SWITCH

A DIVISION OF LVC INDUSTRIES INC.

135-25 37th AVENUE • FLUSHING, NEW YORK 11354 • TEL: (212) 939-9777

MATRIX PROGRAM BOARDS



CO-ORD Matrix Program Boards are composed of 2 to 8 decks of contacts that are bussed on .250 centers. The contact rows of one deck are usually oriented perpendicular to the rows of adjacent deck(s) so as to obtain switching crosspoints. Electrical connections of the bussed contact rows are effected by inserting shorting pins at the desired crosspoints; "CO-AX", phone plug type pins are available for networks which require component insertion (Diodes, resistors, etc.). Single board matrices of up to 11,000 crosspoints are available in standard or special arrangements. Bussed and isolated contacts can be had alone or in combination. Panels may be screened, engraved, or fitted with pre-punched templates for rapid program changing.

U. S. Patent No. 3,349,361

APPLICATIONS

- Computer memories
- Cordless patch panels
- Function generators (Analog/Digital)
- Power distributors
- Thermocouple signal selectors
- Circuit/Component test programmers
- Lighting systems (Special effects)
- Variable sequence selectors
- Variable diode matrices
- Code generators
- Traffic control panels
- Decade switches
- Vending machine control
- Numeric controlled machinery
- Data channeling and logging
- Communications distributors

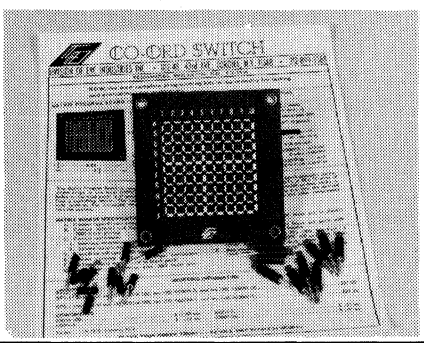
FEATURES

- Closed entry contacts
- High mechanical environment capacity
- Low interlead capacitance
- Attractive and uncluttered
- Compact package
- Standard sizes available
- Permits insertion of components into network without soldering
- Wide variety of switching combinations

SPECIFICATIONS

- Contact Resistance
  - a Total Pin Resistance: .004 OHM MAX.
  - b Volume Resistivity of Strip: .003 OHM/IN
- Breakdown Voltage: 1000 VRMS MIN.
- Current Capacity: 5 AMPS Continuous (up to 100 amps on special application)
- Materials:
  - a Plastic Parts: Black Phenolic XXX
  - b Flexible Contacts: Heat Treated Beryllium Copper
  - c Terminals: Brass
  - d Finishes: Gold, Silver or Nickel

PROGRAM BOARD KITS



KIT BPS-1 consists of a 10 x 10 matrix board similar to #63014-1, below. 10 shorting pins and 10 "CO-AX" diode pins with 1N270's installed $27.00

KIT BPS-2 is the same as BPS-1 but without diodes $22.25

10 x 10 matrix board	$17.00 ea.
Shorting pin	.12 ea.
Diode pin w/1N270	.99 ea.
Diode pin w/o diode	.51 ea.

AVAILABLE FROM STOCK

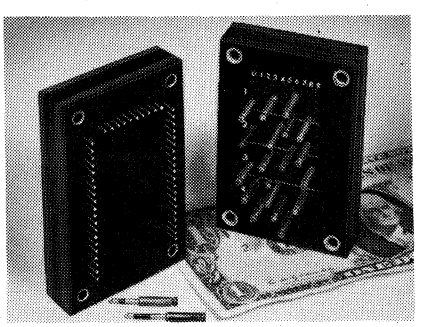
STANDARD MATRIX BOARDS — SERIES 63014

DASH	-1	-2	-3	-4	-5	-6	-7	-8	-9
MATRIX	10 x 10	10 x 15	10 x 20	10 x 25	15 x 20	15 x 25	20 x 20	10 x 50	25 x 25

AVAILABLE FROM STOCK. ADD DASH NO. (1 Thru 9) MATRIX SIZE.

MINIATURE PROGRAM BOARD

.100 and .125 inch Center Line



TENTH INCH MATRIX AT $.08 PER POINT

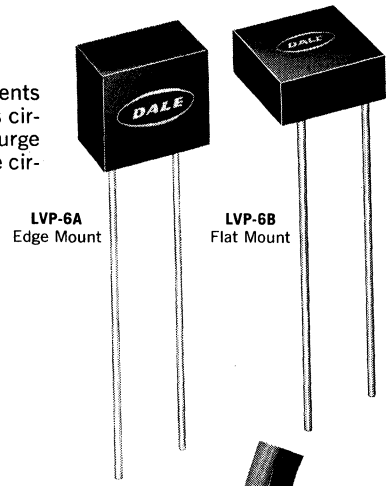
These Matrix Program Boards are designed to meet the increased technological requirements for miniaturization in electronic systems and equipment. They have all the same features of the larger matrices and can be supplied in from 2 to 4 decks of bussed contacts. Single matrix boards of up to 2500 crosspoints can be furnished in one solid unit, with rugged Shorting and CO-AX (diode) pins available for programming functions. A standard 2 deck matrix measures .315 inches thick from the front to rear panel; program pins are .280 inches long by .063 inches in diameter. Termination of the bussed contacts are to .040 diameter pin terminals, which allow the matrix to be plugged into mating female receptacles or connected to directly by wave, dip, or hard soldering. Contact resistance is only .005 ohms per crosspoint; breakdown voltage 600 VRMS; current capacity 3 amps continuous.

See Our BLOC-LITE Lighting Devices • Section 2400

DEPENDABLE DALE® SURGE ARRESTERS

■ SERIES LVP-6 *Low Voltage Protector*

Designed to mount on printed circuit boards to protect solid state circuitry from transients appearing on low voltage DC circuits. Nanosecond response. Automatically restores circuit to normal when transient has passed. Transients substantially above rated surge current cause failure of the LVP-6 in a shorted condition—still safeguarding valuable circuit components.



LVP-6A Edge Mount

LVP-6B Flat Mount

PROTECTIVE CAPABILITIES

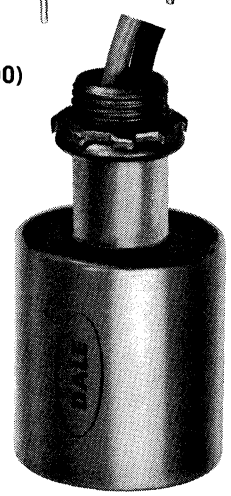
Clamping Voltage: 6.2, 6.8, 7.5, 8.2, 9.1, 10, 11, 12, 13, 15 volts.
Shunt Capacity: 15 μf.
Operating Temperature: −55° C to 85° C
Storage Temperature: −55° C to 125° C

PHYSICAL SPECIFICATIONS

Body Dimensions = .500" L x .500" W x .312" H.
Lead Dimensions = 1" ± 1/32" L x .032" dia.

■ SERIES SPA *Secondary Power Arrester—UL Listed* (Model SPA-100)

Designed for fuse or junction box mounting to protect against direct or indirect lightning and other transient voltages. Unit has hermetically sealed pre-ionized spark gap for increased sensitivity and stable breakdown voltage level. Exceeds applicable NEMA, USAS, and IEEE standards. Conforms to lightning protection requirements of **Occupational Health and Safety Act.**



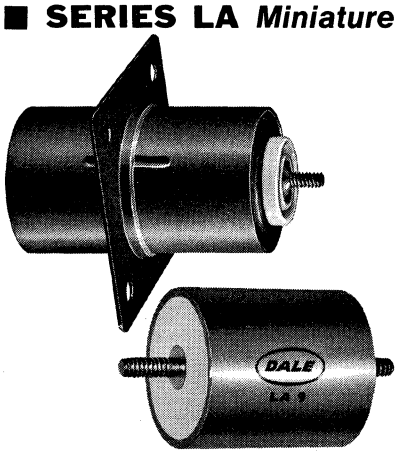
PROTECTIVE CAPABILITIES

DC Arc-Over Voltage: SPA-100 (120 VAC) 500-700 volts; SPA-200 (277 VAC) 600-900 volts. **Fast Rise Arc-Over Characteristics:** Typically 1500 volts with 10KV/μsec. pulse applied; **Bypass Capability:** Will withstand repeated 10KA (10x20 μsec.) current surges. Power follow current extinguished in 1/2 cycle or less. Voltage between terminals less than 2000 volts when conducting 10,000 amps of surge current. **Insulation Resistance:** Greater than 100 megohms. **Shunt Capacity:** Less than 25 pf.

PHYSICAL SPECIFICATIONS

Overall dimensions: 1-3/4"Dx3" L. Two 18" leads provided for circuit connection. Has 1/2"-14 NPSL conduit fitting with nut for mounting in any position indoors or outdoors.

■ SERIES LA *Miniature Size—Maximum Circuit Protection*



Patented design insures much greater reliability and repeatability than standard spark gap designs. Widely used to protect communications equipment from lightning and to guard industrial controls and electronic equipment from heavy transient spikes.

PROTECTIVE CAPABILITIES

Spark-Gap Arc-Over Voltage: LA20 = Factory adjustable from 500 to 6000 VDC, ±20% standard (10% available). LA9 = Factory adjustable from 500 to 5000 VDC, ±20% (10% available). **Bypass Capability:** LA20 = 50 current surges of 2000 amps peak 1x2 millisecond wave shape (2 coulombs). LA9 = 100 current surges of 300 amps peak 2x4 millisecond wave shape. **Insulation Resistance:** Greater than 1000 megohms initially and greater than 10 megohms after rated current surges. **Shunt Capacity:** LA20 = 8 mmfd, LA9 = 3.5 mmfd.

PHYSICAL SPECIFICATIONS

LA20 = 3-3/8" outside length. Body 2-1/16" L x 1-1/4" D. Weight: 5 oz. LA9 = 1-5/8" outside length. Body: 1" L x 3/4" D. Weight: 2 oz. **Mounting:** Clip, stud or flange. **Terminal:** LA20 = 6-32, 8-32, 10-32 stud or wire; LA9 = 4-40 stud or wire. **Seal:** LA20 and LA9 hermetic.

■ ADDITIONAL MODELS

- Aircraft lightning arresters of all types
- Arresters for high voltage circuits
- Miniature transient suppressors for circuit board mounting.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

Submit your specifications to

DALE ELECTRONICS, INC.

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Complete lightning laboratory facilities and engineering assistance available to develop your applications.

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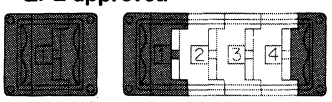
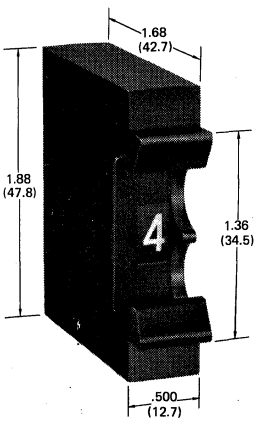
DIGITAL

DIGISWITCH®

- Hundreds of codes available
- P/C board terminations
- .025" sq wire wrap posts
- Wire bundle terminations
- Replaceable dial lighting
- Special dial markings
- Series 300, 13000 & 9000 QPL approved



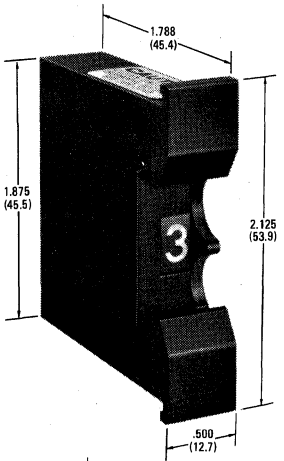
Modular Construction



Series 300
8, 10, 12 & 16 DIAL POSITIONS

This one module shown is our standard, general purpose unit. When grouped together with end flanges, the assembly is installed through a cut-out from the rear of the panel. Simple mounting screws are required. Note that the DIGISWITCH, which is the largest of all our switches, can be supplied with up to 16 dial positions.

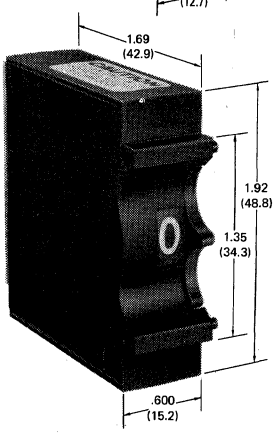
The Series 300 is QPL approved to MIL-S-22710/11.



Series 13000
FRONT PANEL MOUNT 8, 10, 12 & 16 DIAL POSITIONS

This series is identical to the Series 300, except that the case is designed to allow mounting from the front of the panel. Four mounting screws required.

The Series 13000 is QPL approved to MIL-S-22710/14.



Series 9000 & 19000
SEALED & DUST PROOF 8, 10, 12 & 16 DIAL POSITIONS

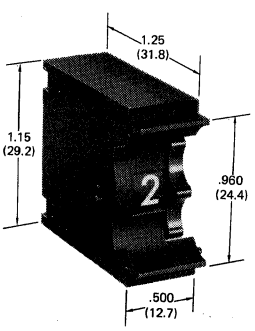
The Series 9000 is completely sealed. Excellent for use on machines or equipment that are exposed to heavy concentrations of liquids such as oils or water. Further on, you will see that our MINISWITCH also comes in a sealed version. Consider this, however, if your application requires the operator to wear heavy protective gloves, this larger (.6" wide) switch might be more practical.

The Series 9000 is QPL approved to MIL-S-22710C/12.

Series 19000 is unsealed, but is considered "dust proof".

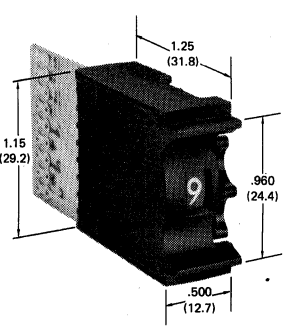
MINISWITCH®

- Hundreds of codes available
- P/C board terminations
- .025" sq.wire wrap posts
- Wire bundle terminations
- Replaceable dial lighting
- Special dial markings
- Miniature
- Series 200 & 700 QPL approved



Series 8000
8, 10 & 16 DIAL POSITIONS

This switch is a miniaturized version of the Series 300 DIGISWITCH. It is mounted from the rear of the panel with four mounting screws and, like the DIGISWITCH, can be grouped with end mounting flanges into as many switching units in a row as desired. Like most of our thumbwheel switches, the MINISWITCH will give you over 1,000,000 reliable detent operations.

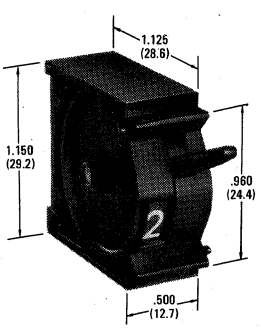


Series 200 & 700
SEALED 8, 10 & 12 DIAL POSITIONS

The Series 200 has potted wire lead terminations, and the Series 700 has a P/C board extending from the rear of the switch. Both are completely sealed. The 700 Series can be furnished unsealed but with the dust proof feature for commercial or non-critical applications. Note that both are physically identical, and therefore may be mixed in one complete assembly with end mounting flanges.

Series 200 is QPL approved to MIL-S-22710C/15.

Series 700 is QPL approved to MIL-S-22710C/20.

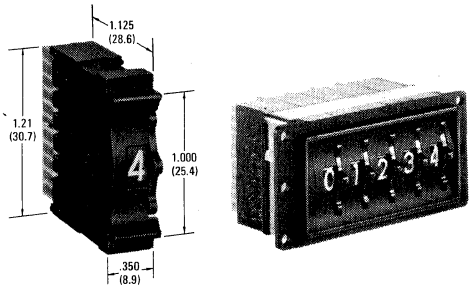


Series 28000
MINILEVER 10 & 12 DIAL POSITIONS

Each module is actuated by a geared type lever. By moving the lever in either direction, you can instantly position the digits from zero (0) to ten (10), or zero (0) to twelve (12). For instance, they have been used on credit checking machines. The operator can set up the customers' credit card number rapidly, then push a button and check the customers' credit. He can then instantly reset all digits back to zero with one sweep of the hand.

SWITCHES

THE LARGEST SELECTION OF CODES AVAILABLE



ECONOMY MINISWITCH

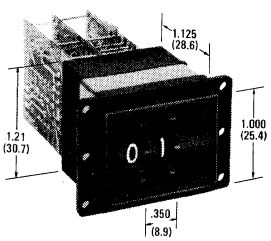
Series 29000

Here is our new little money saver. Although slightly derated electrically from our Series 8000 MINISWITCH, certain mechanical and material changes have reduced the selling price considerably without reducing quality. If you have an application where the ultimate in low cost is mandatory, this is the switch. This switch is also sealed against normal exposure to dust and other dry contaminants.

Series B29

PURE BINARY 10 DIAL POSITIONS

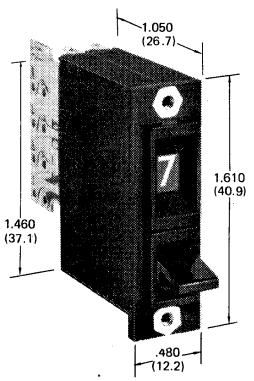
Using the basic Series 29000 construction, this switch has been developed for systems which must convert binary-coded decimal input to pure binary output. It automatically converts any decimal from from 0 to 999,999 to its binary equivalent. Compatible with both TTL and DTL circuitry, the Series B29 is available with either positive or negative logic output. Mechanical operation, mounting, etc., is the same as the Series 29000.



Series 24000

SEALED, BI-DIRECTIONAL SWITCH 10 DIAL POSITIONS

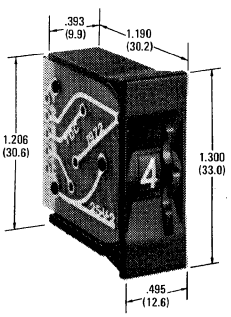
This little toggle or paddle handle switch mounts in a panel cut-out with two screws. You can mount a row of them in one large cut-out, or mount them in a series of individual cut-outs. By actuating the toggle in either direction, the digits click in view, in sequence. And, you will like the short arc between each position. It's faster than ordinary toggle and thumbwheel switches. The front face is completely sealed so that with a mounting gasket, your equipment will be properly protected against contamination.



Series 25000

"SNAP-IN" UNIT 10 DIAL POSITIONS

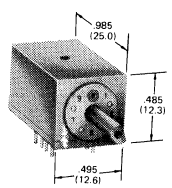
Here's a unit that simply snaps into a panel cut-out. No mounting screws are required. They do not assemble together with end flanges like most of our other standard switches, but are mounted side-by-side in one large cut-out, or snapped into individual cut-outs. They also snap-in from the front of the panel too, which makes assembly very simple and very attractive. This is a very economical unit that costs even less to install.

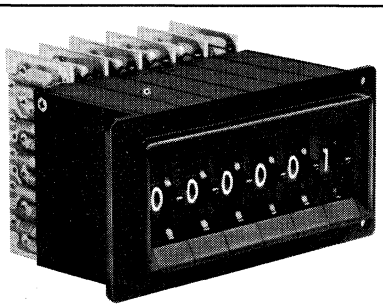


Series 26000

"DIGIDIP" 10 DETENT POSITIONS

The DIGIDIP is a tiny switch that can be plugged into a dual inline IC socket, or dip soldered to a printed circuit board. You can order them as BCD with one common and single pole/decimal as standard. Other special outputs are available on request.





DIGIVIDER/DIGIDECADE

DIGIVIDER is a thumbwheel switch that has been converted into a voltage divider. When you dial the voltage setting you desire, that's precisely what you get as an output. You can also order a model that provides high resolution trimming in the least significant digit.

DIGIDECADE is also a thumbwheel switch, only it has been converted to a resistance decade. You dial the output resistance you want and that's precisely what you get.

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THE DIGITRAN® COMPANY

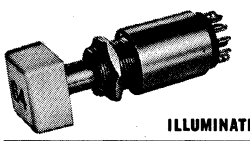
855 South Arroyo Parkway / Pasadena, California 91105 / Phone: (213) 449-3110 / TWX 910-588-3794

electro-mech components, inc.

illuminated

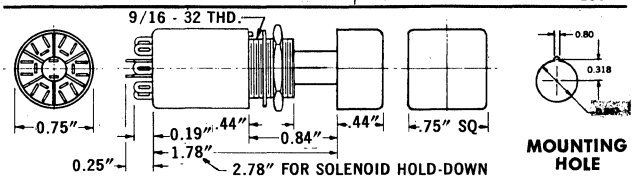
PUSHBUTTON SWITCHES

"switchline" STANDARD 6-POLE DOUBLE THROW



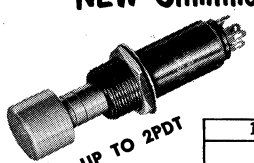
- **Ratings:** 30 volts DC or 115 volts AC 2 amps resistive; 1 amp inductive
- **Weight:** 0.8 oz. (approx.)
- **Operating Pressure:** 2 lbs. ±1 lb.
- **Plunger Travel:** 3/16" (approx.)
- **Actuations:** 100,000
- Accommodates all **"switchline"** standard lenses
- Uses one T1¾, AN3140-327, 328, 330 bulb or neon lamp. 3 actuation modes standard also in 2, 3, 4 and 5-pole configuration.

	ILLUMINATED				NONILLUMINATED			
	Mom.	Push On Push Off	Push On Remain In Push Off	Snap Feel Mom.	Mom.	Push On Push Off	Push On Remain In Push Off	Snap Feel Mom.
2 PDT	2650	2750	2850	2550	1650	1750	1850	1550
3 PDT	2651	2751	2851	2551	1651	1751	1851	1551
4 PDT	2652	2752	2852	2552	1652	1752	1852	1552
5 PDT	2653	2753	2853	2553	1653	1753	1853	1553
6 PDT	2654	2754	2854	2554	1654	1754	1854	1554



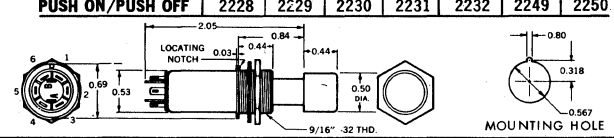
LENSES: Available in ½", ¾", 1" dia., ½", ⅜", ¾" square. Translucent Lexan in white, red, green, blue and yellow.

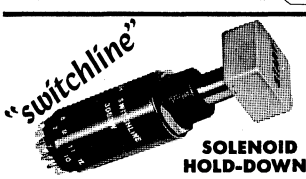
NEW Slimline by "switchline"



A new 2100 series Slimline version of our standard Illuminated Pushbutton Switch featuring silver slide bar action. Add BR after part number for mounting on ⅝" centers. Utilizes AN3140-T 1-¾ or ALC-100 bulb. All other specifications same as standard.

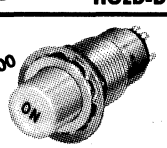
	1 PST		2 PST				
	N.O.	N.C.	2 N.O.	2 N.C.	1 N.O. 1 N.C.	1 PDT	2 PDT
MOMENTARY	2128	2129	2130	2131	2132	2149	2150
PUSH ON/PUSH OFF	2228	2229	2230	2231	2232	2249	2250





Switchline Illuminated Pushbutton switches with an integral hold-down coil which is activated with switch. Holds the pushbutton in the depressed position until coil is de-energized returning it to relaxed position. Available in all circuit configurations up to 6 PDT. Same secifications as standard model.

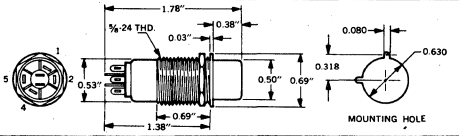
NEW SERIES 5000



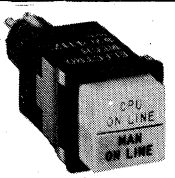
FRONT PANEL MOUNT MINIATURE MOMENTARY SWITCHES

An exceptionally short momentary switch available in circuit configurations up to 2 PDT. Clear anodized case. All specifications same as standard model except plunger travel which is 3/32".

	1 PST		2 PST				
	N.O.	N.C.	2 N.O.	2 N.C.	1 N.O. 1 N.C.	1 PDT	2 PDT
MOMENTARY	5128	5129	5130	5131	5132	5149	5150



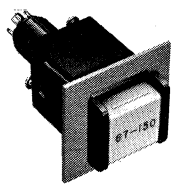
NEW



600 SERIES DUAL LITE-QUAD LITE

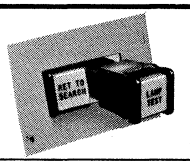
This series features our 2100 switch incorporated as an integral part of the assembly. Accommodates either 2 or 4 T1 ¾ bulbs. Snaps into ⅞" square hole or may be mounted in a row. Up to 2PDT momentary or alternate action.

NEW



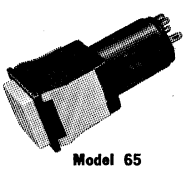
60 SERIES LOW COST SELF MOUNTING SWITCH ASSEMBLY

This series features our 2100 switch incorporated as an integral part of the mounting hardware. All plastic, front mounting case with barriers. "U" shaped channel bracket is easily attached to back of panel and switch is installed with two screws. Same circuitry and specifications as 2100 series.

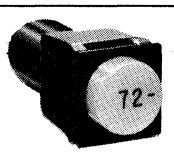


"switchline" MOUNTING ADAPTERS

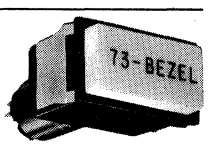
- Snaps in from front panel
- Mounts in panel thickness up to ⅛"; for thicker panel mounting add "Z" to Model No.
- Fingernail groove in lens for easy removal
- Bezel available in white, gray or black Lexan.



Model 65
0.94" sq. flange
0.75" sq. Lens

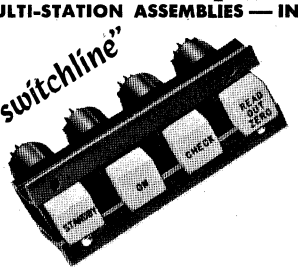


Model 72
0.75" dia.
Lens



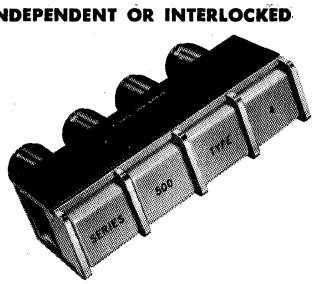
Model 73
0.75" x 1.50"
Lens

MULTI-STATION ASSEMBLIES — INDEPENDENT OR INTERLOCKED



SERIES 400

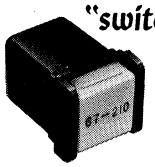
Multi-station switch assemblies designed for sub-panel mounting by means of a flanged "U" channel. All standard Switchline switches can be incorporated with several types of mechanical interlocking/lockout actions between stations. Up to 12 stations in one or two row configurations.



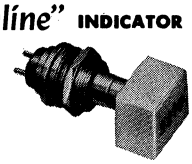
SERIES 500

A new line of front panel mounting assemblies featuring long-lasting chrome barriers between each switch. All standard Switchline switches in ten types of tracking action and switching sequences. Up to 12 switches in single or dual row on ⅞" or 1" centers.

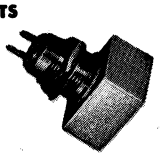
"switchline" INDICATOR LIGHTS



60 SERIES-210
1.57" length
0.75" sq. Lens
Channel mount



Model 3210
1.84" length
0.33" dia. shaft
0.75" dia. Lens
9/16 -32 THD.



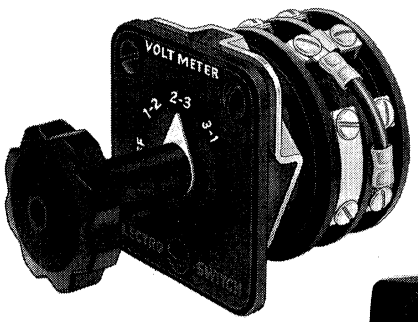
Model 3220
1.81" length
0.75" sq. Lens
15/32 -32 THD.

Accommodates all **"switchline"** lenses. Utilizes AN3140-T 1-¾ or ALC-100 bulb.

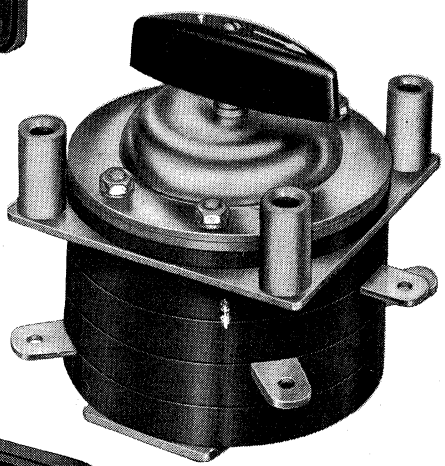
Write, wire or phone for complete literature. We invite your inquiries regarding our capabilities in custom switch design and production.

electro-mech components, inc.
1826 NO. FLORADALE AVE. • SOUTH EL MONTE, CALIF. 91733
TELEPHONE (213) 442-7180

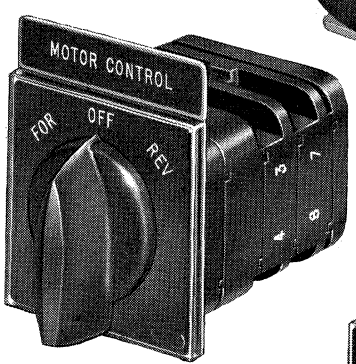
ROTARY POWER SWITCHES?



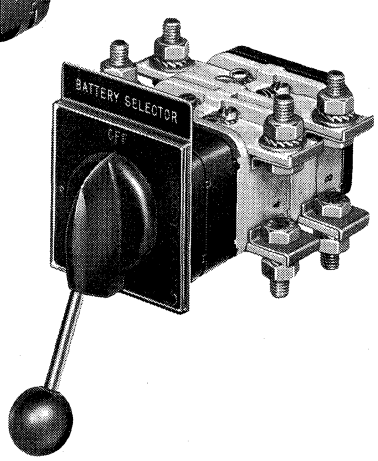
INSTRUMENT AND CONTROL SWITCHES



MULTIPOLE ROTARY SWITCHES



HEAVY DUTY CAM-OPERATED SWITCHES



PRE-WIRED SPECIAL APPLICATION SWITCHES

Send for Bulletin C-1...Our "catalog of available catalogs" or give specific needs for detailed information.

CHECK OUR SPECS!

SWITCH SPEC	Minimum	Maximum
RATING	1/2 amp	200 amp
POSITIONS	2	16
CONTACTS (Poles)	1	72
ACTION	SNAP•DETENT•CAM	
OPTIONS	Key-operated...Key-locking...Tandem units...Gear-train units...Solenoid-locking...Push-to-turn operation...Waterproof mounting...Base & Panel mounting...Explosion-proof housing...AND MANY MORE!	

So far, we've built 132,892 types of Rotary Power Switches within these parameters.

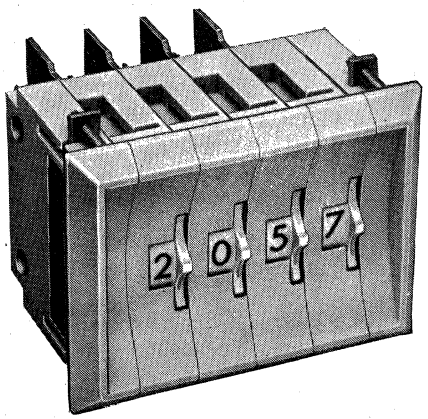
Your application may be number 132,893!

Chances are, there are several switches you can profitably choose from among our literally *hundreds* of stock units. But if you do require a special, you can have it assembled to order from a few *thousand* basic components...off-the-shelf! From simple pushbuttons to complex gear-train models...from light to heavy duty...from stock to custom...there's bound to be a perfect match to your specifications and applications.

ELECTRO SWITCH CORP.
Weymouth, Massachusetts 02188
Telephone: 617/335/5200 TWX: 710/388/0377

SWITCHES

CR103 TYPE F THUMBWHEEL SWITCHES



RATINGS

Contacts

Carry continuously ..... 3 ampere max., a-c/d-c
Voltage ..... 150 volts max., a-c/d-c
Make ..... 30 va a-c inductive, 7.5 va d-c inductive, 30 va a-c/d-c resistive
Break ..... 15 va a-c inductive, 7.5 va d-c inductive, 30 va a-c/d-c resistive
Resistance ..... 100 milliohms max. (6 v @ 100 mA)
Torque Force ..... 16 oz. max. force
Dielectric Test ..... Frame to terminal: 1300 V rms, 60 Hz — 1 min.
Between open circuit terminals: 500 V rms, 60 Hz — 1 min.
Insulation Resistance ..... 100 megohms at max. temp.
Temperature Range ..... 0 to 55°C

Oiltight forms and components for customer assembly of general-purpose thumbwheel switches are also available.

Write for Bulletin GEA-8124

GENERAL-PURPOSE FORMS

Circuit Board Type	Terminal Type	Single Module Only		Complete Units — Factory Assembled							
					Number of Modules — List Price						
		CR103	List Price	CR103	1	2	3	4	5	6	7
Decimal	Solder/Taper Tab	FX1†A‡	$10.50	FA1†A‡**	$15.40	$26.30	$37.20	$48.10	$59.00	$69.90	$80.80
	Wire Wrap	FX3†A‡	11.50	FA3†A‡**	16.40	28.30	40.20	52.10	64.00	75.90	87.80
	Plug-in	FX5†A‡	10.50	FA5†A‡**	15.40	26.30	37.20	48.10	59.00	69.90	80.80
Binary Coded	Solder/Taper Tab	FX1†B‡	18.00	FA1†B‡**	22.90	41.30	59.70	78.10	96.50	114.90	133.30
	Wire Wrap	FX3†B‡	19.00	FA3†B‡**	23.90	43.30	62.70	82.10	101.50	120.90	140.30
	Plug-in	FX5†B‡	18.00	FA5†B‡**	22.90	41.30	59.70	78.10	96.50	114.90	133.30
Binary with Complement	Solder/Taper Tab	FX1†C‡	22.00	FA1†C‡**	26.90	49.30	71.70	94.10	116.50	138.90	161.30
	Wire Wrap	FX3†C‡	23.00	FA3†C‡**	27.90	51.30	74.70	98.10	121.50	144.90	168.30
	Plug-in	FX5†C‡	22.00	FA5†C‡**	26.90	49.30	71.70	94.10	116.50	138.90	161.30
Binary with Odd-bit Parity	Solder/Taper Tab	FX1†D‡	20.00	FA1†D‡**	24.90	45.30	65.70	86.10	106.50	126.90	147.30
	Wire Wrap	FX3†D‡	21.00	FA3†D‡**	25.90	47.30	68.70	90.10	111.50	132.90	154.30
	Plug-in	FX5†D‡	20.00	FA5†D‡**	24.90	45.30	65.70	86.10	106.50	126.90	147.30
Binary Complement	Solder/Taper Tab	FX1†E‡	20.00	FA1†E‡**	24.90	45.30	65.70	86.10	106.50	126.90	147.30
	Wire Wrap	FX3†E‡	21.00	FA3†E‡**	25.90	47.30	68.70	90.10	111.50	132.90	154.30
	Plug-in	FX5†E‡	20.00	FA5†E‡**	24.90	45.30	65.70	86.10	106.50	126.90	147.30

NOTE: Decade coded forms available at same prices as binary coded; to order, substitute "F" in place of "B" in basic binary nomenclature.

† HOUSING COLOR SUFFIX

Substitute suffix number for † in nomenclature.

Color	Black	Grey	White	Beige	Dull Black
Suffix	0	1	2	3	4

** NO. OF MODULES (Use in place of double asterisk for factory assembled forms). Use 01, 02, 03, etc. up to 0.7. Units with 8 to 24 modules are also available.

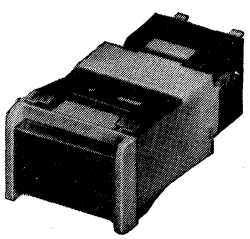
‡ WHEEL COLOR COMBINATION

Substitute suffix letter for ‡ in nomenclature.

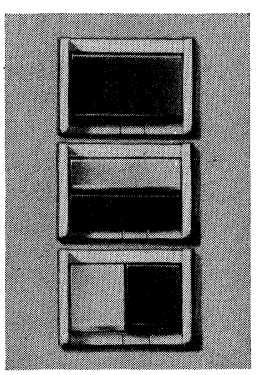
Suffix	Numerals		Background Color
	Marking	Color	
A	0-9	White	Black
B	0-9	Red	White
C	0-9	Black	White
D	+ −	White	Black
E	+ −	Red	White
F	+ −	Black	White

Prices subject to change without notice. OEM quantity prices available on request.

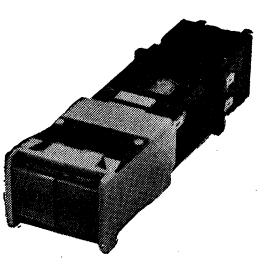
CR103 TYPE D ILLUMINATED PUSH-BUTTON SWITCHES



Illuminated push button/light with horizontal lens caps installed



Solid or split color fields give added flexibility. Colors can be mixed in the split field forms for even more combinations.



Illuminated magnetically-held push button with vertical lens caps installed

General Electric's new line of CR103 Type D illuminated push buttons are designed for a wide variety of applications such as control and instrument panels, office machines, laboratory instruments, computers and other data processing equipment. Matching indicating lights are shown in Section 3900 on page of General Electric indicating lights.

Push buttons are rated 5 amp carry and break, 30 amp make at 125 volts a-c; 3 amp inductive make and break at 30 volts d-c; 0.55 amp inductive make and break at 125 volts d-c. Lamps are rated 28 volts maximum.

FEATURES

- Units snap into panels from front without tools, and can be gang-mounted horizontally to save space or for group functions.
- Convenient slide-on lens caps in five colors; four housing colors.
- Units are single button only, and have solid, horizontally- or vertically-split color fields.
- Legend inserts for all forms can be printed or engraved on acetate or similar material of 10 mils or less thickness.
- Three types of contact action are available: momentary contact with or without audible indication, maintained contact (push-on, push-off), and magnetically held contacts with or without audible indication. Terminals are designed for either quick-connect or solder connections.
- Miniature flange-base incandescent lamps such as GE No. 327 (28 volts) or GE No. 328 (6 volts) are easily replaced without tools; without removing housing from panel. Lamps are supplied by customer.
- 2-lamp and 4-lamp forms are available.

Write for Bulletin GEA-7390

For complete information contact your nearby GE Sales Office, or write to General Electric Co., Section **998-60**, Schenectady, N. Y. 12345.

GENERAL ELECTRIC

GORDOS CORPORATION 250 GLENWOOD AVENUE • BLOOMFIELD, NEW JERSEY 07003 U.S.A. • 201-743-6800

Representatives Throughout The World

GORDOS MERCURY SWITCHES

- SEALED CONTACTS
- RELIABLE OPERATION
- ANY OPERATING ANGLE
- POSITION SENSING
- LOW CONTACT RESISTANCE
- HEAVY OVERLOAD
- LONG LIFE
- MINIATURIZATION

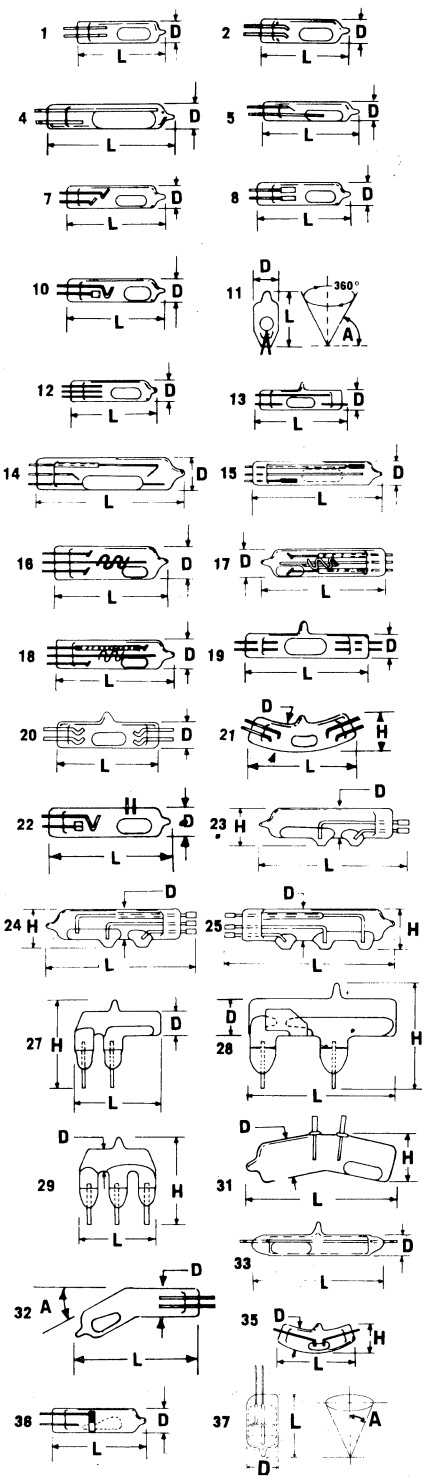
Switch Part No. Without Lead Wire	Nominal Load Current Amps At 115 V AC Resistive	Differential Angle (Degrees) Max.	Differential Angle (Degrees) Min.	Sketch Number	Nominal Dimensions (Inches) D	L	H	Type of Contact: MM — Mercury to Mercury MWM — Merc. to Wet Metal MDM — Merc. to Dry Metal	Suitable for Low Voltage Application	NOTES
SPST										
HG 414 LO	0.1	5	—	8	.350	1 3/16	—	MWM	√	PtTE
HG 220 LO	0.1	10	—	4	.155	1/2	—	MDM	—	Under 6 volts HG 520LO is Recommended.
HG 520 LO	0.1	10	—	4	.155	1/2	—	MDM	√	—
HG 221 LO	0.1	15	—	4	.155	7/8	—	MWM	√	PtTE
HG 242 LO	0.1	25	15	11	.275	7/8	—	MDM	—	N.C. Conical Tipover Series. Angles are Measured from Horizontal (A° on Sketch No. 11) Contact is Open at Min. Degree Angle and Closed at Max. Degree Angle Shown in Table.
HG 245 LO	0.3	50	10	11	.275	3/4	—	MDM	—	
HG 243 LO	0.5	See Note	See Note	37	.350	1	—	MDM	√	N.O. Conical Tipover Series. Angles are Measured from Vertical (A° on Sketch No. 37) Min. Angle: 20° ±5°, Max. Angle: 65° ±5°.
HG 244 LO	0.5	See Note	See Note	37	.495	1 1/2	—	MDM	√	
HG 253 LO	0.3	3	—	8	.325	1 5/16	—	MWM	√	PtTE
HG 260 LO	0.3	180	—	1	.325	2 3/4	—	MWM	√	PtE. Nonmagnetic
HG 261 LO	0.3	15	—	1	.325	1 1/4	—	MWM	√	PtE. Nonmagnetic
HG 402 LO	0.3	.25	—	2	.400	1 1/4	—	MDM	—	Slow Tilting Action
HG 251 LO	1	2	—	1	.325	1	—	MDM	—	—
HG 252 LO	2	14	—	1	.325	1	—	MWM	√	General Purpose Switch
HG 407 LO	2	5	—	1	.325	1 1/2	—	MDM	—	—
HG 256 LO	2	15	—	12	.325	1	—	MWM	—	Make 2 Ckts. to Common
HG 217 LO	3	10	—	8	.325	1 3/8	—	MDM	√	—
HG 708 LO	2	15	5	36	.400	1 3/8	—	MDM	√	Splash Resistant
HG 566 LO	4	10	—	16	.495	2	—	MDM	—	N.C. 2 Ckts. to Common Lead End Down
HG 567 LO	4	10	—	17	.495	2	—	MDM	—	N.C. 2 Ckts. to Common Lead End Up
HG 431 LO	5	4	—	7	.495	2	—	MDM	√	—
HG 447 LO	7	1.5	—	10	.600	2 5/8	—	MDM	√	Slow Tilting Action
HG 457 LO	10	See Note	—	32	.435	See Note	—	MDM	—	High Diff. Angle Switch Make to Customer Specifications
HG 259 LO	2		—	32	.325		—	MDM		
HG 445 LO	10	8	—	10	.600	2	—	MDM	√	—
HG 455 LO	10	5	—	1	.435	1 11/16	—	MDM	√	General Purpose Switch
HG 454 LO	10	5	—	10	.600	2 1/4	—	MDM	√	—
HG 412 LO	15	8	—	23	.520	2 1/4	—	MM	√	—
HG 421 LO	15	10	—	27	.450	1 3/8	1 1/2	MM	√	High Load Reliability
HG 721 LO	25	8	—	27	.520	2 1/8	1 11/16	MM	√	—
HG 482 LO	45	5	—	28	.675	2 1/8	2	MM	√	—
HG 803 LO	0.2	1.4	—	5	.325	1 3/8	—	MWM	√	PtTE. Thermostat Control Switch
SPDT										
HG 804 LO	0.2	2	—	14	.350	1 3/16	—	MWM	√	PtTE. Thermostat Control Switch
HG 569 LO	4	10	—	18	.495	2	—	MDM	—	—
HG 621 LO	8	7	—	13	.435	2 1/4	—	MDM	√	—
HG 427 LO	10	14	—	25	.520	2 1/4	—	MM	√	MBBr
HG 420 LO	15	10	—	24	.520	2	5/8	MM MDM	√	MBBr, MDM Contact Rating 5 Amp at 115 VAC
HG 461 LO	15	14	9	29	.450	1 3/8	1 1/2	MM	√	Momentary MBBr
HG 719 LO	25	15	—	29	.520	2 3/8	1 11/16	MM	√	MBBr
TWO CKT.										
HG 209 LO	1	6	—	19	.230	1	—	MDM	—	—
HG 628 LO	5	6	—	20	.530	2 5/8	—	MDM	√	MBBr
HG 322 LO	5	13	7	21	.495	2 1/4	1/16	MDM	√	MBBr
HG 638 LO	10	10	—	22	.600	2 1/4	—	MDM	—	Pilot Ckt. 2 Amp 115V Overlap Angle 3° to 6°
PULSE										
HG 381 LO	1	—	8	33	.225	1	—	MDM	—	Duty Cycle 20 to 50 Milliseconds
HG 702 LO	3	20	15	31	.495	1 1/2	5/8	MDM	—	Duty Cycle 30 to 70 Milliseconds

Abbreviations:

MBB — Make Before Break Action

PtE — Platinum Electrodes

PtTE — Platinum Tipped Electrodes



GORDOS CORPORATION 250 GLENWOOD AVENUE • BLOOMFIELD, NEW JERSEY 07003 U.S.A. • 201-743-6800

REPRESENTATIVES THROUGHOUT THE WORLD

SUB-MINIATURE AND MINIATURE REED SWITCHES

• GENERAL SPECIFICATIONS

MOUNTING POSITION: Any Plane (WR-126 mercury wetted contacts limited to ±30° from vertical)

INTERNAL ATMOSPHERE: Inert gas (WR-126, MR-138 pressurized)

INSULATION RESISTANCE: (Higher values attained by special treatment)
SPST Form A — 1 x 10^{12} ohms Typical
SPDT Form C — 1 x 10^{9} ohms Typical
Mercury Wetted Form A — 1 x 10^{10} ohms Typical

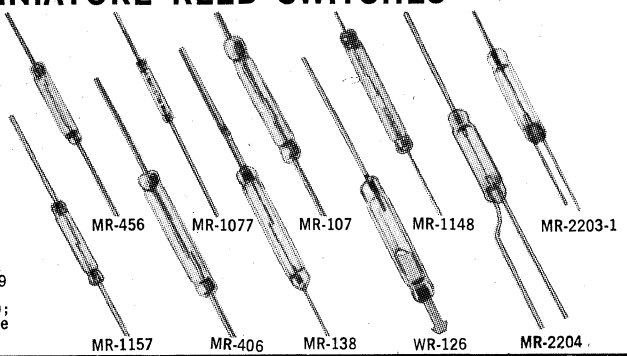
CAPACITANCE: SPST Form A — 0.2 picofarad Typical
SPDT Form C — 1.2 picofarad Typical

SHOCK: 50 g's @ 11ms

VIBRATION: 35 g's from 50 to 2000 Hz

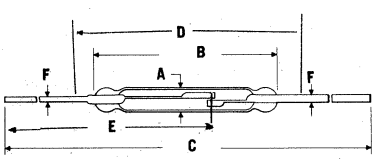
STANDARD TEST COIL: R — 5105. Exceptions: MR2203-1 #R532, MR2204 #R5109

AVAILABLE SENSITIVITY: 15/70 ampere turns; 40/80 ampere turns (WR-126); 10/50 ampere turns (MR1077, MR1078); 15/45 ampere turns (MR2203-1, MR2204).

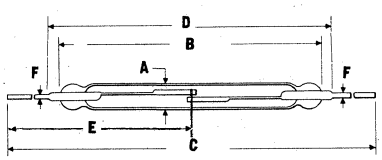


Part #	A — Maximum Glass Diameter (Inches)	B — Maximum Glass Length (Inches)	C — Nominal Uncut Switch Length (Inches)	D — Minimum Trim Length (Inches)(1)	E — Nominal Uncut Armature Length (Inches)	F — Lead Configuration (Inches)	Maximum Current (Amps)	Maximum Switching Voltage (VDC)	Maximum Contact Rating (Watts)	Minimum Breakdown Voltage (VRMS)	Maximum Initial Contact Resistance (Ohms)	Typical Operate Time Including Bounce (Milliseconds)	Contact Material (2)
SUB-MINIATURE SPST — FORM A OFFSET GAP													
MR-456	.090	.560	1.90	0.810	1.045	.023 Dia.	.250	100	7	250	.100	0.6	D
MR-458	.090	.560	1.90	0.810	1.045	.023 Dia.	.250	100	7	250	.100	0.6	R
CENTER GAP													
MR-1157	.105	.673	1.98	.923	.992	.023 Dia.	.125	28	3	100	.150	0.75	D
MR-1077	.070	.455	1.98	.705	.990	.020 Dia.	.250	28	3	200	.150	0.25	D
MR-1078	.070	.455	1.98	.705	.990	.020 Dia.	.250	28	3	200	.150	0.25	R
MINIATURE SPST — FORM A OFFSET GAP						**Pole**							
MR-406	.105	.885	2.75	1.13	1.238	.028 Dia.	.500	200	10	250	.100	1.0	D
MR-408	.105	.885	2.75	1.13	1.238	**Arm.** .015 x .030	.500	200	10	250	.100	1.0	R
CENTER GAP													
MR-087	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	D
MR-088	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	R
MR-086	.090	.785	2.10	1.03	1.043	.015 x .030	.500	200	10	250	.100	0.75	D
MR-089	.090	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.200	0.75	P
MR-107	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	D
MR-108	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	R
MR-106	.105	.785	2.10	1.03	1.043	.015 x .030	.500	200	10	250	.100	0.75	D
MR-118	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.200	0.75	P
MR-138	.105	.815	2.10	1.25	1.043	.023 Dia.(3)	.500(4)	1000	10	1200	.100	0.75	R
MR-306	.125	.785	2.10	1.03	1.043	.015 x .030	.500	200	10	250	.100	0.75	D
MR-307	.125	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	D
MR-308	.125	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.75	R
MR-318	.125	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.200	0.75	P
MR-1148	.105	.785	2.10	1.03	1.043	.023 Dia.	.500	200	10	250	.100	0.5	R
MERCURY WETTED						**Pole**						**No Bounce**	
WR-126-1	.125	.690	1.62	1.08	.740	.023 Dia.	1.0(4)	1000	50	1500	.050	1.75	Hg
WR-126-20	.125	.690	2.10	1.08	1.240	**Arm.** (3)	1.0(4)	1000	50	1500	.050	1.75	Hg
SPDT — FORM C (5)											**N.O./N.C.**	**N.O./N.C.**	**N.O./ARM./N.C.**
MR-2203-1	.125	.600	2.10	.850	1.048	.023 Dia.	.100	20	2	200	.15/.2	0.5/0.4	R/R/P
MR-2204	.125	.600	2.10	.850	1.048	.023 Dia.	.100	20	2	200	.15/.2	0.5/0.4	R/R/P

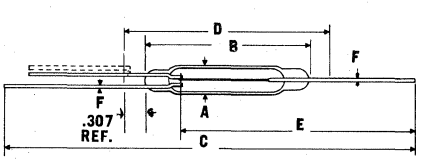
(1) Consult factory before exceeding minimum.
(2) D-Dimet — dropout normal; R-Rhodium — dropout normal; Hg-Mercury — dropout normal; P-Precious Metal — dropout high.
(3) WR-126 Hollow Tube: .040" Dia.; WR-126-20 Solid Lead: .023" Dia.; MR-138 Hollow Tube: .040" Dia.
(4) Derate to .010 amp. @ 1000 VDC.
(5) N.C. contact designated by shorter lead on MR-2203-1 and bent lead on MR-2204.



SPST — Form A Offset Gap
SPST — Form A Mercury Wetted



SPST — Form A
Center Gap



SPDT — Form C

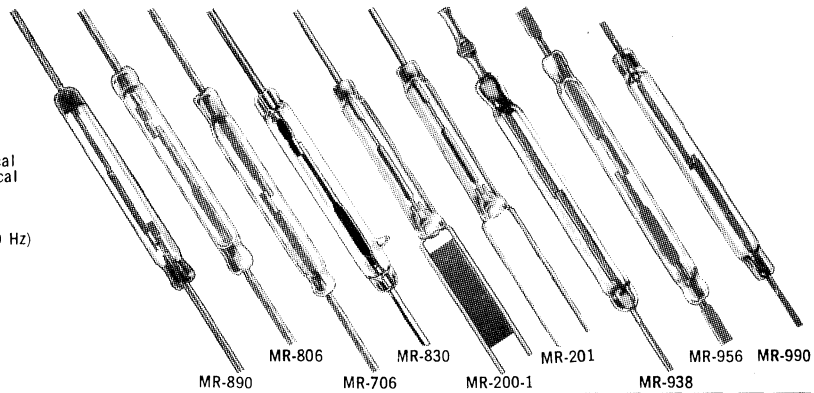
GORDOS CORPORATION
250 GLENWOOD AVENUE • BLOOMFIELD, NEW JERSEY 07003 U.S.A. • 201-743-6800

COMPACT/STANDARD/LARGE REED SWITCHES

• GENERAL SPECIFICATIONS

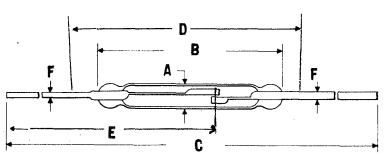
MOUNTING POSITION: Any Plane
INTERNAL ATMOSPHERE: Inert Gas: (MR-893, 938, 2208: Pressurized) (MR-830: Vacuum)
INSULATION RESISTANCE: (Higher values attained by special treatment)
SPST Form A — 1 x 10^{12} ohms Typical
SPDT Form C — 1 x 10^{10} ohms Typical
CAPACITANCE: SPST Form A — 0.8 picofarad Typical
SPDT Form C — 4.0 picofarad Typical
SHOCK: 50 g's @ 11ms (MR-990: 30 g's @ 11ms)
VIBRATION: 35 g's 50 to 2000 Hz (MR-990: 20 g's 50 to 2000 Hz)
STANDARD TEST COIL: COMPACT — R-580
STANDARD — R-580
LARGE — R-584

AVAILABLE SENSITIVITY:	
COMPACT	30/80
STANDARD	30/80
(Except MR-890, 830, 893, MR-200-1, 200-2)	60/100
	20/50
LARGE	40/100

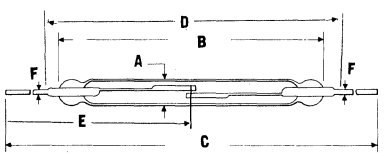


Part #	A — Maximum Glass Diameter (Inches)	B — Maximum Glass Length (Inches)	C — Nominal Uncut Switch Length (Inches)	D — Minimum Trim Length (Inches) [1]	E — Nominal Uncut Armature Length (Inches)	F — Lead Configuration (Inches)	Maximum Current (Amps)	Maximum Switching Voltage (VDC)	Maximum Contact Rating (Watts)	Minimum Breakdown Voltage (VRMS)	Maximum Initial Contact Resistance (Ohms)	Typical Operate Time Including Bounce (Milliseconds)	Contact Material [2]
COMPACT SPST — FORM A OFFSET GAP						**Pole**							
MR-606	.190	1.45	3.20	1.70	1.79	.055 Dia.	1.0	250	15	300	.050	2.0	D
MR-608	.190	1.45	3.20	1.70	1.79	**Arm.**	1.0	250	15	300	.050	2.0	R
MR-618	.190	1.45	3.20	1.70	1.79	.035 x .061	1.0	250	15	300	.100	2.0	P
CENTER GAP													
MR-506	.190	1.40	3.12	1.65	1.56	.022 x .061	1.0	250	15	300	.050	2.0	D
MR-508	.190	1.40	3.12	1.65	1.56	.022 x .061	1.0	250	15	300	.050	2.0	R
MR-518	.190	1.40	3.12	1.65	1.56	.022 x .061	1.0	250	15	300	.100	2.0	P
STANDARD SPST — FORM A OFFSET GAP													
MR-806	.195	1.70	3.20	1.95	1.79	**Pole**	1.0	250	15	500	.050	2.0	D
MR-808	.195	1.70	3.20	1.95	1.79	.055 Dia.	1.0	250	15	500	.050	2.0	R
MR-818	.195	1.70	3.20	1.95	1.79	**Arm.**	1.0	250	15	500	.100	2.0	P
MR-890	.195	1.70	3.20	1.95	1.79	.035 x .061	3.0	200	100	400	.500	2.5	W
MR-830	.215	1.70	3.20	1.95	1.79		3.0 [3]	3500	50	5000	.500	2.5	M
MR-893	.195	1.70	3.20	2.50	1.79	[4]	3.0 [3]	1500	100	2000	.500	2.5	W
CENTER GAP													
MR-706	.190	1.65	3.40	1.90	1.70	.035 x .061	1.0	250	15	300	.050	2.0	D
MR-708	.190	1.65	3.40	1.90	1.70	.035 x .061	1.0	250	15	300	.050	2.0	R
MR-718	.190	1.65	3.40	1.90	1.70	.035 x .061	1.0	250	15	300	.100	2.0	P
SPDT — FORM C [5]												**N.O./N.C.**	**N.O./ARM./N.C.**
MR-2208	.218	1.50	3.50	2.10	2.093	.045 Dia. [4]	.500	250	10	1000	.100	2.5/3.5	R/R/P
MR-201	.190	1.20	3.15	1.45	1.923	**Pole**	.250	100	10	250	.200	2.5/3.5	G/D/P
MR-200-1	.190	1.20	3.15	1.45	1.923	.030 x .055	.250	100	10	250	.200	3.5/2.5	G/D/G
MR-200-2 (Latcher)	.190	1.20	3.15	1.45	1.923	**Arm.** .045 Dia. [4]	.250	100	10	250	.200	3.5/3.5	G/D/G
LARGE SPST — FORM A CENTER GAP													
MR-906	.210	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	15	500	.050	2.5	D
MR-908	.210	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	15	500	.050	2.5	R
MR-918	.210	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	15	500	.100	2.5	P
MR-956	.195	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	15	500	.050	2.5	D
MR-958	.195	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	15	500	.050	2.5	R
MR-920	.210	2.07	3.20	2.32	1.60	.021 x .100	1.0	250	25	500	.035	2.5	S
MR-938	.210	2.07	3.20	2.50	1.60	.021 x .100 [4]	1.0 [3]	1200	25	1400	.050	2.5	R
MR-990	.210	2.07	3.20	2.32	1.60	.021 x .100	3.0	250	100	300	.050	3.0	D-W

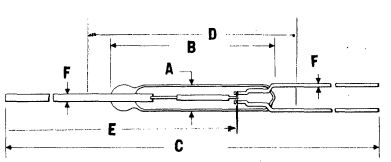
[1] Consult factory before exceeding minimum.
[2] D-Dimet — dropout normal; R-Rhodium — dropout normal; P-Precious Metal — dropout high; M-Molybdenum — dropout high; W-Tungsten — dropout high; S-Silver — dropout high.
[3] Derate to .010 amp. @ 1000 VDC.
[4] Hollow Tube: .075" Dia.
[5] N.C. contact designated by color dot. MR-200-1, 200-2 are magnet biased and polarity sensitive.



SPST — Form A Offset Gap



SPST — Form A Center Gap

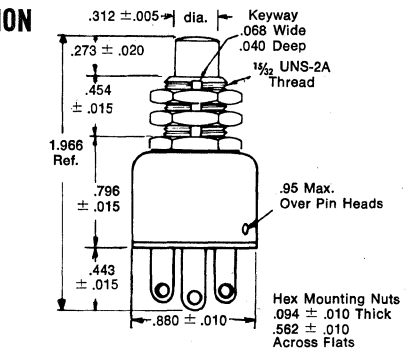


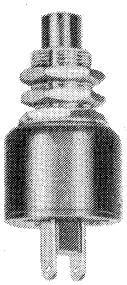
SPDT — Form C

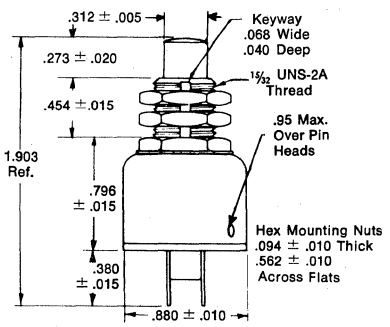
Grayhill®

PUSH BUTTON SWITCHES

10 AMP SNAP ACTION







RATING:

Rating at 115 VAC Resistive: 10 Amps.
Contact Resistance: Less than 25 milliohms on new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 25,000 operations.

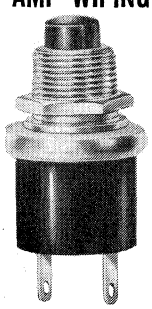
OPERATING FEATURES:

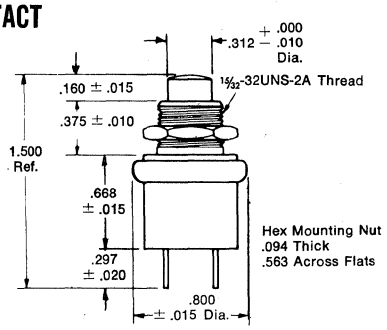
Circuitry: SPST and SPDT, momentary contact. Audible "Click" is produced by the snap action mechanism featuring extremely fast make and break, minimum contact "bounce."
Total Button Travel: .065" approximately.
Overtravel: .008" approximately.
Actuating Force: 36 ounces approximately.
Mounting Hole: 31/64"
Terminal Type: Solder. Also available with FASTON Terminals.

ORDERING INFORMATION:

Part Number	Button Color	Terminal Type	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
2201 (N.O.)	Red	Solder	$2.85 Ea.	$1.71 Ea.
7-7 (N.O.)	Black	Solder	2.85 Ea.	1.71 Ea.
2202 (N.C.)	Black	Solder	2.85 Ea.	1.71 Ea.
7-8 (N.C.)	Red	Solder	2.85 Ea.	1.71 Ea.
7-26R (SPDT)	Red	Solder	4.05 Ea.	2.43 Ea.
7-26B (SPDT)	Black	Solder	4.05 Ea.	2.43 Ea.

1 AMP WIPING CONTACT





The Series 4000 wiping contact push button switches are available in standard and positive feel contact action versions. Contact factory for positive feel versions.

RATING:

Rating at 115 VAC Resistive: 1 Amp.
Contact Resistance: Less than 25 milliohms on new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 100,000 operations.

OPERATING FEATURES:

Circuitry: SPST (N.O.) or (N.C.) momentary contact.
Total Button Travel: .140" ±.032 (4001, 10-9).
.110" +.020 −.010 (4002, 10-10).
Overtravel: .020" minimum (4001 10-9).
Pretravel: .010" minimum (4002 10-10).
Actuating Force: 22 ounces ±8 (4001, 4002, 10-9, 10-10).
Mounting Hole: 31/64".
Terminal Type: Solder.

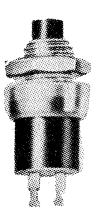
ORDERING INFORMATION:

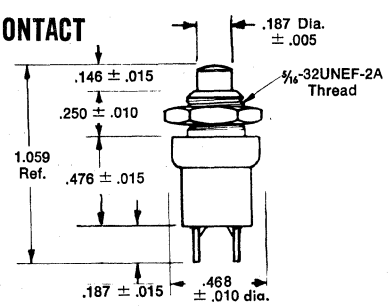
Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
4001* (N.O.)	Red	$1.05 Ea.	$0.63 Ea.
10-9 (N.O.)	Black	1.05 Ea.	0.63 Ea.
4002* (N.C.)	Black	1.05 Ea.	0.63 Ea.
10-10 (N.C.)	Red	1.05 Ea.	0.63 Ea.

* Add UL to part number for UL listed switches.

DISCOUNTS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE

¼ AMP WIPING CONTACT





RATING:

Rating at 115 VAC Resistive: ¼ Amp.
Contact Resistance: Less than 25 milliohms on new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulated Resistance: 1,000 megohms minimum.
Life Expectancy: 100,000 operations.

OPERATING FEATURES:

Circuitry: SPST (N.O.) momentary contact switch.
Total Button Travel: .095" ±.010.
Overtravel: .005 minimum.
Actuating Force: 16 ounces ±4.
Mounting Hole: 21/64".
Terminal Type: Solder.

ORDERING INFORMATION:

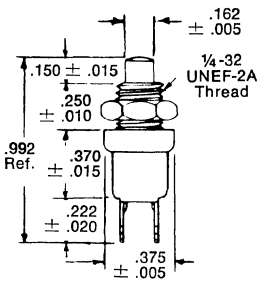
Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
23-1 (N.O.)	Red Button	$1.20 Ea.	$0.72 Ea.
23-4 (N.O.)	Black Button	1.20 Ea.	0.72 Ea.

Grayhill®

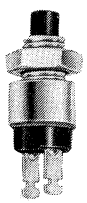
PUSH BUTTON SWITCHES

1 AMP BUTT CONTACT

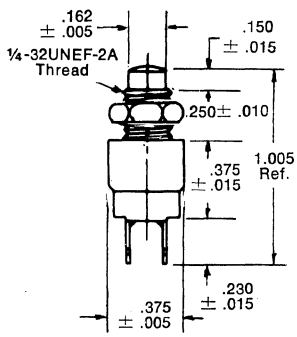
30-1 (N.O.)
30-3 (N.O.)



HEX MOUNTING NUT, .109 Thick, .375 Across Flats



30-2 (N.C.)
30-6 (N.C.)



The Series 30 butt contact push button switches are available in standard, normally open with overtravel, positive feel and push-pull versions. Contact factory for part numbers of overtravel, positive feel and push-pull versions.

RATING:

Rating at 115 VAC Resistive: 1 Amp.
Contact Resistance: 25 milliohms or less on a new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 1,000,000 operations.

OPERATING FEATURES:

Circuitry: SPST (N.O.) or (N.C.), Momentary Contact.
Total Travel: .062″ ±.010″ (30-1, 30-3).
.065″ +.010″ −.015″ (30-2, 30-6).
Actuating Force: 10 ounces ±4 (30-1, 30-3).
8 ounces ±4 (30-2, 30-6).
Mounting Hole: 17/64″.
Terminal Type: Solder.

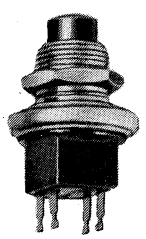
ORDERING INFORMATION:

Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
30-1* (N.O.)	Red	$0.90 Ea.	$0.54 Ea.
30-2* (N.C.)	Black	0.90 Ea.	0.54 Ea.
30-3 (N.O.)	Black	0.90 Ea.	0.54 Ea.
30-6 (N.C.)	Red	0.90 Ea.	0.54 Ea.

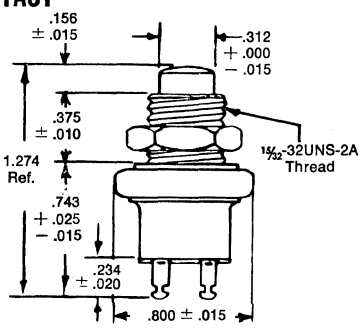
* Add UL to part number for UL listed switches.

DISCOUNTS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

½ AMP WIPING CONTACT



35-1 (N.O.)



RATING:

Rated at 115 VAC, Resistive: ½ Amp.
Contact Resistance: Less than 25 milliohms on new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 100,000 operations.

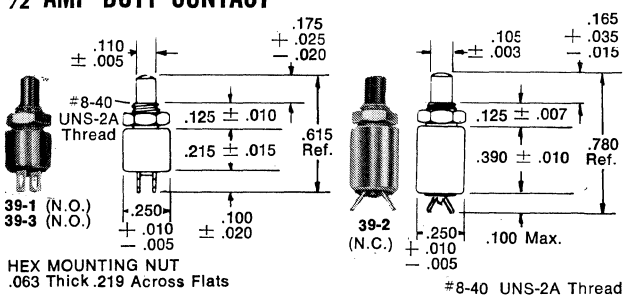
OPERATING FEATURES:

Circuitry: DPST (N.O.) momentary contact switch.
Total Button Travel: .062 ±.015.
Overtravel: .005 minimum.
Actuating Force: 20 ounces ±8.
Mounting Hole: 31/64″.
Terminal Type: Solder.

ORDERING INFORMATION:

Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
35-1 (N.O.)	Red Button	$1.50 Ea.	$0.90 Ea.
35-3 (N.O.)	Black Button	1.50 Ea.	0.90 Ea.

½ AMP BUTT CONTACT



39-1 (N.O.)
39-3 (N.O.)

39-2 (N.C.)

HEX MOUNTING NUT
.063 Thick .219 Across Flats

#8-40 UNS-2A Thread

GOLD PLATED CONTACT SYSTEM
MOLDED-IN TERMINALS (N.O. VERSIONS) PREVENTS FLUX CONTAMINATION

The Series 39 butt contact push button switches are available in standard, normally open with overtravel and PC mountable (right angle actuated) versions. Contact factory for part numbers of overtravel and PC mountable versions.

RATING:

Current Rating at 115 VAC Resistive: ½ Amp. (39-1, 39-3) ¼ Amp. (39-2).
Contact Resistance: Less than 25 milliohms on a new switch.
Voltage Breakdown: 500 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 1,000,000 operations (39-1, 39-3).
250,000 operations (39-2).

OPERATING FEATURES:

Circuitry: SPST (N.O.) or (N.C.), Momentary Contact.
Total Travel: .035″ ±.015″ (39-1, 39-3).
.042″ ±.010″ (39-2).
Actuating Force: 4 ounces +4, −2 (39-1, 39-3).
4 ounces ±2 (39-2).
Mounting Hole: 11/64″.
Terminal Type: Solder.

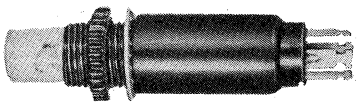
ORDERING INFORMATION:

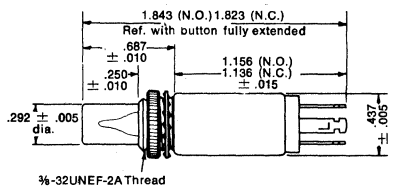
Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
39-1 (N.O.)	Red Button	$1.15 Ea.	$0.69 Ea.
39-3 (N.O.)	Black Button	1.15 Ea.	0.69 Ea.
39-2 (N.C.)	Black	1.60 Ea.	0.96 Ea.

Grayhill®

PUSH BUTTON SWITCHES

ILLUMINATED 1 AMP BUTT CONTACT





RATING:

Rating at 115 VAC Resistive: 1 Amp.
Contact Resistance: 25 milliohms or less on a new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 500,000 operations.

OPERATING FEATURES:

Circuitry: SPST (N.O.) or (N.C.), momentary contact.
Button Travel: .062″ ±.010″ for N.O. Switches.
.050″ ±.015″ for N.C. Switches.
Actuating Force: 16 ounces +8, −4 for N.O. Switches.
7 ounces ±3 for N.C. Switches.
Mounting Hole: 25/64″.
Switch Terminals: Solder.
Lamp: Neon, General Electric A9A or equivalent.
Incandescent, General Electric 1764 (20 VDC Max.) or equivalent.
Independent Lamp and Switch Circuits.
EXTENDED LAMPLIFE: Lamp does not move during actuation of the switch. Incandescent operation at the voltage stated above provides lamp life commensurate with the switch life.
Lamp Terminals: Neon and Incandescent — Lead Tin Fused.
LED: Cathode — Steel, Gold Plated.
Anode — Steel, Tin Plated.
EXTERNAL LIMIT RESISTOR REQUIRED

ORDERING INFORMATION:

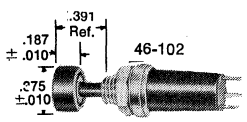
Part Number	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
NEON LAMP		
40-1 (Specify Color*) (N.O.)	$2.65 Ea.	$1.59 Ea.
40-2 (Specify Color*) (N.C.)	2.90 Ea.	1.74 Ea.
INCANDESCENT LAMP		
40-100 (Specify Color†) (N.O.)	$2.95 Ea.	$1.77 Ea.
40-102 (Specify Color†) (N.C.)	3.20 Ea.	1.92 Ea.
LED		
40-200 (Red) (N.O.)	$4.40 Ea.	$2.64 Ea.
40-202 (Red) (N.C.)	4.40 Ea.	2.64 Ea.

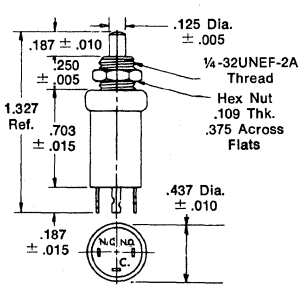
* Clear, Transparent Amber, Transparent Red, and Frosted White.
† Clear, Transparent Amber, Transparent Red, Frosted White, Frosted Red, Frosted Green, and Frosted Yellow.

Companion indicator lights are available for the Series 40.

½ AMP WIPING CONTACT

46-101



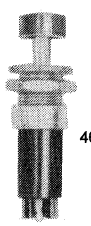


RATING:

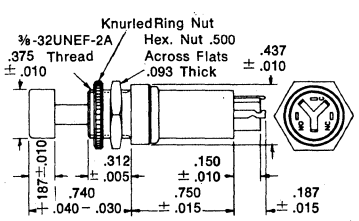
Rating at 115 VAC Resistive: ¼ Amp.
Contact Resistance: Less than 25 milliohms on a new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 250,000 operations.

OPERATING FEATURES:

Circuitry: SPDT (break before make), momentary contact.
Button Travel: Total Travel .180″ minimum.
Break before Make: Rest Position to N.O. Break .020″ min.
Rest Position to N.O. Make .140″ max.
Actuating Force: Momentary Contact 17 ounces ±5.
Mounting Hole: 17/64″.
Terminal Type: Solder.

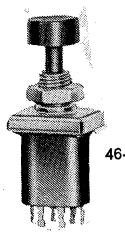


46-502

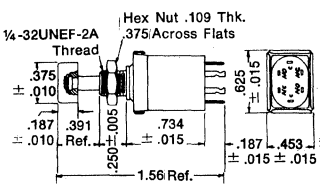


Series 46-502 provides an alternate action (push-on/push-off) version of the Series 46 contact system. The ratings and operating features listed above for the Series 46 are applicable to the 46-502 with the following exceptions:

Circuitry: SPDT (break before make only) maintained contact.
Button Travel: Rest Position to Bottom Position .210″ ±.015″.
Rest Position to Lock-down Position .085 ±.015″.



46-200



Series 46-200 and 46-201 provide DPDT circuitry in the Series 46 contact system. The ratings and operating features listed above for the Series 46 are applicable to the 46-200 and 46-201 with the following exceptions:

Circuitry: DPDT (break before make), momentary contact.
Actuating Force: 35 ounces ±9.

ORDERING INFORMATION:

Part Number	Button Color	List Price Subject to Qty. Disc.	Net Price For 100 Pieces
MOMENTARY BREAK BEFORE MAKE*			
46-101R	Red Button	$1.40 Ea.	$0.84 Ea.
46-101B	Black Button	1.40 Ea.	0.84 Ea.
46-102R	Red Button Cap	1.50 Ea.	0.90 Ea.
46-102B	Black Button Cap	1.50 Ea.	0.90 Ea.
ALTERNATE ACTION			
46-502R	Red Button Cap	$3.50 Ea.	$2.10 Ea.
46-502B	Black Button Cap	3.50 Ea.	2.10 Ea.
MOMENTARY BREAK BEFORE MAKE			
46-200R	Red Button Cap	$3.10 Ea.	$1.86 Ea.
46-200B	Black Button Cap	3.10 Ea.	1.86 Ea.

* Available in Momentary Make Before Break versions.

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"GRAYHILL . . . the Difference Between Excellent and Adequate"

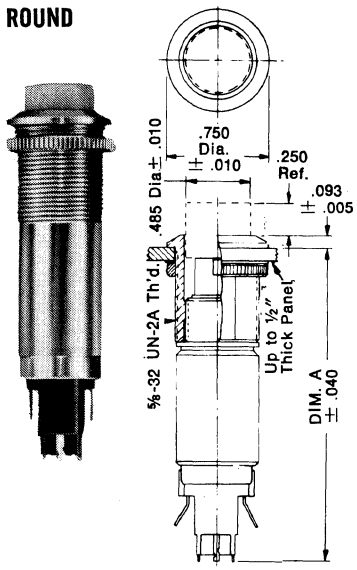
Grayhill®

PUSH BUTTON SWITCHES

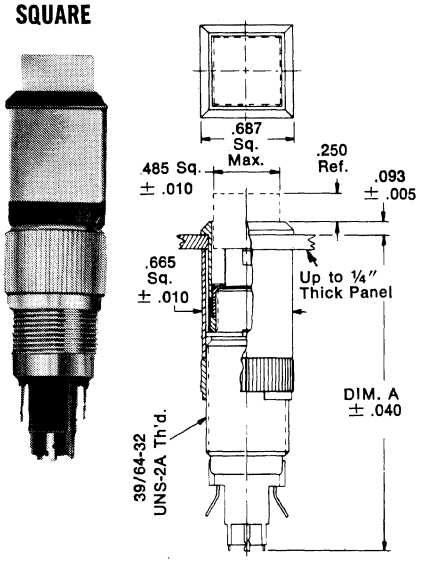
LIGHTED DECORATOR LINE — ¼ AMP RATINGS

FRONT PANEL BEZEL MOUNTING

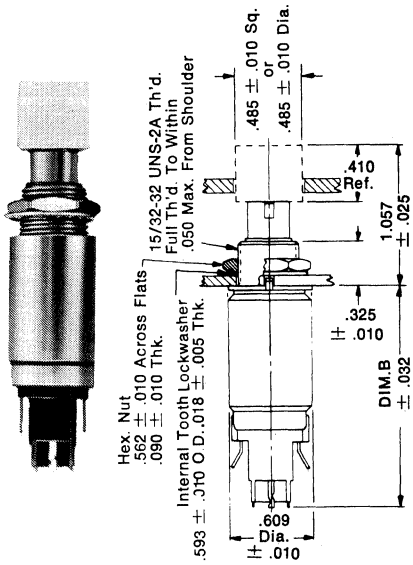
ROUND



SQUARE



SUB-PANEL MOUNTING



Circuitry	Dim. A	Dim. B
SPST — N.O. Momentary	1.883	1.159
SPST — N.C. Momentary	1.883	1.159
SPDT (Break before Make) Momentary	1.883	1.159
SPDT (Break before Make) Alternate Action	2.240	1.516
DPDT (Break before Make) Momentary	1.883	1.159
DPDT (Break before Make) Alternate Action	2.240	1.516

RATING:

Rating at 115 VAC Resistive: ¼ Amp.
Contact Resistance: Less than 25 milliohms on a new switch.
Voltage Breakdown: 1,000 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 250,000 operations.

LAMPS:

All button caps accept standard T-1¾ midget flange base lamps. Lamps are not supplied with button caps or assemblies of caps and switches. Companion indicator lights are available for the Series 80.

LEGENDS:

To order, contact factory.

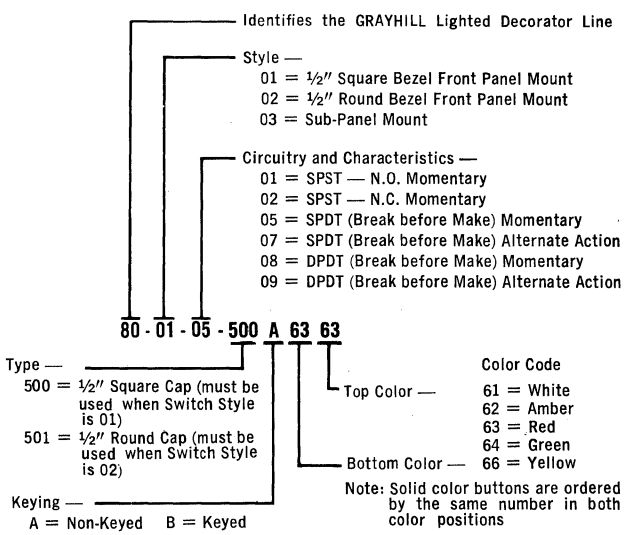
HOW TO ORDER:

Part number is stylized to select desired switch and cap. Switches and button caps can be ordered separately or as an assembly.

For Switches Select —
- Style of Mounting.
- Circuitry and Characteristics.

For Button Caps Select —
- Proper or desired Button Cap Shape.
- Keyed or non-keyed Caps (Keyed preferable on legended buttons to ensure proper alignment).
- Button Cap Color and Top Cap Color — Button can be made in one color or in two colors, such that the lower half of the button is one color and the top half is another. When assembled, the lower color forms a color ring. This color ring disappears in the down position. This effect is particularly useful with alternate action switches as an indication of switch position.

EXAMPLE OF SWITCH WITH BUTTON CAP:



PRICES:

Part Number shown is for basic switch. Price includes switch and cap.

Switch Part No.	List Part	Switch Part No.	List Part	Switch Part No.	List Part
80-01-01	$4.70	80-02-01	$4.70	80-03-01	$3.80
80-01-02	4.70	80-02-02	4.70	80-03-02	3.80
80-01-05	4.70	80-02-05	4.70	80-03-05	3.80
80-01-07	6.05	80-02-07	6.05	80-03-07	4.80
80-01-08	5.25	80-02-08	5.25	80-03-08	4.35
80-01-09	6.60	80-02-09	6.60	80-03-09	5.35

All prices are subject to quantity discount. For example, 100 pieces of a single part number (button cap, basic switch, or combination) are discounted 40% from the above prices. Contact factory for specific quantity.

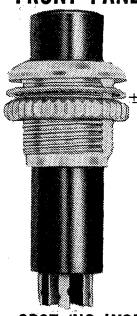
DISCOUNTS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

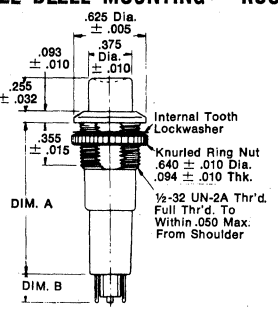
Grayhill®

PUSH BUTTON SWITCHES

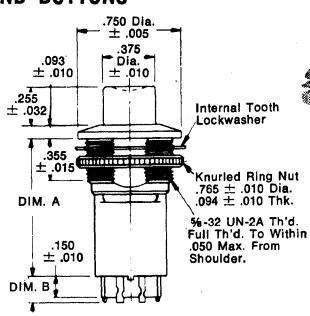
DECORATOR LINE — ¼ AND 1 AMP RATINGS

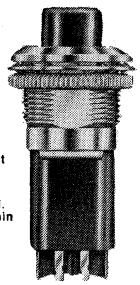
FRONT PANEL BEZEL MOUNTING — ROUND BUTTONS





SPST (NO INSULATING POST)
SPDT

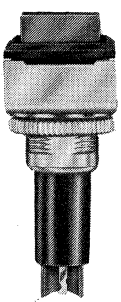


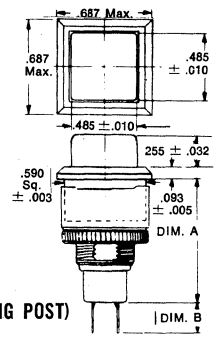


DPDT

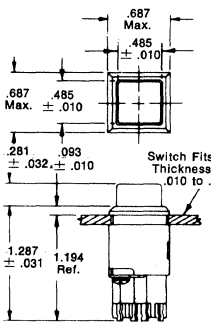
	Part No.	Dim. A	Dim. B
SPST —			
(N.O.) Momentary	30-05-01	.710 ±.015	.222 ±.020
(N.C.) Momentary	30-05-02	.690 ±.015	.230 ±.015
(N.O. Overtravel) Momentary	30-05-03	.780 ±.015	.222 ±.020
(N.O. Positive Feel) Momentary	30-05-04	.910 ±.020	.222 ±.020
SPDT —			
Momentary	46-05-05	.992 ±.015	.187 ±.015
Alternate Action	46-05-07	1.278 ±.015	.187 ±.015
DPDT —			
Momentary	46-05-08	1.001 ±.015	.187 ±.015
Alternate Action	46-05-09	1.130 ±.015	.187 ±.015

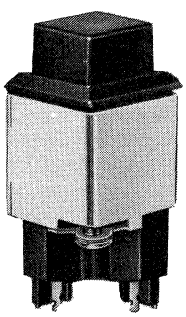
FRONT PANEL BEZEL MOUNTING — SQUARE BUTTONS





SPST (NO INSULATING POST)
SPDT

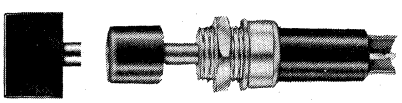




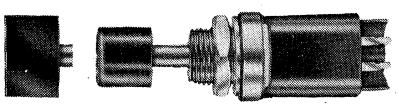
DPDT

	Part No.	Dim. A	Dim. B
SPST —			
(N.O.) Momentary	30-01-01	.880 ±.020	.222 ±.020
(N.C.) Momentary	30-01-02	.830 ±.020	.230 ±.015
(N.O. Overtravel) Momentary	30-01-03	.920 ±.020	.222 ±.020
(N.O. Positive Feel) Momentary	30-01-04	1.037 ±.020	.222 ±.020
SPDT —			
Momentary	46-01-05	1.174 ±.015	.187 ±.015
Alternate Action	46-01-07	1.264 ±.015	.187 ±.015
DPDT —			
Momentary	46-01-08	As Shown	
Alternate Action	46-01-09		

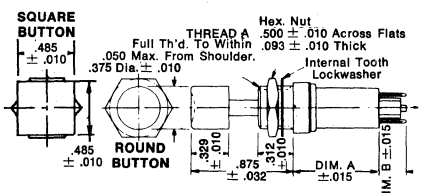
SUB-PANEL MOUNT — ROUND OR SQUARE BUTTONS

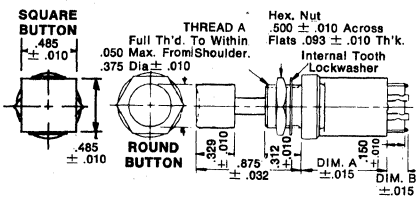


SPST (NO INSULATING POST)
SPDT



DPDT





	Part No.	Thread A	Dim. A	Dim. B
SPST —				
(N.O.) Momentary	30-03-01	⅜-32	.359	.222
(N.C.) Momentary	30-03-02	⅜-32	.308	.230
(N.O. Overtravel) Momentary	30-03-03	⅜-32	.387	.222
(N.O. Positive Feel) Momentary	30-03-04	15/32-32	.377	.222
SPDT —				
Momentary	46-03-05	⅜-32	.703	.187
Alternate Action	46-03-07	⅜-32	.750	.187
DPDT —				
Momentary	46-03-08	⅜-32	.701	.187
Alternate Action	46-03-09	⅜-32	.750	.187

RATING:

Rating at 115 VAC Resistive: 1 Amp. (Series 30); ¼ Amp. (Series 46).

Contact Resistance: 25 milliohms or less on a new switch.

Voltage Breakdown: 1,000 VAC between mutually insulated parts.

Insulation Resistance: 1,000 megohms minimum.

Life Expectancy: Series 30; minimum of 200,000.
Series 46; 250,000 operations, all circuitry versions.

LEGENDS:

To order, contact factory.

PRICES:

Part No.*	List Price Subject to Qty. Disc.	Net Price 100 Pieces	Part No.*	List Price Subject to Qty. Disc.	Net Price 100 Pieces
30-01-01	$2.10 Ea.	$1.26 Ea.	46-01-05	$2.35 Ea.	$1.41 Ea.
30-01-02	2.35 Ea.	1.41 Ea.	46-01-07	3.90 Ea.	2.34 Ea.
30-01-03	2.20 Ea.	1.32 Ea.	46-01-08	3.40 Ea.	2.04 Ea.
30-01-04	2.95 Ea.	1.77 Ea.	46-01-09	4.85 Ea.	2.91 Ea.
30-03-01	1.25 Ea.	.75 Ea.	46-03-05	2.00 Ea.	1.20 Ea.
30-03-02	1.50 Ea.	.90 Ea.	46-03-07	3.50 Ea.	2.10 Ea.
30-03-03	1.50 Ea.	.90 Ea.	46-03-08	3.10 Ea.	1.86 Ea.
30-03-04	2.30 Ea.	1.38 Ea.	46-03-09	4.20 Ea.	2.52 Ea.
30-05-01	2.10 Ea.	1.26 Ea.	46-05-05	2.35 Ea.	1.41 Ea.
30-05-02	2.35 Ea.	1.41 Ea.	46-05-07	3.90 Ea.	2.34 Ea.
30-05-03	2.20 Ea.	1.32 Ea.	46-05-08	3.40 Ea.	2.04 Ea.
30-05-04	2.95 Ea.	1.77 Ea.	46-05-09	4.85 Ea.	2.91 Ea.

* Part No. shows series, mounting and circuitry for price purposes only. Complete Part No. must contain button cap information.

Prices shown include switch and button cap.

DISCOUNTS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

"GRAYHILL . . . the Difference Between Excellent and Adequate"

PUSH BUTTON SWITCHES

DECORATOR LINE — ¼ & 1 AMP RATINGS (Continued)

HOW TO ORDER:

Select —

Switch Series.

Style of Mounting.

Circuitry.

Proper or desired Button Cap shape.

Bottom Cap Color and Top Cap Color — Buttons for the round and square bezel mounted switches and the square sub-panel mounted switches can be made in two colors. When assembled, the lower color forms a color ring. This color ring disappears in the down position. This effect is particularly adaptable to alternate action switches as an indication of switch position. Additionally, a translucent top cap can be ordered for the ½" square caps. Contact factory for two color caps.

The example part number to the right, describes a Series 30, ½" square button, front bezel mount, SPST-N.O., momentary push button switch with a solid white button cap.

Part number 30-03-04-500-0707 describes a Series 30, sub-panel mount, SPST-N.O., positive feel, momentary push button switch with a square solid black button cap.

SWITCH SELECTION:

Series 30 — 1 Amp Rating (Circuitry 01, 02, 03, & 04)
Series 46 — ¼ Amp Rating (Circuitry 05, 07, 08, & 09)

Style —
01 = ½" Square Button, Front Panel Bezel Mounting
05 = ⅜" Round Button, Front Panel Bezel Mounting
03 = Sub-Panel Mount

Circuitry —
SERIES 30
01 = SPST — N.O. Momentary
02 = SPST — N.C. Momentary
03 = SPST — N.O., Overtravel, Momentary
04 = SPST — N.O., Positive Feel, Momentary
SERIES 46
05 = SPDT (Break before Make) Momentary
07 = SPDT (Break before Make) Alternate Action
08 = DPDT (Break before Make) Momentary
09 = DPDT (Break before Make) Alternate Action

30 - 01 - 01 - 500 - 01 01

BUTTON CAP SELECTION

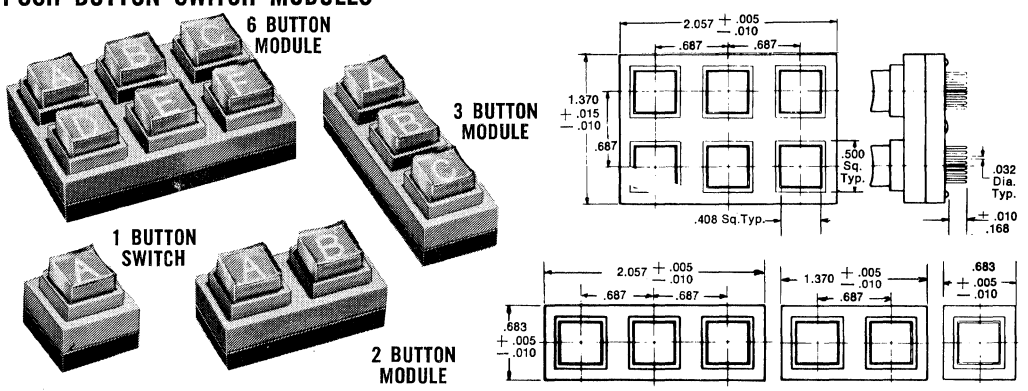
Top Color — Color Code
01 = White
03 = Red
04 = Green
05 = Blue
06 = Yellow
07 = Black

Bottom Color —

Note: Solid color buttons are ordered by the same number in both color positions.

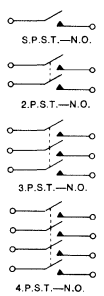
Type —
500 = ½" Square Cap (Must Be Used With -01 Switch Style)
502 = ⅜" Round Cap (Must Be Used With -05 Switch Style)

PUSH BUTTON SWITCH MODULES



CIRCUIT DIAGRAMS

Each switch in the module can be provided with one of the following configuration.



RATING:

Rating at 5 VDC: 100 milliamps.
Contact Resistance: 25 milliohms or less on a new switch.
Voltage Breakdown: 250 VAC between mutually insulated parts.
Insulation Resistance: 1,000 megohms minimum.
Life Expectancy: 1,000,000 operations.

OPERATING FEATURES:

Button Travel: 0.150" total travel.
Overtravel: 0.100" nominal.
Operating Force: 4-7 ounces (dependent on number of poles).

LEGENDS:

To order, contact factory.

MOUNTING:

Modules are designed to plug into any printed circuit board from 1/16 inch to ⅛ inch thick.

Modules can be stacked horizontally or vertically for any combination of button array and still maintain 1 1/16 inch button centers.

ORDERING INFORMATION:

To order a Series 82 push button module, there are five areas in which information is required:

1. Type of module: 1-, 2-, 3-, or 6-button.
2. Type of mounting: either horizontal or vertical.
3. Circuitry required for each button (A = SPST; B = 2PST; C = 3PST, etc.).
4. Color for each internal button (GRAY is standard; other available colors are WHITE, RED, GREEN, and BLACK. Colors can be intermixed. For example, Buttons A thru E are GRAY and F is WHITE).
5. Hot-stamping required on buttons (Button A legend #1, Button B legend #2, etc.).

Upon receipt of your order, a part number will be assigned to facilitate future identification of this part. These numbers are sequentially assigned as the need arises and are non-descriptive.

PRICES:

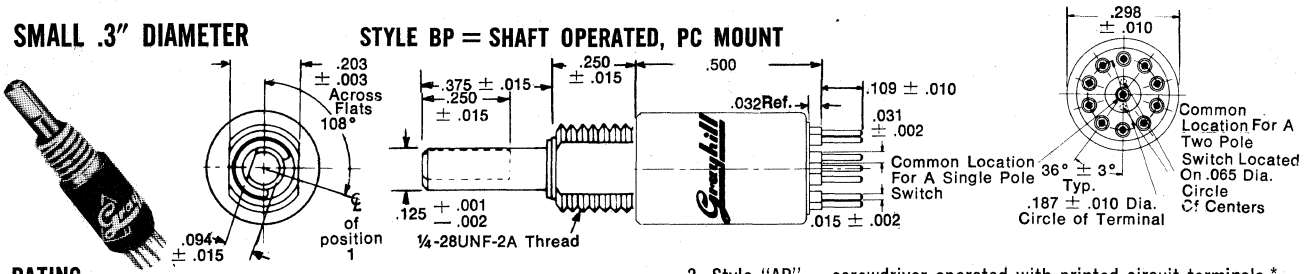
Contact GRAYHILL or our local representative.

Grayhill®

ROTARY SWITCHES

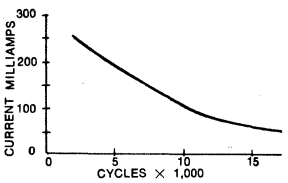
SMALL .3" DIAMETER

STYLE BP = SHAFT OPERATED, PC MOUNT



RATING:

Life Expectancy:



CIRCUIT DIAGRAM

(Switch is viewed from shaft end and shown in position 1.)

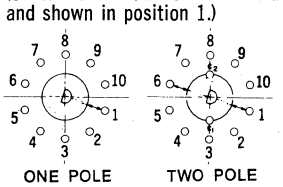


Chart shown for non-shorting contacts (break before make). Voltage: 115 VAC or 30 VDC, resistive load.

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the above curve was measured at sea level, 25°C. and 68% relative humidity with the following life limiting criteria.

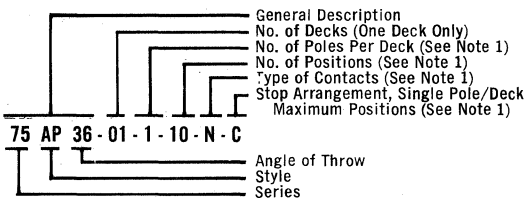
Contact Resistance: 50 milliohms maximum. (15 milliohms initially).

Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

Voltage Breakdown: 500 VAC minimum between mutually insulated parts.

ORDERING INFORMATION AND NOTES:

1. This switch is available in one or two pole configuration with non-shorting type contacts. All switches are one pole, two thru ten positions or two pole, two thru five positions.
   Suffix "C" or "F" **must** be added to part number of a 1 Pole/Deck, 10 Position Switches to indicate continuous rotation (C) or a fixed stop (F) between positions 10 and 1.
2. Style "AP" = screwdriver operated with printed circuit terminals.*
   Style "BP" = shaft operated with printed circuit terminals.
   Style "CP" = Integral knob operated with printed circuit terminals.*
3. How to determine part number: "Suffix "C" or "F" is required for a complete part number when ordering single pole/deck switches with maximum number of positions.
   Sample part number for a 1 pole, 10 position continuous rotation Style "AP," 36° angle of throw, screwdriver operated non-shorting type switch.



4. Sample part number for a 2 pole, 2 position, Style "BP," 36° angle of throw, shaft operated, non-shorting type switch: 75BP36-01-2-2N.

*Contact Factory

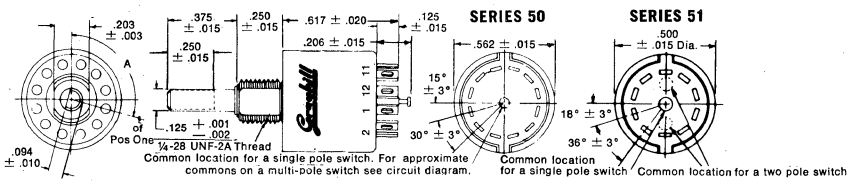
PRICES:

Style	List Price	
	1 Pole/Deck	2 Pole/Deck
AP	$4.70 Ea.	$6.30 Ea.
BP	5.85 Ea.	7.45 Ea.

ALL PRICES SUBJECT TO QUANTITY DISCOUNT.

For example, quantities of 100 switches of a single part number are discounted 50% from the above prices.

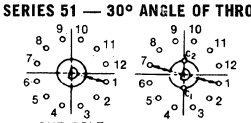
SMALL VERSATILE ¼ AMP RATING



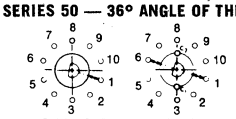
CIRCUIT DIAGRAMS

Switches are viewed from shaft end and shown in Position 1.

SERIES 51 — 30° ANGLE OF THROW



SERIES 50 — 36° ANGLE OF THROW



RATING: Life Expectancy:

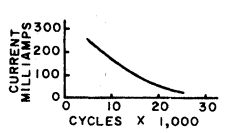


Chart shown for non-shorting contacts (break before make) Voltage: 115 VAC or 30 VDC, resistive load.

One cycle is 360° rotation and a return through all switch positions to the starting position. The data for the above curve as measured at sea level, 25°C and 68% relative humidity with the following life limiting criteria.

Contact Resistance: 50 milliohms maximum. (10 milliohms initially.)

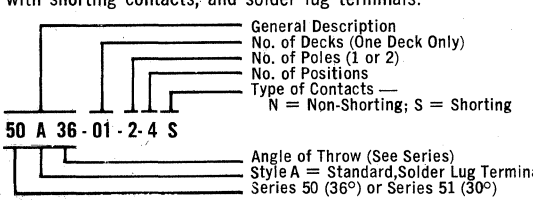
Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

Voltage Breakdown: 600 VAC minimum between mutually insulated parts.

Contact Carry Rating: Switch will carry 6 amperes continuously with a maximum contact temperature rise of 20°C.

ORDERING INFORMATION:

How to determine part number: sample part number for fixed stop, unsealed style, 36° angle of throw, 1 deck, 2 pole, 4 position switch with shorting contacts, and solder lug terminals:



For other angles of throw; 3 or 4 poles per switch; military, sealed, adjustable stop, or PC mountable styles, contact factory.

PRICES:

STYLE A

No. of Poles	Non-Shorting		Shorting	
	Series 50	Series 51	Series 50	Series 51
1	$6.20	$6.75	$6.50	$7.05
2	8.75	9.30	9.35	9.90

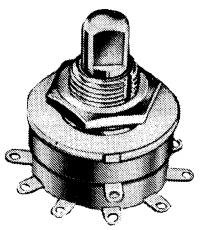
ALL PRICES SUBJECT TO QUANTITY DISCOUNT.

For example, quantities of 100 switches of a single part number are discounted 50% from the above prices.

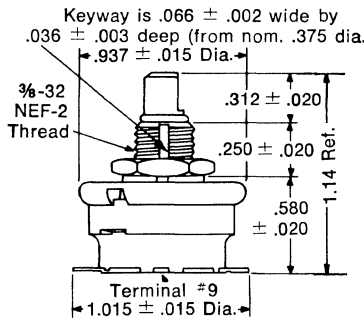
Grayhill®

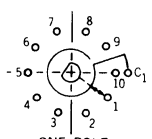
ROTARY SWITCHES

POSITIVE DETENT 1 AMP RATING



Single Deck Construction

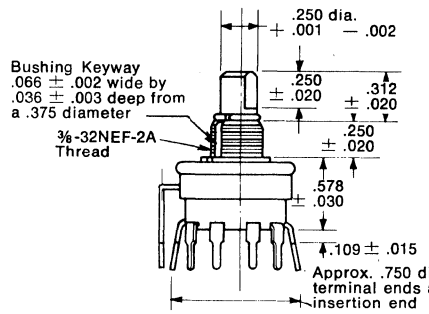


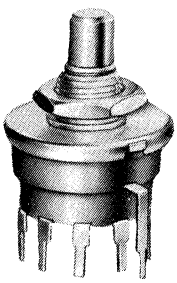


ONE POLE CIRCUIT DIAGRAM

(Switch is viewed from shaft end.)

NOTE: Common Terminal located above Base Terminals as shown.





Voltage Breakdown: 1,000 VAC, (500 VAC, or better after most environmental tests).

Life Expectancy: 100,000 mechanical cycles of operation normally.

Stop Strength: 12 pound-inches.

Rotational Torque: 12 ounce-inches.

Contacts: Shorting or non-shorting contacts. All are wiping contacts with over 300 grams contact force.

Shaft Flat Orientation: Opposite point of contact of pole number one. (See circuit diagram.)

RATING:

Rated: To break 1 amp. at 115 VAC, resistive circuit, or to carry ten amps. Ratings (make and break) at other voltages are as follows: ¼ amp., 115 VAC inductive; 1/50 amp., 115 VDC inductive; 1/10 amp., 6 to 28 VDC inductive; 1/10 amp., 115 VDC resistive; 1 amp., 6 to 28 VDC resistive.

Contact Resistance: .010 ohms initial. After 25,000 cycles of operation .020 ohms maximum.

Insulation Resistance: 50,000 megohms.

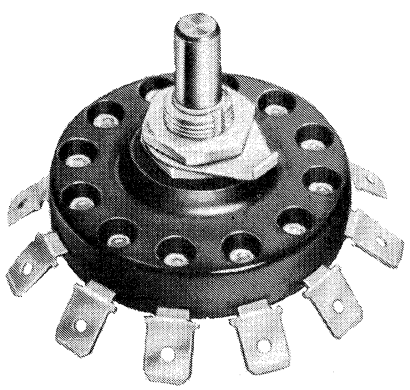
ORDERING INFORMATION AND PRICES:

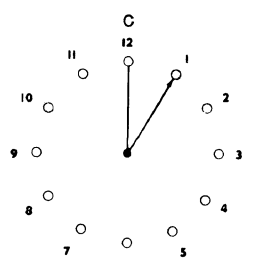
Part Number	Description	Price Subject to Quantity Discount
24-001-X*	Solder Lug	$4.65 Ea.†
24-878-X*	PC Mountable	5.25 Ea.

* Replace "X" with number of positions and add "S" for shorting contacts. Without an "S," switches are non-shorting type.

† Deduct 10¢ for each position less than 10 from list price.

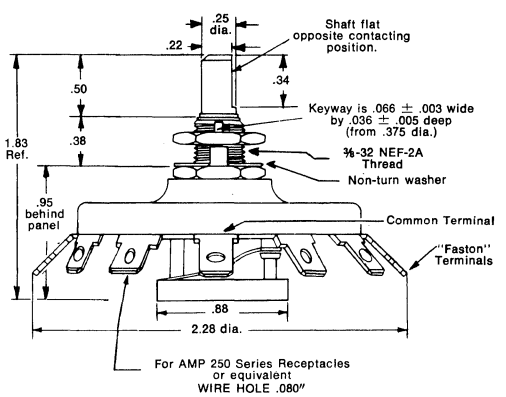
15 AMP — 1800 WATTS





CIRCUIT DIAGRAM

Drawings and Spec. For Ref. Only



RATING:

Rated: 15 amps. at 125 VAC resistive.

Contact Resistance: (Measured at 2 VDC and approx. 100 MA) for new switch approx. .010 ohms.

Insulation Resistance: Between mutually insulated parts, approx. 100,000 megohms.

Voltage Breakdown: Between mutually insulated parts, approx. 2500 VAC.

Rotational Torque: 30 to 75 ounce-inches on a new switch. Approx. 22 ounce-inches after 25,000 cycles of operation.

Contact Force: Approx. 12 ounces.

Life Expectancy: In excess of 50,000 cycles of operation at rated load.

CONSTRUCTION:

Single pole, single deck: 30° indexing. With from 2 to 11 positions plus common. Built-in stops omit common, unless otherwise specified. Non-shorting contacts only.

HOW TO ORDER:

Part Number 19101-* UL.

* (Indicate number of positions — 2, 3, 4, etc.)

No. of Positions	2	3	4	5	6	7	8	9	10	11
PRICES	$4.50 Ea.	$4.75 Ea.	$5.00 Ea.	$5.25 Ea.	$5.50 Ea.	$5.75 Ea.	$6.00 Ea.	$6.25 Ea.	$6.50 Ea.	$6.75 Ea.

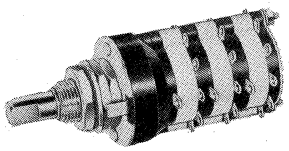
ALL PRICES SUBJECT TO QUANTITY DISCOUNT.

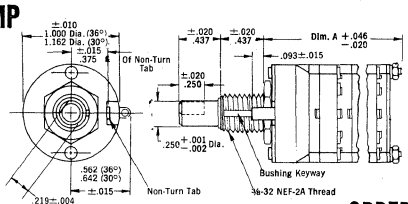
For example, quantities of 100 switches of a single part number are discounted 50% from the above prices.

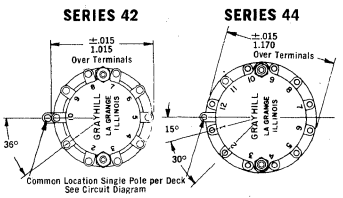
Grayhill®

ROTARY SWITCHES

VERSATILE CIRCUITRY — 1 AMP

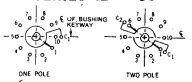




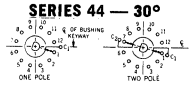


CIRCUIT DIAGRAMS

SERIES 42 — 36°



SERIES 44 — 30°

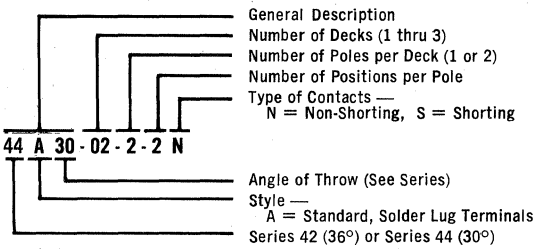


RATING:

Rated: To make and break the following loads with 30° or 36° angle of throw: 1 amp., 115VAC resistive; 1 amp., 6 to 28 VDC resistive; 0.25 amp., 115 VAC inductive; 0.02 amp., 115 VDC inductive; 0.10 amp., 6 to 28 VDC inductive; 0.10 amp., 115 VDC resistive. To carry 10 amps continuously.
Contact Resistance: .010 ohms initial. After 25,000 cycles of operation .020 ohms maximum.
Insulation Resistance: 50,000 megohms minimum (initially).
Voltage Breakdown: 1,000 VAC initially (500 VAC or better after most environmental tests).
Life Expectancy: 100,000 mechanical cycles of operation.
Stop Strength: 15 pound-inches minimum.
Rotational Torque: 20-96 ounce-inches, depending on the number of poles per deck and the number of decks.
Contacts: Shorting or non-shorting wiping contacts with over 150 grams contact force.
Shaft Flat Orientation: Flat opposite contacting position of pole number one. (See circuit diagram.)

ORDERING INFORMATION

How to determine part number — Sample part number for a standard style, fixed stop, 2 deck, 2 poles per deck, 2 position per pole, 30° angle of throw rotary switch with non-shorting contacts.



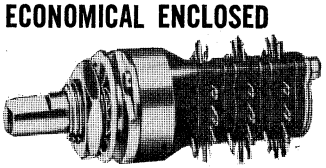
For other angles of throw; 3 to 6 poles per deck; 4 thru 12 decks; military, sealed, adjustable stop, or PC mountable styles, contact factory.

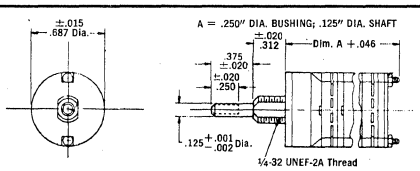
PRICES:

		ONE POLE PER DECK												TWO POLES PER DECK						
		SERIES 42A 36 AND 44A 30										SERIES 44A 30		SERIES 42A 36 AND 44A 30					SERIES 44A 30	
No. of Decks	Dim. A	Number of Positions												No. of Decks	Number of Positions					
		2	3	4	5	6	7	8	9	10	11	12			2	3	4	5	6	
1	1.025	$7.20	$7.30	$7.40	$7.50	$7.60	$7.70	$7.80	$7.90	$8.00	$8.10	$8.20		1	$8.20	$8.40	$8.60	$8.80	$9.00	
2	1.375	8.40	8.60	8.80	9.00	9.20	9.40	9.60	9.80	10.00	10.20	10.40		2	10.40	10.80	11.20	11.60	12.00	
3	1.717	9.60	9.90	10.20	10.50	10.80	11.10	11.40	11.70	12.00	12.30	12.60		3	12.60	13.20	13.80	14.40	15.00	

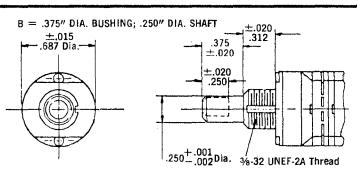
QUANTITY DISCOUNTS APPLY. For example 100 pieces of one part number carry a 50% discount from list prices shown.

ECONOMICAL ENCLOSED





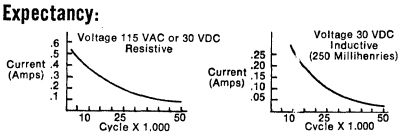
STYLE A



STYLE B

RATING:

Life Expectancy:

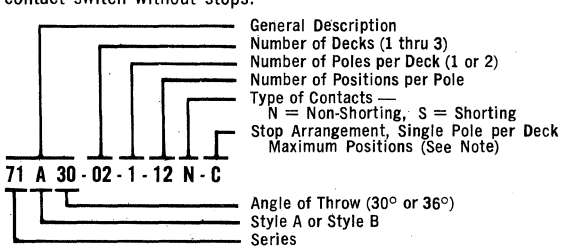


Switch rating for break before make contacts.
Curve data based on test data conducted at sea level, 25°C, and 68% relative humidity.
Cycle equals 360° rotation and return.
Cycling rate is 10 cycles per minute.
These switches will carry 4 amperes with a maximum contact temperature rise of 20°C.

Life limiting or failure criteria for these curves are:
Contact Resistance: 50 milliohms maximum (10 milliohms initially).
Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)
Voltage Breakdown: 500 VAC minimum between mutually insulated parts.
Rotational Torque: 4 - 32 ounce-inches, depending on the number of poles per deck and the number of decks.
Contacts: Shorting or non-shorting wiping contacts with over 100 grams of contact force.
Shaft Flat Orientation: Flat opposite contacting position pole #1 (See Circuit Diagrams).

ORDERING AND PRICING INFORMATION:

How to determine part number: Suffix "C" or "F" is required for a complete part number when ordering single pole/deck switches with maximum number of positions. Sample part number for a 2 deck, 1 pole/deck, 12 position, Style "A," 30° angle of throw, non-shorting contact switch without stops:



Sample part number for a 2 deck, 1 pole/deck, 12 position, style "B," 30° angle of throw, non-shorting contact switch with a stop between positions 1 and 12: 71B30-02-1-12N-F.

Same part number for a 1 deck, 1 pole/deck, 6 position, style "A," 30° angle of throw, shorting contact switch: 71A30-01-1-6S.

No. of Decks	Dim. A	NUMBER OF POLES PER DECK 30° or 36° Throw 1	2
1	.761	$4.70	$4.95
2	.979	6.70	7.20
3	1.197	8.70	9.45

Note: Number of positions does not affect price.

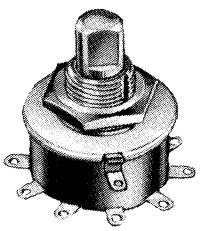
For 3 to 6 poles per deck; 4 thru 12 decks; sealed or PC mountable styles, contact factory.

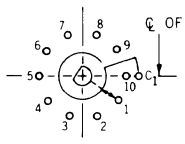
"GRAYHILL . . . the Difference Between Excellent and Adequate"

Grayhill®

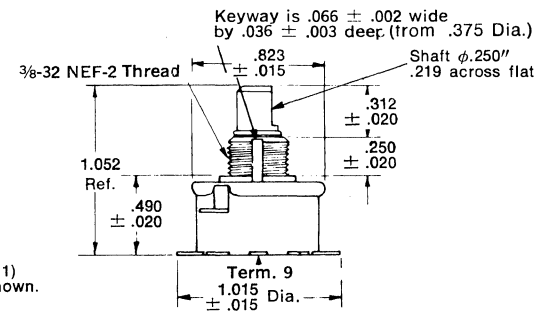
ROTARY SWITCHES

ECONOMICAL — 1 AMP RATING





(Switch is viewed from Shaft End and shown in Position No. 1)
All Common Terminals are located above Base Terminals, as shown.



RATING:

Rated: To break 1 amp. at 115 VAC, resistive circuit, or carry 5 amps. Rating (make or break) at other voltages are as follows: ¼ ampere, 115 VAC inductive; $^1/_{50}$ ampere, 115 VDC inductive; $^1/_{10}$ amp., 6 to 28 VDC inductive; $^1/_{10}$ amp., 115 VDC resistive; 1 amp., 6 to 28 VDC resistive.

Contact Resistance: .010 ohms initial. After 25,000 cycles of operation .020 ohms, maximum.

Insulation Resistance: 30,000 megohms initially.

Voltage Breakdown: 1,000 VAC, (500 VAC, or better after most environmental tests).

Life Expectancy: 100,000 mechanical cycles of operation.

Stop Strength: 12 pound-inches.

Rotational Torque: 12 ounce-inches.

Contacts: Shorting or non-shorting wiping contacts with over 500 grams contact force.

Shaft Flat Orientation: Opposite point of contact.

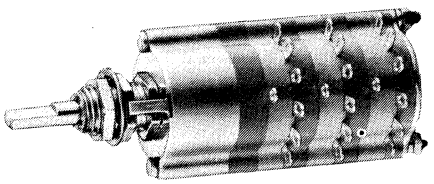
ORDERING INFORMATION AND PRICES:

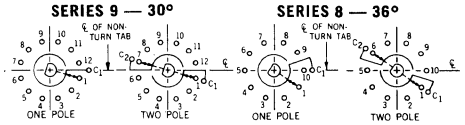
Part Number	Price Subject to Quantity Discount
5001-X*	$3.25†

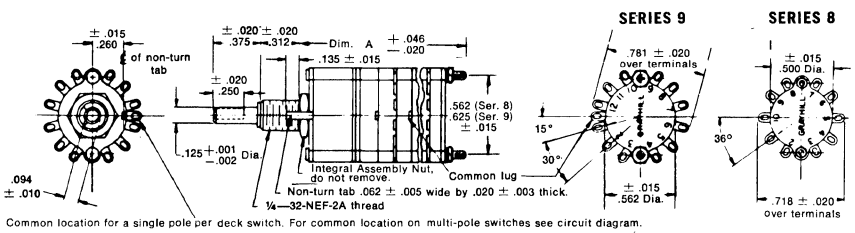
* Replace "X" with number of positions and add "S" for designating shorting type switch.

† Deduct 10¢ from list price for each position less than 10.

MILITARY QUALIFIED M = MILITARY QUALIFIED TO MIL-S-3786/13 AND LISTED ON QPL







Common location for a single pole per deck switch. For common location on multi-pole switches see circuit diagram.

RATING:

Rated: To make and break the following loads: ¼ amp. at 115 VAC resistive; ¼ amp. 6.28 VDC resistive; 20 MA. 115 VDC resistive; 50 MA. 115 VAC inductive; 20 MA. 28 VDC inductive; to carry 4 amps. continuous.

Contact Resistance: .010 ohms initial. After 25,000 cycles of operation .020 ohms maximum.

Insulation Resistance: 50,000 megohms minimum (initially).

Voltage Breakdown: 1000 VAC (initially).

Life Expectancy: 50,000 cycles of operation.

Contacts: Shorting or Non-Shorting wiping contacts with over 100 grams of contact force.

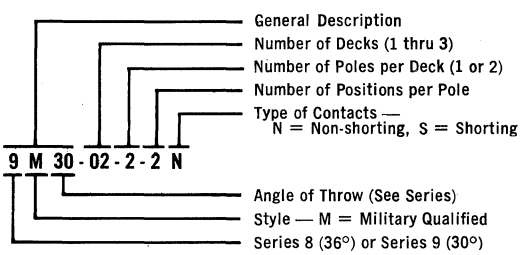
Stop Strength: 12 pound-inches minimum.

Rotational Torque: 8 - 64 ounce-inches depending upon the number of poles per deck and the number of decks.

Shaft Flat Orientation: Flat opposite contacting position of pole number one (see circuit diagram).

ORDERING INFORMATION

How to determine part number: Sample part number for a 2 deck, 2 pole per deck, 2 position Style "M," 30° angle of throw, non-shorting contact switch.



For other angles of throw; 3 to 6 poles per deck; 4 thru 12 decks; industrial quality, PC mountable, sealed styles, contact factory.

PRICES

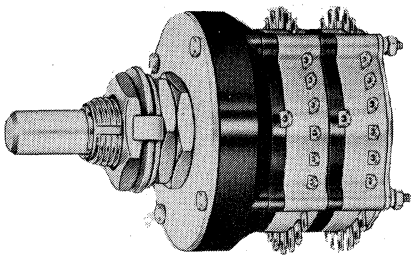
ONE POLE PER DECK													TWO POLES PER DECK					
SERIES 8M 36 AND 9M 30											SERIES 9M 30		SERIES 8M 36 AND 9M 30					SERIES 9M 30
No. of Decks	Dim. A	Number of Positions 2	3	4	5	6	7	8	9	10	11	12	Number of Decks	Number of Positions 2	3	4	5	6
1	9.60	$ 9.40	$ 9.55	$ 9.70	$ 9.85	$10.00	$10.15	$10.30	$10.45	$10.60	$10.75	$10.90	1	$10.20	$10.50	$10.80	$11.10	$11.40
2	1.228	11.30	11.60	11.90	12.20	12.50	12.80	13.10	13.40	13.70	14.00	14.30	2	12.90	13.50	14.10	14.70	15.30
3	1.496	13.20	13.65	14.10	14.55	15.00	15.45	15.90	16.35	16.80	17.25	17.70	3	15.60	16.50	17.40	18.30	19.20

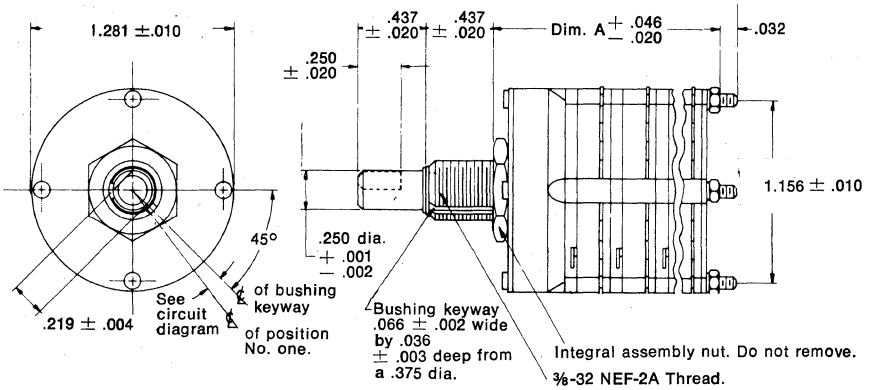
QUANTITY DISCOUNTS APPLY. For example 100 pieces of one part number carry a 50% discount from list price shown.

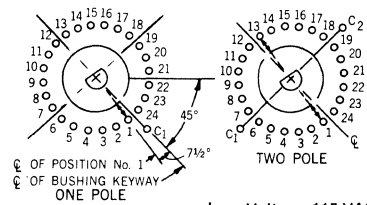
Grayhill®

ROTARY SWITCHES

24 POSITIONS/POLE

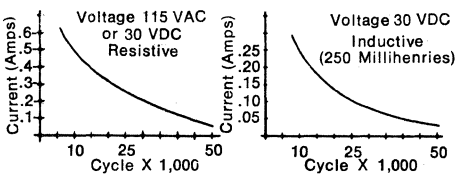






RATING:

Life Expectancy:



Switch rating for break before make contacts.

Curve data based on test data conducted at sea level, 25°C, and 68% relative humidity.

Cycle equals 360° rotation and return.

Cycling rate is 10 cycles per minute.

Life limiting or failure criteria for these curves are:

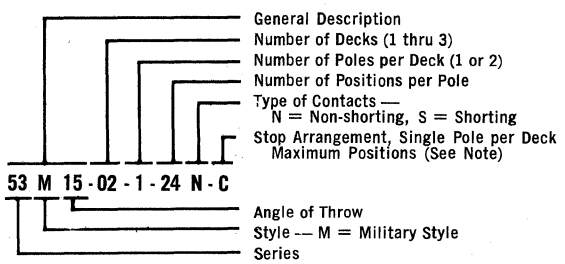
Contact Resistance: 50 milliohms maximum (15 milliohms initially).

Insulation Resistance: 10,000 megohms minimum between mutually insulated parts. (50,000 megohms initially.)

Voltage Breakdown: 500 VAC minimum between mutually insulated parts. These switches will carry 4 amperes with a maximum contact temperature rise of 20°C.

ORDERING INFORMATION AND PRICES:

How to determine part number: Suffix "C" or "F" is required for a complete part number when ordering single pole/deck switches with maximum number of positions. Samle part number for a 2 deck, 1 pole/deck, 24 position, Style M, 15° angle of throw, non-shorting contact switch without stops:



For other angles of throw; 3 to 12 poles per deck; 4 thru 12 decks; military qualified, sealed styles, contact factory.

SERIES 53 LIST PRICES

Poles/Deck and Positions/Pole			
No. of Decks	Dim. A	1 (2-24)	2 (2-12)
1	.916	$14.40	$15.25
2	1.249	20.40	22.10
3	1.582	26.40	28.95

ALL PRICES SUBJECT TO QUANTITY DISCOUNT. For example, quantities of 100 switches of a single part number are discounted 50% from the above prices.

DISCOUNTS AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

OTHER SWITCH TYPES

ISOLATED POSITION ROTARY SWITCHES

Isolated position(s) require Push-to-Turn or Pull-to-Turn action to rotate shaft.

SPRING RETURN ROTARY SWITCHES

Momentary position(s) included within switch's normal rotation.

KEYLOCK ROTARY SWITCHES

Switch rotation can only be accomplished with the proper key.

CONCENTRIC ROTARY SWITCHES

Shaft within a shaft permits two separate rotary switches in the same panel space.

ADD-A-POT ROTARY SWITCHES

Concentric shafts with center shaft free to drive pot to be mounted at rear of rotary section.

YOUR OWN CATALOG

For FREE complete Engineering Catalog, which includes dimensions, ratings, materials and finishes, circuitry, operating features, prices and discounts as well as other switch features, accessories and optional modifications — contact

Grayhill

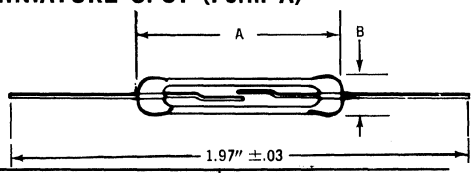
569 Hillgrove Avenue • P.O. Box 373
LaGrange, Illinois 60525
Area Code 312, Phone 354-1040
TWX: 910-683-1850

"GRAYHILL . . . the Difference Between Excellent and Adequate"

HATHAWAY
industries
P.O. BOX 45381 • S.E. STATION • TULSA, OKLAHOMA 74145
(918) 663-0110 • TWX 910-845-2129

DRIREED SWITCHES

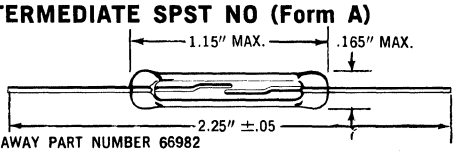
MINIATURE SPST (Form A)



Hathaway Part No.		
Gold	Rhodium	A B
68262	330-0007	.800 x .090 Inches Max.
59128	65375	.800 x .135 Inches Max.
59636	64668	.850 x .106 Inches Max.

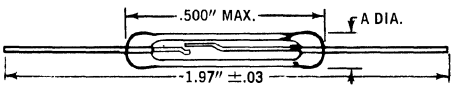
Standard Magnet: P/N 62139

INTERMEDIATE SPST NO (Form A)



HATHAWAY PART NUMBER 66982
Standard Magnet: P/N 61007

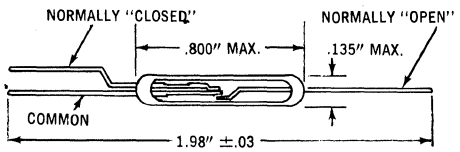
SUB MINIATURE SPST (Form A)



Hathaway Part No.		
Gold	Rhodium	A (Max.)
63300	0330005	.106"
0330001	0330015	.090"

Standard Magnet: P/N 62139

MINIATURE SPDT (Form C)



HATHAWAY PART NUMBER 64068 Standard Magnet: P/N 62139

ELECTRICAL & ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE RANGE (ALL SWITCHES): −65°C TO +150°C

Characteristic		Max. DC Current		Initial Contact Resistance‡	Dielectric Strength	Insulation Resistance	Operate Time	Release Time	Shock	Vibration
		Switching	Carry Only							
Unit		Amperes, Watts	Amperes	Milliohms, Max.	Volts, 60 Hz RMS	Megohms, Min. @ 85°C	Milliseconds Max. (Inc. Bounce)	Milliseconds Max. (Inc. Bounce)	G Duration of 11 ±1 ms	See Note 1
Miniature SPST (Form A)	Gold	.125A, 4W	1.5	200	250 (P/N0330022-600 VDC)	10,000	1.0	0.5	50	B
	Rhodium	1.0A, 10W	1.5							
Intermediate SPST (Form A)		2.0A, 25W	3.0	100	350	10,000	1.5	0.5	35	A
Subminiature SPST (Form A)		.125A, 2W	1.0	200	200	5000	1.0	0.5	50	B
Miniature SPDT (Form C)		.125A, 2W	1.0	200	200	500	1.0	1.5	35	B

‡ Measured with 10 mA d-c thru contact

Note 1 — "A" Designates: Meets MIL-STD-202C, Method 204A, Test Condition A. (10G, 10-500 Hz)

"B" Designates: Meets MIL-STD-202C, Method 204A, Test Condition B. (15G, 10-2000 Hz)

GENERAL CHARACTERISTICS

TERMINAL FINISH (ALL SWITCHES): TIN PLATE

	Terminal Cross Section Inches Max.	Pull-In Ampere-Turns (AT) Standard	Drop Out Ampere-Turns (AT) % of Pull-In
Miniature SPST (Form A)	.028" x .018"	41 ±14	Rhodium 30 to 95%
			Gold 30 to 75%
Intermediate SPST (Form A)	.045" x .025"	65 ±15	30 to 75%
Subminiature SPST (Form A)	.028" x .018"	30 ±10	30 to 75%
Miniature SPST (Form C)	.028" x .018"	41 ±14	10% Min.

* **MEASURED** in a coil of 10,000 turns of #48 AWG magnet wire with a length of .76 ±.01 and an ID of .170 maximum.

** **MISS LEVEL** is defined as a contact resistance greater than specified for any closure, or failure to open after any closure.

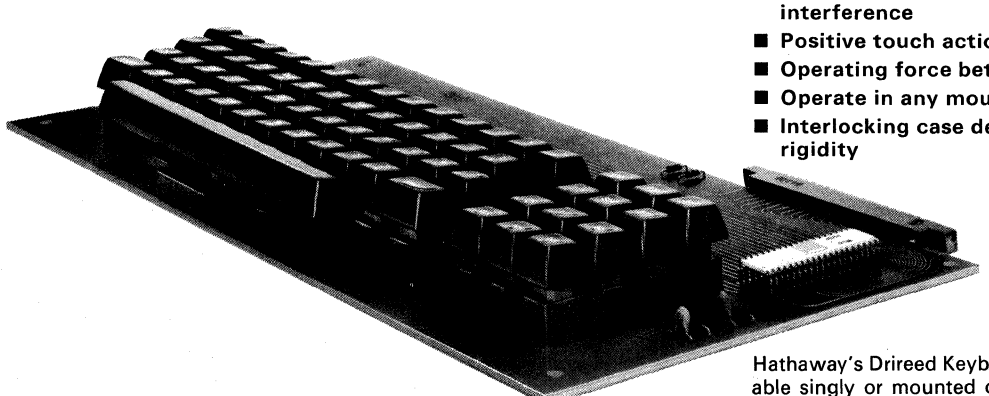
*** **FAILURE** is defined as five (5) or more misses in 100,000 consecutive operations.

**** **MEASURED** in a coil of 10,000 turns of #41 AWG magnet wire with a length of 1.03 ±.01 and an ID of .210 maximum.

ORDER BY HATHAWAY PART NUMBER

This page includes only a portion of our Drireed Switch Line. For switches with other characteristics (size, configuration, rating) contact the factory.

HATHAWAY KEYBOARD SWITCHES



- High reliability at low cost
- Space-saving compact design
- Unique Drireed design eliminates switch interference
- Positive touch action with no teasing
- Operating force between 50 to 60 grams
- Operate in any mounting plane
- Interlocking case design for mounting rigidity

Hathaway's Drireed Keyboard Switches are available singly or mounted on PC boards ready for installation. Contact your Hathaway Representative for complete specifications. He's listed in the yellow section.

HAMLIN INC

MAGNETIC REED SWITCHES • ASSOCIATED SWITCH PRODUCTS

LAKE AND GROVE STREETS
LAKE MILLS, WISCONSIN 53551
Phone Sales: 414/648-2361 • TWX: 910-260-3740

SWITCH PART NO.	FORM	MAX. D.C. CONTACT RATING	MAXIMUM AMPS	MAXIMUM D.C. VOLTS	MAX. INITIAL CONTACT RESISTANCE — OHMS	MIN. D.C. BREAKDOWN VOLTAGE	STOCK AMPERE TURN PULL-IN RANGE	NORMAL STOCKING TOLERANCE — A.T.	OVERALL LENGTH NOMINAL	GLASS LENGTH MAXIMUM	GLASS DIAMETER MAXIMUM	ACTUATING MAGNET	SPECIAL FEATURES
HAMLIN DRY REED FORM C MAGNETIC REED SWITCHES													
MINI-DT	C	.1W	.010	10	.200	200	15-40	±7.5	1.385	.475	*	H-31	Low Profile Form C
MDRR-DT	C	3W	.240	28	.150	250	20-50	±7.5	2.076	.562	.105	H-33	3W Low Profile Form C
MRH-DT	C	3W	.250	28	.150	250	20-60	±7.5	2.124	.610	.130	H-33	Instrument Grade Form C
MRG-DT	C	3W	.250	28	.150	250	20-60	±7.5	2.125	.610	.130	H-33	Moderate Current and Voltage
MLC-DT	C	3W	.110	28	.500	250	27.5, 32.5 & 37.5	±10	2.125	.610	.130	H-33	Economy Form C — Sub-Miniature
DLC-DT	C	10W	.500	200	.100	350	50-115	±15	3.375	1.562	.218	H-32	Economy Form C — Standard
DRR-DTH	C	10W	.500	250	.075	1,000	50-115	±7.5	3.375	1.562	.218	H-34	High Breakdown Form C
DRT-DTH	C	20W	1.5	500	.150	1,000	60-115	±7.5	3.375	1.562	.218	H-34	Inductive Loads
HAMLIN DRY REED FORM A MAGNETIC REED SWITCHES													
MMRR-2	A	.3W	.010	28	.200	250	17.5-52.5	±7.5	2.000	.375	.090	H-31	"Grain of Wheat" Size
MINI-2	A	3W	.110	28	.200	200	7.5-32.5	±7.5	2.000	.500	.070	H-31	The Mini-Reed
MTRR-2	A	10W	.250	100	.150	250	17.5-52.5	±7.5	2.125	.560	.092	H-33	Moderate Current and Voltage
MDRR-4	A	10W	.500	100	.100	200	12.5-52.5	±7.5	1.235	.600	.105	H-33	Low Profile Form A
MSRR-2	A	10W	.500	200	.100	400	17.5-52.5	±7.5	2.250	.800	.090	H-33	Moderate Current and Voltage
MSRR-2CD	A	3W	.500	200	.200	400	17.5-52.5	±7.5	2.250	.800	.090	H-33	Close Differential
MSRR-2WD	A	10W	.500	200	.100	400	17.5-52.5	±7.5	2.250	.800	.090	H-33	Wide Differential
MRR-2	A	10W	.500	200	.100	400	17.5-52.5	±7.5	2.230	.800	.130	H-33	Moderate Current and Voltage
MRR-5	A	10W	.500	500	.100	1,000	27.5-62.5	±7.5	2.230	.800	.130	H-33	Breakdown Voltage to 1,000 VDC
SRR-2	A	15W	1.0	400	.060	500	35-115	±7.5	3.375	1.425	.195	H-32	Moderate Current and Voltage
DRG-2	A	15W	1.0	250	.075	500	42.5-132.5	±7.5	3.250	2.100	.207	H-34	Low Cost Standard
DRR-1	A	15W	1.0	400	.060	500	42.5-132.5	±7.5	3.250	2.100	.207	H-34	Moderate Current and Voltage
DRS-2	A	25W	1.0	250	.050	500	57.5-132.5	±7.5	3.250	2.100	.207	H-34	High Inrush Type Contacts
DRR-5	A	25W	1.0	1,000	.060	1,500	52.5-132.5	±7.5	3.250	2.100	.207	H-34	Breakdown Voltage to 1,500 VDC
DRT-5	A	50W	3.0	1,000	.100	1,500	57.5-132.5	±7.5	3.250	2.100	.207	H-34	Inductive Load Type Contacts
HAMLIN MERCURY-WETTED MAGNETIC REED SWITCHES													
MRC-3	A	28W	1.0	100	.050	1,000	65	±15	2.250	.710	.130	H-33	Miniature Size Mercury-Wetted
MRC-DT	C	14W	.500	28	.050	1,000	70	±15	1.500	.805	.214	H-32	Miniature Form C Mercury-Wetted
HRC-1	A	50W	3.0	400	.050	1,000	57.5-132.5	±7.5	3.250	1.950	.218	H-34	Standard Size Mercury-Wetted
HAMLIN INSTRUMENT GRADE MAGNETIC REED SWITCHES													
MSRH-2	A	10W	.500	200	.100	250	17.5-52.5	±7.5	2.230	.800	.105	H-33	Instrument Grade — Premium Performance
MRH-DT	C	3W	.250	28	.150	250	20-60	±7.5	2.125	.610	.130	H-33	Instrument Grade — Premium Performance
HAMLIN "SPECIAL" MAGNETIC REED SWITCHES													
MDLS-4	A	3W	.100	28	.100	200	—	—	1.235	.600	.105	—	Latching Reed Switch
SRR-3	A	10W	.500	250	.075	1,000	110 max.	—	3.185	1.562	.218	H-34	High Impedance
MAAC-2	A	1W	.100	110VAC	.250	300	17.5-52.5	±7.5	1.775	.800	.105	H-33	Lamp or Other High Inrush Loads
HAMLIN HIGH VOLTAGE MAGNETIC REED SWITCHES													
MRO-2	A	1W	.001	1,000	.100	2,000	32.5-62.5	±10	2.230	.800	.130	H-33	Breakdown Voltage to 2,000 VDC
DRVT-10	A	50W	3.0	7,500	.080	10,000	100-150	±10	3.250	1.950	.218	H-34	Breakdown Voltage to 10,000 VDC
DRVT-20	A	50W	.004	17,500	.100	20,000	250 max.	—	3.195	1.950	.218	H-34	Breakdown Voltage to 20,000 VDC
DRVT-30	A	50W	.001	27,500	.250	30,000	500 max.	—	3.550	2.295	.290	—	Breakdown Voltage to 30,000 VDC
DRVT-158	B	50W	.001	12,500	—	15,000	250 max.	—	3.195	1.950	.207	—	Form B — Breakdown Voltage to 15K VDC
HAMLIN HIGH CURRENT MAGNETIC REED SWITCHES													
SRT-2	A	110VA	1.0	28VDC 110VAC	.500	300	57.5-132.5	±7.5	3.375	1.610	.195	H-32	High Power Inductive Loads
DRHC-5	A	330VA	3.0	28VDC 110VAC	—	700	100	±20	3.400	1.640	.212	H-34	3 Amp Power Switch
HAMLIN KEYBOARD (LOW LEVEL) MAGNETIC REED SWITCHES													
MARK-3	A	3W	.100	28	.150	300	17.5-52.5	±7.5	1.775	.750	.105	H-33	Designed for Keyboard Applications
MARK-4	A	3W	.100	28	.150	200	17.5-52.5	±7.5	1.235	.600	.105	H-33	Low Profile Reed Switch for Keyboards
MARK-6	A	3W	.100	28	.150	250	17.5-52.5	±7.5	2.125	.560	.105	H-33	Off-Center Gap — Minimum Magnet Travel
HAMLIN RADIO FREQUENCY MAGNETIC REED SWITCHES													
MSRF-2	A	.3W	.010	28	.150	250	27.5-52.5	±10	2.230	.830	.102	H-33	Low R.F. Losses
MTRF-2	A	.3W	.010	28	.150	250	27.5-52.5	±10	2.125	.635	.092	H-33	Low Resistive Losses to 100 MC
MRMF-2	A	.3W	.010	28	.100	250	27.5-52.5	±10	2.230	.830	.130	H-33	Low Thermal EMF 5μv/°C
HAMLIN ECONOMY MAGNETIC REED SWITCHES													
MLC-2	A	10W	.500	100	.150	300	30, 35 & 40	±10	2.230	.800	.105	H-33	Economy Form A
MLC-DT	C	3W	.110	28	.500	250	27.5, 32.5 & 37.5	±10	2.125	.610	.130	H-33	Economy Form C — Sub-Miniature
DLC-DT	C	10W	.500	200	.100	350	50-115	±15	3.375	1.562	.218	H-32	Economy Form C — Standard

*Oval Envelope .110 x .072

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

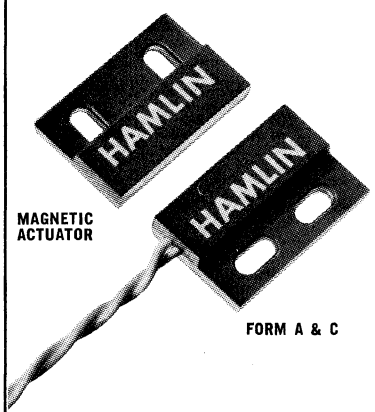
HAMLIN INC

MAGNETIC REED SWITCHES • ASSOCIATED SWITCH PRODUCTS

LAKE AND GROVE STREETS
LAKE MILLS, WISCONSIN 53551
PHONE: (414) 648-2361 TWX: 910-260-3740

Hamlin now offers the extreme reliability and long life associated with magnetic reed switches in our family of temperature sensing reed switches and reed proximity switches. All models listed are available from stock for immediate delivery. Please consult your local HAMLIN representative or distributor for more information.

REED PROXIMITY SWITCHES —



MAGNETIC ACTUATOR

FORM A & C

These reed proximity switches offer all the advantages of magnetic reed switches **and** come packaged ready for mounting. Epoxy packaging and Teflon coated wires resist solvents, acids and salts. These sensors are completely safe for use in hazardous environments and the shock and vibration characteristics are comparable with that of the basic reed switch.

FORM A AND C MODELS — For AC or DC Operation

Contact Arrangement	Contact Rating Max.	Switching Voltage Min.	Current Rating Max.	Breakdown Voltage Max.	EACH			
					1-24	25-49	50-99	100-249
SPST-Form A	10 watts	500 VDC	.500 amp	400 V	$3.75	$3.40	$3.00	$2.60
SPDT-Form C	3 watts	28 VDC	.250 amp	200 V	7.75	7.00	6.20	5.35

FORM A — 1½ Amp Reed/Triac Combination — AC only

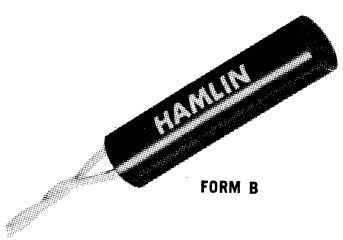
Contact Arrangement	Current Rating Max.	Voltage Rating	Blocking Voltage	EACH			
				1-24	25-49	50-99	100-249
SPST-Form A	1.5 amps*	120-240 VAC 50-60 Hz	400 V peak	$7.75	$7.00	$6.20	$5.35

*At 25°C-peak single cycle surge (non-repetitive)-15 amps

MAGNETIC ACTUATOR — For Form A and C Models

Operating Distance	Differential	Release Distance	EACH			
			1-24	25-99	50-99	100-249
to 5/8"*	1/8" to 1/4"*	5/16" to 13/16"*	$2.00	$1.80	$1.60	$1.40

*Head-On Mode



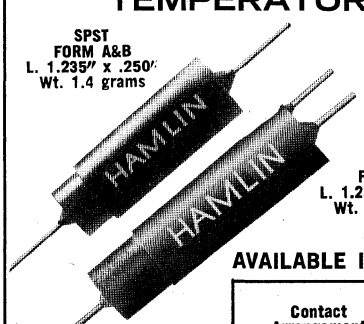
FORM B

FERROUS OPERATED FORM B — 1½ Amp Reed/Triac Combination — AC Only

Contact Arrangement	Current Rating Max.*	Voltage Rating	Blocking Voltage	EACH			
				1-24	25-49	50-99	100-249
SPST-Form B	1.5 amps	120-240 VAC 50-60 Hz	400 V peak	$9.75	$9.50	$9.25	$8.50

*At 25°C peak single cycle surge (non-repetitive) 15 amps

TEMPERATURE SENSING REED SWITCHES —



SPST
FORM A&B
L. 1.235" x .250"
Wt. 1.4 grams

SPDT
FORM C
L. 1.235" x .250"
Wt. 1.6 grams

Hamlin temperature sensing reed switches feature automatic resetting, high repeatability, compact size and very long life. Hermetically sealed, safe for use in hazardous environments. Reed switch dependability permits millions of cycles. Standard units from −20°C to +120°C; specials up to 300°C. Applications include temperature sensing in air, liquids, semi-solids, or solids or anywhere that temperature control is needed.

AVAILABLE IN SPST FORM A AND B OR SPDT FORM C

Contact Arrangement	Contact Rating	Voltage A.C.	Voltage D.C.	Current (Amps) Carry	Current (Amps) Break	Current (Amps) Make	Tolerance	Reset Differential	EACH 1-24	EACH 25-49	EACH 50-99	EACH 100-249
SPST-Form A (NO)	10W 12VA	120 max.	100 max.	2 max.	1 max.	.500 max.	±5°C	10°C max.	$2.45	$2.20	$2.00	$1.70
SPST-Form B (NC)	10W 12VA	120 max.	100 max.	1 max.	1 max.	.500 max.	±5°C	10°C max.	2.10	1.90	1.70	1.43
SPDT-Form C	3W 3VA	24 max.	28 max.	1 max.	1 max.	.250 max.	±5°C	10°C max.	5.65	5.10	4.55	3.90

CALL TOLL FREE for the name and number of your nearest HAMLIN sales representative or distributor.
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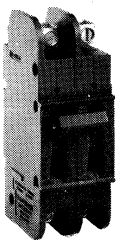
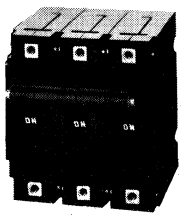
HEINEMANN

HYDRAULIC-MAGNETIC CIRCUIT BREAKERS

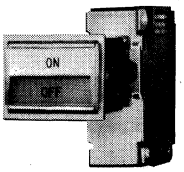


E-FRAME

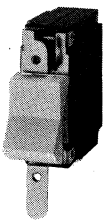


SERIES AM1

SERIES JA



SERIES JL



SERIES JC

Heinemann breakers offer almost unlimited options: integral or fractional ratings from 10 milliamp to 100 amp, and in steps to 225 amp; single and multipole models; breakers for 60 or 400 Hz AC, or DC service; breakers that meet Mil Specs; and models with special internal circuits like relay-trip and calibrating-tap for control functions. Hydraulic-magnetic actuation assures that ratings and trip points are unaffected by ambient temperature changes. A wide selection of time-delay characteristics permits close match of breaker to equipment requirements. Request the Heinemann Engineering Guide (Bulletin 202), or the Condensed Guide (303), or contact your Heinemann representative. Individual product bulletins listed below.

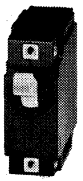
E-FRAME: Smaller than other E-Frame breakers, competitively priced. Approx. 5¾h x 2w x 2⅜d (2-pole). Available in 1 to 6 poles.

SERIES AM1: 1, 2, 3 poles. UL-component-recognized. Special circuits available. Approx. 2.5h x 2.5d, .75w per pole.

SERIES JA: Compact OEM breaker. Only 2.5 oz/pole. 1, 2, or 3 pole. Approx. 2h x 1.875d, .75w per pole.

JA VARIANTS. Snap-In JB (1 to 3 poles) installs in rectangular panel cutout without screws. JC (1 to 3 poles—single-pole shown) has white or gray rocker handle. JD has round button for push-push operation. JE has moisture-sealed bat-type toggle for marine applications. Square pushbutton of JL (shown) lights in both "on" and "off" modes.

CROWBAR IN A CIRCUIT-BREAKER PACKAGE



SERIES JA/Q

The newest **Heinemann JA/Q Electronics Protector** is nearly all-encompassing in its ability to prevent damage to solid-state components. In one standard Series JA package it provides:

- transient/overvoltage crowbar protection, response time 500 nanoseconds;
- electromechanical equipment disconnect (protection for the crowbar) in 10 milliseconds;
- normal overcurrent protection

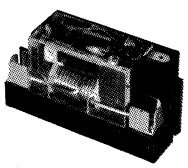
A thick-film hybrid SCR crowbar microcircuit is packaged into the rear of a Series JA hydraulic-magnetic circuit breaker. A transient or overvoltage on the AC or DC supply line will cause the SCR to fire, placing a dead short across the load to common. The short opens the breaker, removing the equipment from the line. Current ratings 0.020 to 10 A (DC), firing voltages 4.5 to 50 V (DC). Dimensions 2h x .75w x 1.8d. Bulletin 3371.

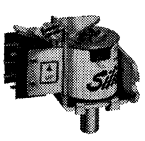
CONDENSED GUIDE TO HEINEMANN CIRCUIT BREAKERS

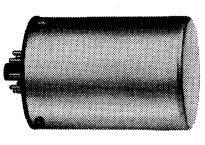
Type	Series	Bulletin	Poles	Maximum* Voltages	Interrupting Cap. (amp)	Current (amp)
PANEL MOUNTING	E-Frame	CF-3104	1,2,3,4,5,6	240 AC 480 AC 240 AC (400~) 125 DC	5,000 5,000 5,000 5,000	0.01 to 100 0.01 to 100 0.15 to 100 0.05 to 50
	EH-Frame	3441	2,3	480 AC	15,000	0.5 to 100
	CJ	3111	2	120/240 AC	10,000	125 to 200
			3	240 AC	10.000	100 to 225
GENERAL PURPOSE	1163	3412	1,2,3	250 AC 125 DC	5,000 5,000	0.01 to 100 0.016 to 100
AUXILIARY	0111	3201	1	250 AC	1,500	0.01 to 50
AM SERIES	AM1,2,3,4	AM-3306	1,2,3,4	250 AC 250 AC (400~) 65 DC	1,000 1,000 1,000	0.02 to 60 0.02 to 60 0.02 to 60
	AM1000	3305	1,2,3	250 AC 250 AC (400~) 125 DC	1,500 1,500 2,000	0.01 to 70 0.15 to 65 0.015 to 100
MINIATURE	JA, JB, JC, JD, JE, JL	J-3333	1,2,3	250 AC 250 AC (400~) 65 DC	1,000 1,000 1,000	0.020 to 30 0.100 to 30 0.020 to 20
SUBMINIATURE	HE	HE-3504	1,2,3	250 AC 250 AC (400~) 50 DC	300 300 500	0.05 to 30 0.05 to 30 0.05 to 30

*AC voltages are 60 Hz unless marked with (400~).

TIME-DELAY AND OVERLOAD RELAYS



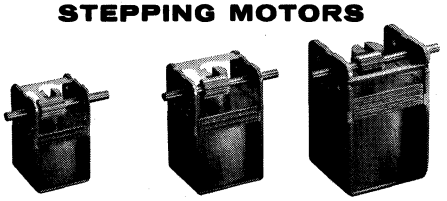




Silic-O-Netic® overload relays: close-tolerance overload protection. Always carry 100% of rated current, trip as low as 115% of load. Up to 70 amp. Bulletin 5104.

Silic-O-Netic time-delay relays: dependable, economical, for delays from ¼ to 120 seconds. Five models: open or enclosed contacts, dust-proof covers, hermetic, or trip-indication. Continuous-duty coils, DPDT contacts eliminate slave circuits, reduce equipment costs. Bulletin 5006.

STEPPING MOTORS



Roto-Netic® stepping motors operate on a totally new principle: simple linear force (solenoid-actuated) converted to discrete rotary motion. Starting torque from 1.4 to 25 oz-in. with avg. power consumption less than 12 watts. Eight, ten, or twelve steps per shaft revolution with no cumulative error. Minimum life 10 million steps, typical life 30 million steps. Priced substantially below motors of comparable performance. Bulletin 702.

HEINEMANN ELECTRIC COMPANY 2636 Brunswick Pike, Trenton, N.J. 08602

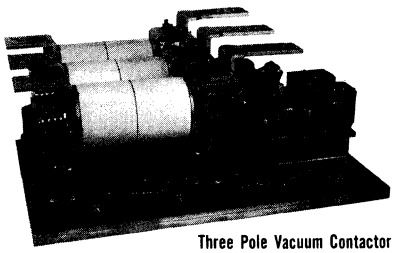
5630

vacuum contactors

INTRODUCTION: Vacuum contactors offer the most reliable means available to control large amounts of power at high voltage. Units designed for dc, power frequency, and rf currents are available in voltage ratings to 50 kv and current ratings to 900 amperes continuous.

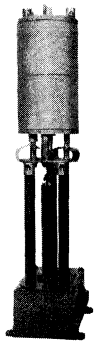
ADVANTAGES: The advantages of this type of unit include a high voltage capability, small physical size, high speed quiet operation, long life with minimum maintenance, non-exposed high voltage arcs, and low stable internal losses.

APPLICATIONS: Contactor applications include primary control of power supplies, industrial control of motors, switching in induction heating and mining equipment, tap changing in rf systems, and fault protection of transmitters.



Three Pole Vacuum Contactor

RF Contactor



AC or DC Contactor

Alternating and Direct Current Contactors—For industrial control applications.

MODEL NUMBER	Test Voltage (Pk KV)	Operate Voltage (Pk KV)	Continuous Current (Amps)	Max. Interrupt AC Current (Amps RMS)	Max. Interrupt DC Power (KW)	Capacitor Discharge Decaying to 0 in 200 μs	Contact Arrangement	Actuator Voltage (Volts)	Time to Close (Ms)	Break Time (Ms)	Weight (Lbs.)
RP101F4903D21B20 RP101F4904D21B20	50	30	200 DC	N/A	300 (10 A Max.)	N/A	N/O N/C	115 60 Hz	60	50	8¾
RP101F4302D26B20 RP101F4304D26B20	50	30	200 DC	N/A	300 (10 A Max.)	N/A	N/O N/C	100 DC	75 55	17 42	8¾
RP103F4903D21B20 RP103F4904D21B20	50	30	200 RMS	2000	N/A	50 K Amps	N/O N/C	115 60 Hz	60	50	8¾
RP103F4302D26B20	50	30	200 RMS	2000	N/A	50 K Amps	N/O	100	75	17	8¾
RP901K4903D21B30 RP901K4904D21B30	70	50	400 DC	N/A	500 (10 A Max.)	N/A	N/O N/C	115 60 Hz	60	50	15
RP901K4601D26B30 RP901K4602D26B30	70	50	400 DC	N/A	500 (10 A Max.)	N/A	N/O N/C	100 DC	34 27	11 17	15
RP900K4903D21B30 RP900K4904D21B30	70	50	400 RMS	4000 at 13 KV RMS	N/A	100 K Amps	N/O N/C	115 60 Hz	60	50	15
RP900K4601D26B30 RP900K4602D26B30	70	50	400 RMS	4000 at 13 KV RMS	N/A	100 K Amps	N/O N/C	100 DC	34 27	11 17	15

High Voltage RF Contactors—For high power rf load control.

UNIT	Peak Operate Voltage 32 MHz	Continuous Current 32 MHz RMS	Contact Resistance Ohms Max.	Contact Capacitance Pf	Contact Inductance Nh	Contact Arrangement	Open Time	Close Time	Pull-in Current RMS	Hold Current RMS	Hold Power Watts	Actuating Voltage	Motor Current 60 Hz	Weight	Life	Auxiliary Contacts Ratings Volt RMS Current RMS
RP233X4513004M00	25	35	.0005	2	25	N/O	17 Ms.	75 Ms.	.7	.09	10	100 VDC	N/A	3 lbs.	1×10^5	Form C 230/7
RF20B4319D31G00	25	200	.0001	10	2.5	latching	7 Sec.	7 Sec.	N/A	N/A	N/A	115 VAC	.11A	5 lbs. 6 oz.	1×10^5	Form C 230/7

Three Pole Vacuum Contactors—For three-phase and multi-pole power control applications.

MODEL NUMBER	Operate Voltage 50/60/400 Hz	Operate Current 60 Hz	Interrupt Current Amps RMS	Mech. Life (Min.)	Actuator Voltage	Approx. Pull-in Current Amps RMS	Approx. Hold Current Amps RMS	Interrupt Time	Auxiliary Contacts	Weight
RP151B4541X44R20	600	250	3000	1×10^6	26.5 VDC	2.8	.4	Less than 1 Cycle	2 SPDT 230 VAC/10 A	16 lbs.
RP154B4549X41TX0 (60 Hz) RP154B4549X4KTX0 (50 Hz)	1500	300	3000	1×10^6	115 VAC	22.0	1.9	Less than 2 Cycles	4 SPDT 230 VAC/5 A	25 lbs.

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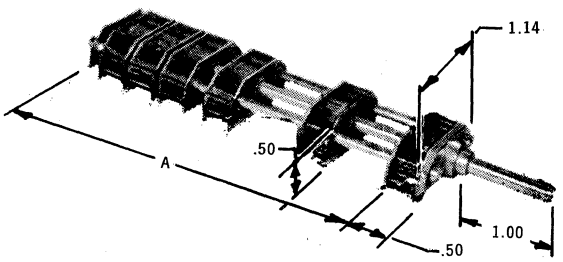
SWITCHES

P.C. ROTARY SWITCH — TYPE JSR-325

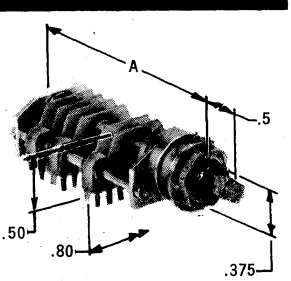


JSR-325 is a miniature, low profile rotary switch specifically designed for printed circuit application. Completely enclosed sections insure uniformly low contact resistance below 30 milliohms for non-shorting contacts. Current rating 50 milliamps switching max. 2 amps max. carry, 60 volts or 3 watts max. All 12 spring loaded, silver bridging contacts insure 50,000 cycle life. Double ball 30° detent, and angle of throw mechanism. Up to five sliding switch sections per switch offer maximum flexibility. Twist tabs provide secure mounting to PC board. Shaft .125 inch diameter, 1 inch long. Temperature range −40°C to +50°C. (Other combinations are available directly from factory including shorting switches.)

CATALOG NUMBER (All contacts non-shorting)	Number of Sections	Poles per Section	Total No. of Poles	Number of Positions	Inner Shaft Length	LIST PRICE
JSR-325-30-1100NA	1	1	1	Cont. rot	1.04	$6.70
JSR-325-30-1112NA	1	1	1	12	1.04	6.70
JSR-325-30-1206NA	1	2	2	6	1.04	7.05
JSR-325-30-1204NA	1	3	3	4	1.04	7.40
JSR-325-30-1403NA	1	4	4	3	1.04	7.65
JSR-325-30-1602NA	1	6	6	2	1.04	8.30
JSR-325-30-2100NA	2	1	2	Cont. rot.	1.81	9.60
JSR-325-30-2112NA	2	1	2	12	1.81	9.60
JSR-325-30-2206NA	2	2	4	6	1.81	10.20
JSR-325-30-2304NA	2	3	6	4	1.81	10.85
JSR-325-30-2403NA	2	4	8	3	1.81	11.50
JSR-325-30-3100NA	3	1	3	Cont. rot.	2.56	12.40
JSR-325-30-3112NA	3	1	3	12	2.56	12.40
JSR-325-30-3206NA	3	2	6	6	2.56	13.35
JSR-325-30-3304NA	3	3	9	4	2.56	14.30
JSR-325-30-3403NA	3	4	12	3	2.56	15.25
JSR-325-30-4100NA	4	1	4	Cont. rot.	3.50	15.25
JSR-325-30-4112NA	4	1	4	12	3.50	15.25
JSR-325-30-4206NA	4	2	8	6	3.50	16.55
JSR-325-30-4304NA	4	3	12	4	3.50	17.80
JSR-325-30-4403NA	4	4	16	3	3.50	19.00
JSR-325-30-5100NA	5	1	5	Cont. rot.	4.05	18.10
JSR-325-30-5112NA	5	1	5	12	4.05	18.10
JSR-325-30-5206NA	5	2	10	6	4.05	19.70
JSR-325-30-5304NA	5	3	15	4	4.05	21.25
JSR-325-30-5403NA	5	4	20	3	4.05	23.60

P.C. ROTARY SWITCH MINIATURE — TYPE JSR-106

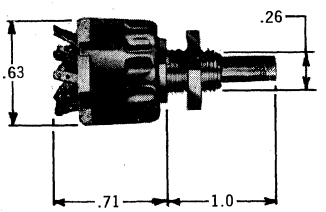
The JSR-106 is a miniature, low profile PC rotary switch with up to three poles and up to six positions. Designed with both PC and chassis mounting, the switch is available with up to five sliding sections. Contact resistance is below 30 milliohms, current rating is 50 milliamps switching, 1.5 amps carry, 60 volts or 3 watts max. Open type bridging contacts gold flash for 50,000 cycle life. Double ball 30° detent angle. Standard shaft .156 inch diameter, ½ inch length from chassis. Temperature range −40°C to +50°C (other combinations available from factory include shorting contacts).



TYPE JSR-106 continued

CATALOG NUMBER (All contacts non-shorting)	Number of Sections	Poles per Section	Total No. of Poles	Number of Positions	Inner Shaft Length A	LIST PRICE
JSR-106-30-1100NA	1	1	1	Cont. rot.	.87	$6.30
JSR-106-30-1106NA	1	1	1	6	.87	6.30
JSR-106-30-1203NA	1	2	2	3	.87	6.45
JSR-106-30-1302NA	1	3	3	2	.87	6.55
JSR-106-30-2100NA	2	1	2	Cont. rot.	1.26	8.30
JSR-106-30-2106NA	2	1	2	6	1.26	8.30
JSR-106-30-2203NA	2	2	4	3	1.26	8.55
JSR-106-30-2302NA	2	3	6	2	1.26	8.85
JSR-106-30-3100NA	3	1	3	Cont. rot.	1.65	10.30
JSR-106-30-3106NA	3	1	3	6	1.65	10.30
JSR-106-30-3203NA	3	2	6	3	1.65	10.75
JSR-106-30-3302NA	3	3	9	2	1.65	11.10
JSR-106-30-4100NA	4	1	4	Cont. rot.	2.04	12.35
JSR-106-30-4106NA	4	1	4	6	2.04	12.35
JSR-106-30-4203NA	4	2	8	3	2.04	12.85
JSR-106-30-4302NA	4	3	12	2	2.04	13.30
JSR-106-30-5100NA	5	1	5	Cont. rot.	2.43	14.55
JSR-106-30-5106NA	5	1	5	6	2.43	14.55
JSR-106-30-5203NA	5	2	10	3	2.43	15.00
JSR-106-30-5302NA	5	3	15	2	2.43	15.60

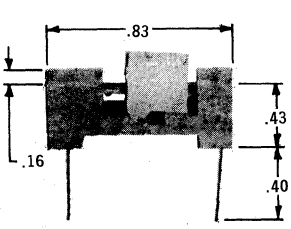
ROTARY SWITCH — TYPE JSR-170



Built in accordance with MIL-S-3786 for resistance to vibration to a level greater than 10G, this switch is suitable for switching very low signal voltages or current up to 2 amperes at 30 Volts AC/DC for over 20,000 cycles. Insulation resistance of the ceramic wafer between contacts is greater than $2x10^{13}$ ohms. Carry current 2.5 amp. Solid silver movable contacts, each pressured by a long life coil spring, insure uniformly low contact resistance. Positive 30° snap action detenting provides accurate positioning through its life.

CATALOG NUMBER	No. of Poles	No. of Pos.	PRICE
JSR-170-30-1100NA	1	Cont. Rot.	$4.60
JSR-170-30-1112NA	1	12	4.60
JSR-170-30-1206NA	2	6	4.75
JSR-170-30-1304NA	3	4	5.05
JSR-170-30-1403NA	4	3	5.20
JSR-170-30-1602NA	6	2	5.50

TRACK SWITCH — TYPE JRTA



This switch is designed to mount directly on a conductive track on a printed circuit board. The wafer thin design avoids distortion of the circuit layout when switches are mounted side-by-side. Bifurcated contacts insure low contact resistance in the range of 10 milliohm. Plastic body with white slide button standard. Red, yellow, green, and blue slide buttons also available. Temperature range −40°C to +50°C.

CATALOG NUMBER	Button Color	Contact Arrangement	Rating (amps)	Life (ops.)	Contact Resistance (ohms)	Contact Material	LIST PRICE
JRTA-1001W	White	1 Form A (SPST)	1.5	10,000	0.010	Gold over Silver	$.65
JRTA-1001R	Red		1.5	10,000	0.010		.65
JRTA-1001Y	Yellow		1.5	10,000	0.010		.65
JRTA-1001G	Green		1.5	10,000	0.010		.65
JRTA-1001B	Blue		1.5	10,000	0.010		.65

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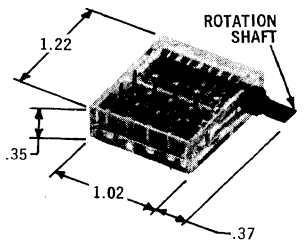
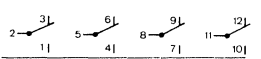
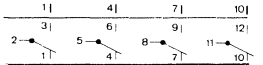
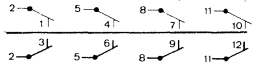
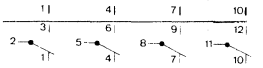
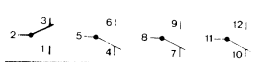
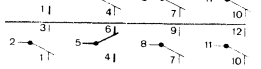
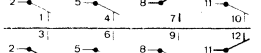
SWITCHES

PROGRAMMED 4 PDT SWITCH — TYPE JAEP

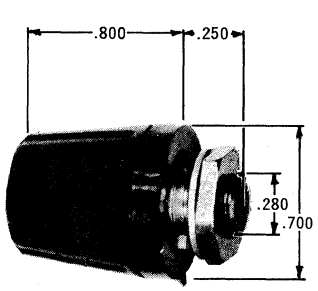


Hand or mechanical actuated printed circuit switch. Ideal for changing programs on boards. Switches may be mounted side by side and up to three coupled to common shafting. Twin contacts rated 50 VA, 1 amp max. switching load. 100 volts max. Life greater than $5x10^5$ ops. 10G vibration resistance. 100°C max. ambient.

Two standard programs available with 360° rotation. 1) all contacts off-on-off-on. 2) Every 90° turn momentarily on. 1, 2, 3, 4.

CATALOG NUMBER	Contact Material	Program Position	Output Contacts 1 2 3 4	PRICE
JAEP-3750A	Ag/Pd	1		$2.30
		2		
		3		
JAEP-3770G	Au/Ag	4		3.10
JAEP-3752A	Ag/Pd	1		2.30
		2		
		3		
JAEP-3772G	Au/Ag	4		3.10

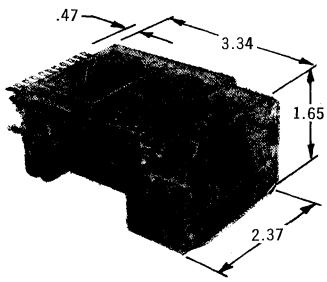
DETENT IN KNOB — J-MIKE



A complete detenting mechanism built into a knob. For designers requiring to reduce space directly behind control panels. Knob contains click detent mechanism for 1 through 12 positions. 30 degree throw. Supplied ready for using in positions 2, 4, 5, 7, 8, 10, 11 and 12 as stops. Accessory ring available when 3, 6 and 9 positions are desired. With J-MIKE all click torque is contained in the knob and click assembly and is not transmitted along the shaft to contacts or potentiometer. 30° detent, 10 to 20 in-oz torque. Adjustable stops, 0.125 shaft diameter. Mounted by hexagonal nut or locking spring.

CATALOG NUMBER	PRICE
J-MIKE-1	$2.65

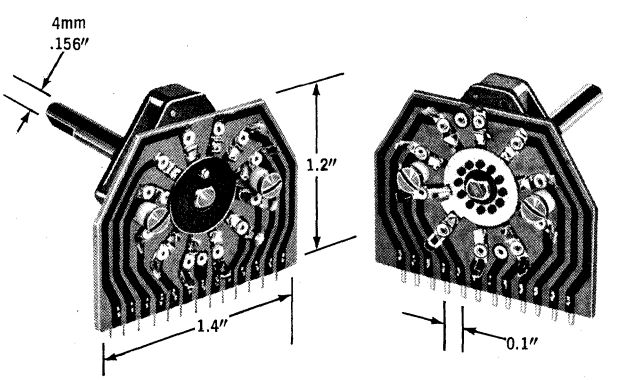
10 COUNTS / DC or AC ACTUATED — TYPE JKAA



A DC or ½ wave AC operated counting and storing relay rated .3 amps @ 30 VDC or 10 W resistive max. Its compact size, and telephone system reliability render it invaluable for applications such as machine tool control, sending and packaging systems, traffic control, etc. Mount to either chassis or by bar or plug into socket. Transparent dust cover standard. 10 normally open (Form A) individually operated counting contacts plus one set of auxiliary contacts in choice of Form A or B. The contacts are electrically insulated from each other and therfore can be used to control different circuits. Counts on each pulse to coil. Reset coil erases count anytime desired. Long life is assured as there is effectively no mechanical wear. Temperature range −10°C to +50°C. Weight 17.5 oz.

CATALOG NUMBER	Nominal Volts	Coil Ohms	Power Watts	CONTACT Arrangement/ material	CONTACT Rating (amps)	LIST PRICE
JKAA-1036	12 DC	9	12 to 19.5	10 Form A	200 mA	$25.60
JKAA-1040	24 DC	37	pulsed	+1 aux.	200 mA	25.60
JKAA-1044	48 DC	96	power	**break**	200 mA	25.60
JKAA-1048	60 DC	145				25.60
JKAA-1037	12 DC	9	12 to 19.5	10 Form A	200 mA	25.60
JKAA-1041	24 DC	37	pulsed	+1 aux.	200 mA	25.60
JKAA-1045	48 DC	96	power	**make**	200 mA	25.60
JKAA-1049	60 DC	145				25.60
JKAS-1000	Mounting kit (necessary when mounting directly to any magnetic material)					1.10
JKAS-1001	Socket with accessories					5.60

MINIATURE ROTARY PC SWITCHES — TYPE JSZVPL



NEW standard miniature PRINTED CIRCUIT rotary switches with 10 positions 12 positions, shorting or non-shorting, 36 degree or 30 degree detent up to 3 poles max (36°) and 4 poles max (30°) Single section shown but multi-sections available as required (add $1.95 per each added section). Detent available with adjustable stop contacts rated 1 amp/150 Volts.

Part No.	JSZVPL10-1010N	1 Pole, 10 Position	36° Throw	Non-Shorting	$4.55
Part No.	JSZVPL12-1012N	1 Pole, 12 Position	30° Throw	Non-Shorting	4.55

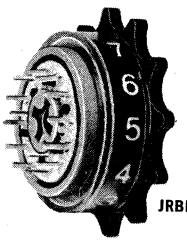
ITT **JENNINGS** **SWITCHES**

INDUSTRIAL PRODUCTS

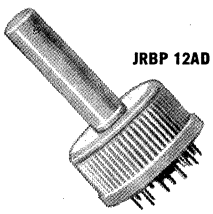
970 McLAUGHLIN AVENUE, SAN JOSE, CALIFORNIA 95116
PHONE: (408) 292-4025 TWX: 910-338-0159, TELEX: 34-6311

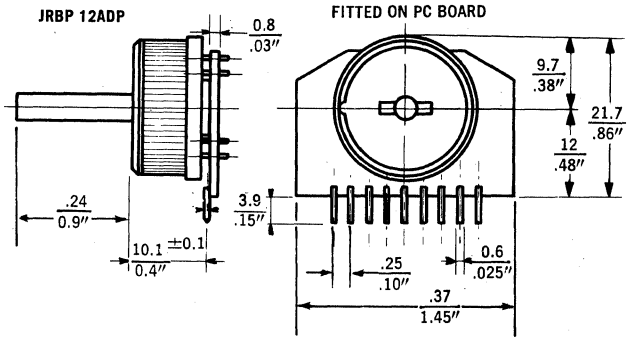
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

SUB-MINIATURE ROTARY KNOB SWITCHES — TYPE JRBP



JRBP 12M

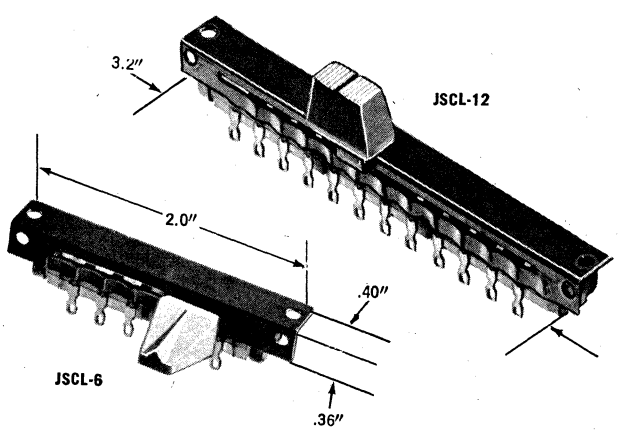

JRBP 12AD



NEW sub-miniature PRINTED CIRCUIT rotary knob switches designed for PC boards both axial and radial design. Detent and contacts in a single knob up to 6 poles, and 2 to 12 positions. Various styles available including thumbwheel, coin slot, concentric and added section — check factory.

Type JRBP 12M-1012N	1 Pole, 12 Position	$2.50
Type JRBP 12AD-1012N	1 Pole, 12 Position	1.25
Type JRBP 12ADP-1012N	1 Pole, 12 Position	3.25

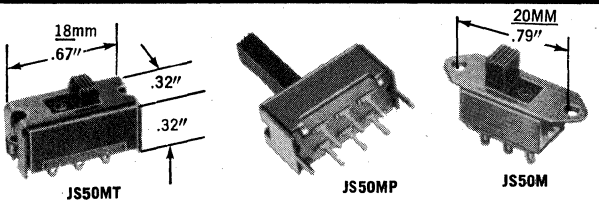
MINIATURE SLIDE SWITCHES — TYPE JSCL



NEW miniature slide switches. Vertical button standard (horizontal button available), contacts 5 amps carry, 0.1 amps switched, 120/240 VAC, 0.2 inch pin spacing, PC or solder terminal (specify).

Type JSCL 12V-1X12	1 Pole, 12 Position	$3.00
Type JSCL 6V-1X6	1 Pole, 6 Position	3.50

SUB-MINIATURE SLIDE SWITCHES — TYPE JS-50

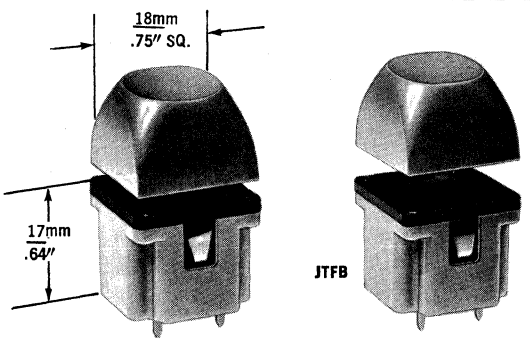


JS50MT JS50MP JS50M

NEW subminiature slide switch; either single or double pole double throw PC or solder lug terminals. Carry 1 amp on contacts or switch max. 0.3 amp, 2.5 watts to 500 VDC or AC. Also available w/spring return.

Type JS50M	(Solder Lug)	Single Pole	$.35
Type JS51M	(Solder Lug)	Double Pole	.45
Type JS50MP	(Printed Circuit Pins)	Single Pole	.35
Type JS51MP	(Printed Circuit Pins)	Double Pole	.45

KEY BOARD / PUSHBUTTONS — TYPE JTFB

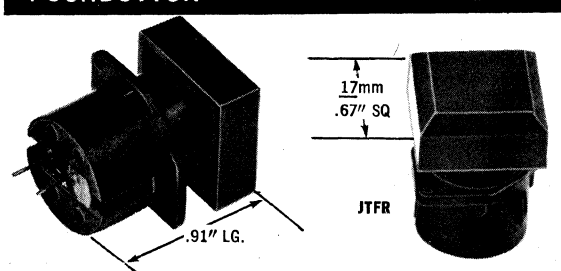


JTFB

NEW small momentary touch button or push on/push off type. Both for keyboards. Either 2 pole normally open or 2PDT. Both designed for PC board with operating pressure approx. 130 grams (perfect for human factor). Contacts rated 20 mA at 24 VDC. Life 5 million for FB and 100 K for FB-1D. Standard color button light grey (others available).

Type JTFB-2NO	Momentary	2 Pole NO	$1.00
Type JTFB-1D-2NO	Latching	2 Pole NO	1.30
Type JTFB-2RT	Momentary	2PDT	1.15
Type JTFB-1D-2RT	Latching	2PDT	1.45

MINIATURE MODULE PUSHBUTTON — TYPE JTFR



JTFR

NEW miniature keyboard pushbutton WITH REED CONTACT. Momentary action single pole - normally open reed rated for 10 watts switching. Life expectancy of 10^7 operations. Button travel 0.120″ with progressive operating pressure (0.4 - 0.8 newton). Standard button color dark grey, other colors available. Mounting on 1/16″ centers thru 0.610 inch dia. hole.

Type JTFR-01G	$2.70

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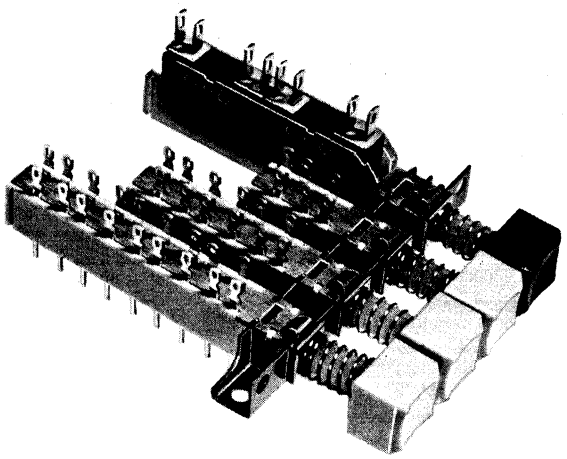
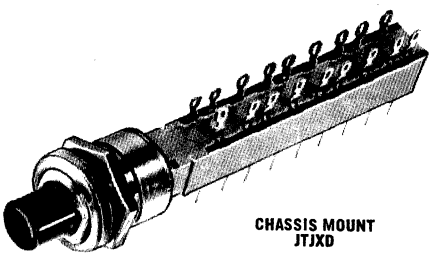
PHONE: (408) 292-4025 TWX: 910-338-0159, TELEX: 34-6311

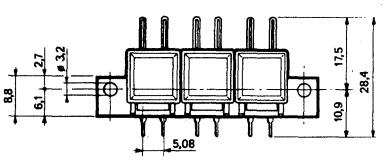
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

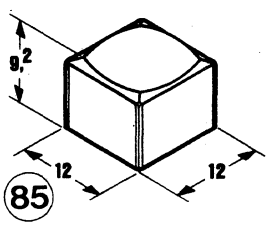
SWITCHES



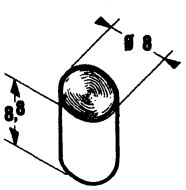


CHASSIS MOUNT
JTJXD





Standard



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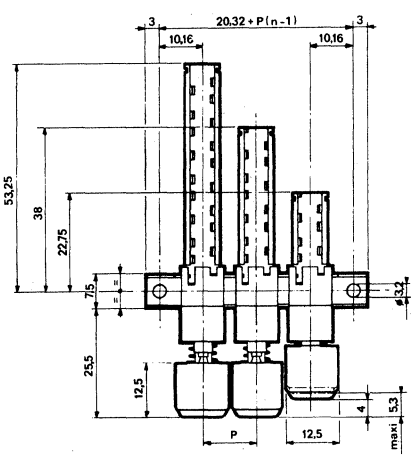
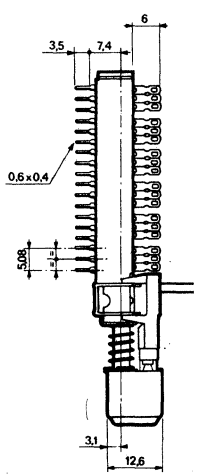
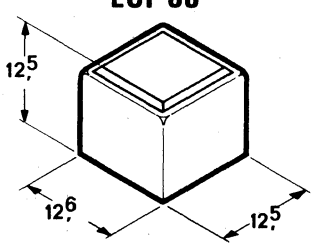




LUF 88



PUSHBUTTON SWITCHES — TYPE JTJ

MINIATURE style pushbutton switches, with patented contact style which results in extremely long life and reliability. Also modules are designed with solder lug terminals on one side and PC pins on the other. Pins are 0.20 inch grid spaced for flexibility of design.

Standard center spacing is **0.5 inch** or 0.4 inch. Also available is 0.6 inch centers and 0.8 inch centers.

Number of Keys: 1 - 13 for 0.5", 0.4", and 0.6" center.
1 - 6 for 0.8 inch center.

Panel mounting by 2 holes ⅛" dia through front panel.

Either shorting or non-shorting contacts.

		Mounted - Price Per Station
2PDT	JTJM	$ .75
4PDT	JTJ	1.00
6PDT	JTJX	1.20

Threaded bushing available for single button (suffix D) adder $.70 ea.

Mechanical functions (suffix):

ID — push on, push off	$.30 adder
N — normal interlock	.10 adder
R — release button	.80 adder
FU — momentary contact	.20 adder

Illuminated buttons (suffix LUF) includes lamp, socket and LUF88 button. Specify 12 or 24 VDC (standard color black). LUF (adder per station) $.40

Standard buttons: No. 81 and 85 (0.5 in center) $.10 ea.

Colors: red, green, blue, black, white, pale grey, dark grey.

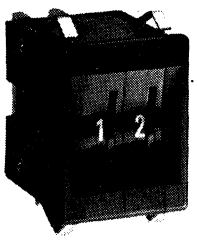
Ask for detailed spec. sheets.

INTERSWITCH

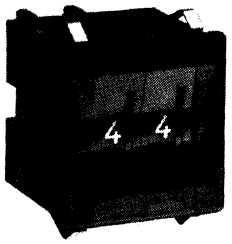
ONE OF THE PURDY GROUP OF COMPANIES

THUMBWHEEL SWITCHES AND ACCESSORIES

FRONT PANEL SNAP-IN MOUNTING

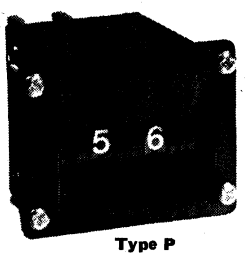


Type M

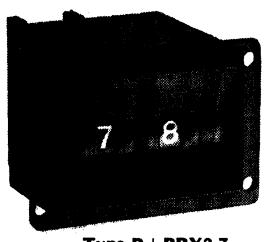


Type H

BACK PANEL SCREW MOUNTING



Type P



Type P+PBY2.7 Interchangeable with industry ½" stds.

- **Thinnest thumbwheel switch**
- **Easy front panel snap-in mounting**
- **Featherweight rotary action**
- **Solder, P.C.B. Pin, or connector termination**
- **Unlimited choice of options and accessories**
- **Large character readout**
- **Over 250 codes to choose from**

- **Back panel mounting**
- **Featherweight rotary action**
- **Two switches in one**
  Minimum panel area (.395" per switch)
  With spacer retro fits .500" industry standard switches
- **Solder, P.C.B. Pin, or connector termination**
- **Unlimited codes, options and accessories**

SPECIFICATIONS

Working Voltage: 0 to 50 VAC or VDC
Switching Capacity: 0.1 amp at rated voltage
Contact Resistance: 0.07 ohms maximum
Insulation Resistance: 100K megohms minimum
Dielectric Strength: 500 VAC rms at 25° C
Housing: ABS polymide plastic
Circuit Board: NEMA Grade FR-3
Contact Rotor: Precious metal alloy
Contact Stator: .0003 Gold over Nickel
Temperature Range: −40° C to +80° C
Life: Exceeds 1 million detent operations

DIMENSIONS

Type	Size	Type	Size
M	.315" w. x 1.5" d. x 1.3" h.	P	.394" w. x 1.5" d. x 1.22" h.
H	.394" w. x 1.5" d. x 1.3" h.	P+PBY2.7	.500" w. x 1.5" d. x 1.22" h.

PRICE TABLE

Description	Interswitch Number			Net Each, Lots of		
	Type M	Type H	Type P	1-49	50-99	100-499
DPDT Reading (+, −) (0, 5) (0, 1)	MB001	HB001	PB001	$4.95	$4.50	$4.25
10 position decimal	MB010	HB010	PB010	3.30	3.00	2.85
10 position BCD	MB731	HB731	PB731	3.30	3.00	2.85
10 position BCD complement only	MB861	HB861	PB861	3.30	3.00	2.85
10 position BCD*	MB731/L	HB731/L	PB731/L	3.65	3.30	3.15
10 position BCD, true not true	MB140	HB140	PB140	4.95	4.50	4.25
10 position BCD with complement	MB531	HB531	PB531	7.35	6.60	6.25
10 position BCD with complement*	MB531/L	HB531/L	PB531/L	7.70	6.90	6.55

ACCESSORIES

Description	Interswitch Number			Net Each, Lots of		
	Type M	Type H	Type P	1-99	100-499	500-999
Mounting Hardware (Assembled)	MBW	HBW	PBW	$1.80	$1.50	$1.25
Blank Spacer Module	MBY	HBY	PBY	.75	.60	.50
Spacer for .500" P switch	.....	.....	PBY2.7	.30	.25	.22
Division Plates (Pair)	MBV	HBV	.....	1.00	.90	.80

*Long P.C.B. for component mounting.

CONNECTORS

Interswitch Number	Description	Net Ea. 1-499
CU400215U	Solder lugs, with mtg. ears	$1.40
CU400216U	Wire wrap, with mtg. ears	1.40
CU400217U	Solder lugs, without mtg. ears	1.10
CU400218U	Wire wrap, without mtg. ears	1.40
CU400354U	Printed circuit pins	1.10

SPECIAL ORDER OPTIONS

Description	Net Ea.
Make-Before-Break Contacts **Dial-Only Modules:** Ten-position (0–9) only.	Write for full information and pricing
Seven Characters per Position: Double width modules for multi-characters.	
Special Colored Characters: Thermally-bonded colored ink characters.	

OPTIONS

Interswitch Suffix	Description	Net Ea. 1-499
A__	Limit stops	$0.50
B	Blind slave	*
D	Decimal point (Hot stamp)	.25
G	Decimal point illuminated (External source)	.50
R	Decimal point illuminated (LED)	3.00
H	Illuminated dial readout	.75
L	Long P.C.B. component mounting	.50
M	Custom wheel marking	.50
P	P.C.B. Pin mounting (BCD)	.50
1	Green thumbwheel, white character	.50
2	Yellow thumbwheel, black character	.50
3	Red thumbwheel, white character	.50
4	Blue thumbwheel, white character	.50
5	White thumbwheel, black character	.50

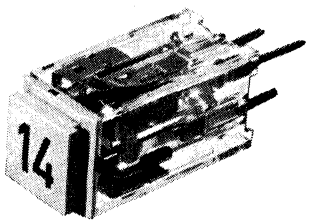
*Priced same as regular module.

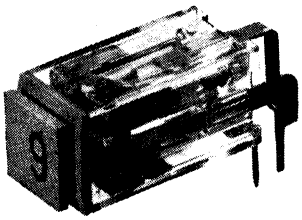
INTERSWITCH

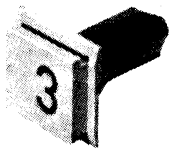
ONE OF THE PURDY GROUP OF COMPANIES

DATA MODULES AND MATRIX BOARDS

DATA MODULES





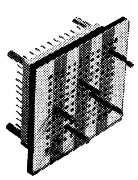


Small input device compared to thumbwheel switches or matrix boards that make it a very versatile device for test equipment, machine tool controls and other programming applications. Inexpensive and miniature coding device uses binary coding techniques. Data module consists of four miniature contact switches, four silicon diodes and a plastic housing. The programming keys actuate the switches when inserted in the data module body. Keys with numerals 0 to 15 are available; i.e., a #3 key closes the 1 and 2 lines, a #14 key closes the 2, 4 and 8 lines. Numerical characters are standard in 7mm (.276″) height to offer a large numeric readout in the smallest possible area. Each switch has four output terminals and common. Data programming module is a lowest-common denominator panel element for data entry. Wiping action set up during key insertion ensures contact reliability. For quick, error-free programming of many characters at once, flexible-plastic program-storing templates enable a complete set of keys to be inserted or removed simultaneously. Switch body is available with or without four internally mounted 1N4148 silicon diodes. Data modules are designed to mount on a printed circuit board and protrude through a rectangular cutout in the front panel. **Working Current:** 1 amp max. **Working Voltage:** 50 VAC/DC max. **Contact Resistance:** 50 milliohms. **Temperature Rating:** −20° to +70° C. **Operating Life:** 10,000 switching cycles min. **Keys:** Molded plastic with black numerals. Other colors and inscriptions also available on special order. **Codes:** 8-4-2-1; Excess 3; Aiken 2-4-2-1 or virtually any 4-bit binary code. **Body Size:** 12mm (0.469″) square x 22mm (.844″) (not including terminals).

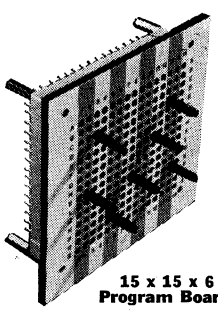
Interswitch Number	Description	Net Ea., Lots 1-99	100-499
675-022-100	Without diodes, hexidecimal	$2.60	$2.22
675-022-150	Without diodes, 4PST normally open	2.60	2.22
675-022-200	Without diodes, hexidecimal with complement	4.60	3.94
675-022-400	Without diodes, hexidecimal 90° terminals	2.80	2.40
675-022-131	With diodes anode to common, hexidecimal	3.00	2.57
675-022-141	With diodes cathode to common, hexidecimal	3.00	2.57
675-022-431	675-022-131 but 90° terminals	3.20	2.74
675-022-441	675-022-141 but 90° terminals	3.20	2.74
675-022-211	Hexidecimal but with complement	5.00	4.30
675-043-190*	Keys	.18	.15

*Add to part number, the key number (0–15) desired, e.g., 675-043-190-**02** for number **2** marked on the face of the key.

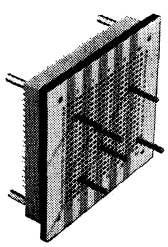
MATRIX PROGRAM BOARDS, PROGRAMMING PINS



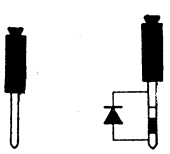
10 x 10 x 4.5 Program Board



15 x 15 x 6 Program Board



20 x 20 x 3 Program Board



Programming Pins

MATRIX PROGRAM BOARDS

Most advanced, reliable and convenient device that is fundamental to the programming of thousands of different kinds of instruments, computers, machines and control systems. Important application advantages are design simplicity, programming ease and flexibility, high area and volumetric density, visual presentation of circuit linkages. Standard matrix boards are an array of X and Y coordinates that locate circuit intersections. The horizontal contact bars, "rows", are mounted directly behind the panel and are identified by letters; the vertical contact bars, "columns", are mounted beneath the horizontal bars and are identified by numbers. Each contact bar has a solder terminal at the rear of the matrix. Board features gold plated beryllium contact strips, gold-plated terminals and an imprinted panel. The front panel is a laminated board, composed of multiple layers of paper and phenolic resin. The top layer, covering the imprinted paper foil, is a transparent melamine resin. **Current Rating (per contact bar):** 10 amps for 6mm spacing; 5 amps for 3mm or 4.5mm spacing. **Working Voltage:** 220 VAC/DC max. **Contact Resistance:** 7 milliohms with short circuit pins. **Terminals:** Solder lug.

Interswitch Number	Description*	Marking	Size, Overall	Net Each, Lots of 1-9	10-24	25-49	50-99
673-11-007-01	10 x 10 x 3	With	2.24″ square	$22.00	$20.00	$17.50	$16.50
673-11-008-02	20 x 20 x 3	With	3.43″ square	49.00	44.00	39.00	36.80
676-11-080-02	10 x 10 x 4.5	With	2.76″ square	24.00	22.00	19.00	18.00
676-110-148-02†	10 x 10 x 4.5	With	2.28″ square	25.00	23.00	19.80	18.70
676-110-112-02	20 x 20 x 4.5	With	5.61″ square	74.00	70.00	66.80	63.00
674-11-800-02	15 x 15 x 6	With	5.20″ square	54.00	49.00	43.00	38.50
674-111-280-02	16 x 16 x 6	With	5.31″ square	68.00	65.00	61.00	57.60

*Rows x columns x spacing (in mm) between centers of holes. †Similar to 676-11-080-02, except without boarder and having pins for PC board mounting.

PROGRAMMING PINS

Standard elements for use with matrix program boards. **Shorting Pins:** For direct connection between horizontal and vertical contact bars. Stocked in black and red colored handles. Also available with shorter handles in brown, yellow, green, blue, gray or white colors on special order. **Diode Pins:** Have a 1N4148 fast switching silicon diode to control current direction and prevent sneak paths between rows and columns when inserted in any hole. Stocked in black and red colored handles with the diodes soldered anode-to-tip making the polarity from column (+) to row (−). Diode pins having opposite current direction, other color handles (specified above) or different diodes also available on special order. CUSTOM ACCESSORIES: **Dummy Plugs:** Insulated plugs used to connect forbidden intersections. **Plug-In-Lamps:** Available in 6mm spacing only. Connect 12-volt lamp between line and column when inserted in any hole. Available in red, green and white colors and indicate which equipment or circuit is on, even from a distance. **Cable Plugs:** One sided or two sided; convert the matrix board into a diagnostic center by converting each hole into a test point, permitting connection of that intersection to external trouble-shooting equipment from the front of panel. **Dual and Triple-Segment Shorting Pins. Programming Templates.**

Write for pricing information on Custom Accessories.

Interswitch Number*	Description	Net Each, Lots of 1-249	250-999
673-31-100-00	3mm or 4.5mm shorting pin	$0.25	$0.20
673-21-301-00	3mm or 4.5mm diode pin	1.50	1.20
674-31-100-00	6mm shorting pin	.40	.32
674-21-301-00	6mm diode pin	1.25	1.00

*Part numbers shown are with black handle, for red handle change last two digits of part number to **02**, e.g., 674-21-301-**02**; same price.

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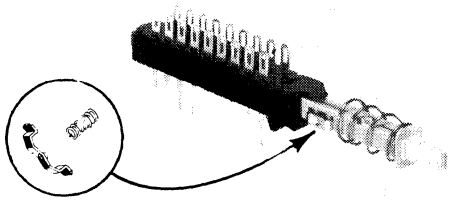
PUSH BUTTON SWITCHES

The Switch Used by Manufacturers of
Home Entertainment Products and Test Equipment

SERIES "F" - MINIATURE MODULAR PUSH-BUTTON SWITCHES

FEATURES

1. Individual coil spring loaded sliding contacts.
2. Solder AND printed circuit terminals provided.
3. Molded stand-offs on printed circuit terminal side to hold switch parallel on PC board.
4. Designed for compatibility with flo-soldering techniques.
5. Completely enclosed switch housing protects internal contact area.
6. Smooth slide action. terminal spacing is 0.157"
7. Competitively priced.
8. Modular design - 2PDT thru 10PDT.
9. Switch plunger with sliding contacts removable from front without disturbing electrical connections.
10. UL and CSA approved 4 amp 250 volt power switch available.
11. TV rated power switches available TV3 thru TV5 - SPST thru DPDT.



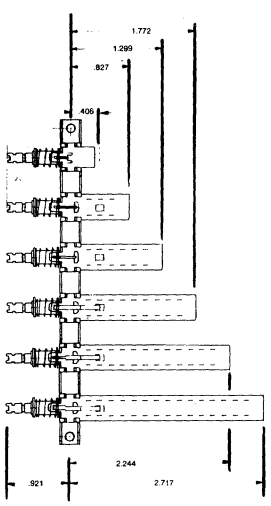
PLUNGER SHOWN PARTIALLY REMOVED
TO ILLUSTRATE SPRING LOADED SLIDING CONTACTS

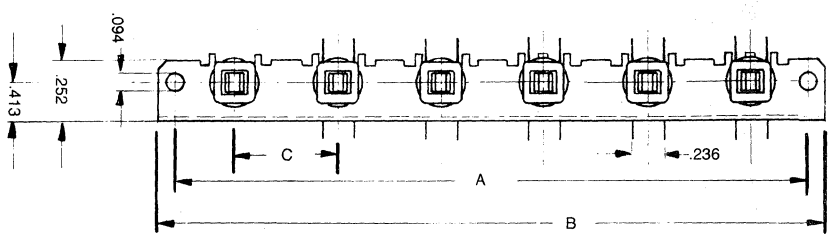
TECHNICAL DATA

Current & Voltage Ratings 0.5A/100VAC
0.2A/250VAC
1A/25VDC
Contact Resistance (max)
after 25,000 cycles .....6 - 20 mOhms
Lifetime Expectation .....50,000 - 100,000 cycles
Contact Material:
Fixed contact surfaces .....Silver coated .0002"
Moving contact surfaces .....Silver coated .0004"
Housing Material .....Fiberglas reinforced Nylon
Plunger Material .....Delrin
Terminal Board Material .....Hard paper grade IV
Contacts .....Non-Shorting ONLY

SWITCH ASSEMBLY DIMENSIONS

ALL DIMENSIONS SHOWN IN INCHES



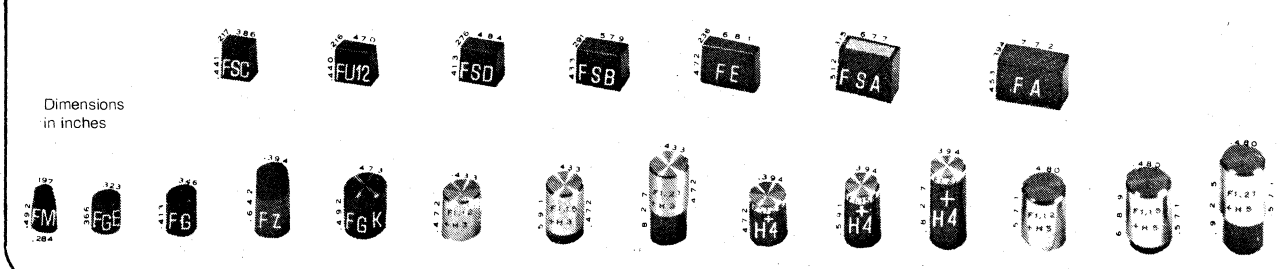


NUMBER OF STATIONS

DIM. C		2	3	4	5	6	7	8	9	10	11	12	13	14	15
SERIES 10	DIMENSION A	1.181	1.575	1.969	2.362	2.756	3.150	3.543	3.937	4.331	4.724	5.118	5.512	5.906	6.299
(.394")	DIMENSION B	1.417	1.811	2.206	2.598	2.992	3.386	3.780	4.173	4.567	4.961	5.354	5.748	6.142	6.536
SERIES 12.5	DIMENSION A	1.280	1.772	2.264	2.756	3.248	3.740	4.232	4.724	5.217					
(.492")	DIMENSION B	1.516	2.008	2.500	2.992	3.484	3.976	4.468	4.961	5.453					
SERIES 15	DIMENSION A	1.378	1.968	2.559	3.150	3.740	4.331	4.921	5.512	6.102	6.693	7.283			
(.590")	DIMENSION B	1.614	2.205	2.795	3.386	3.976	4.567	5.157	5.748	6.339	6.929	7.520			
SERIES 17.5	DIMENSION A	1.476	2.165	2.854	3.543	4.232	4.921	5.610	6.299	6.988					
(.689")	DIMENSION B	1.713	2.402	3.091	3.780	4.468	5.157	5.846	6.535	7.224					
SERIES 20	DIMENSION A	1.575	2.362	3.150	3.937	4.724	5.512	6.299	7.087	7.874					
(.787")	DIMENSION B	1.811	2.598	3.386	4.173	4.961	5.748	6.535	7.323	8.110					

BUTTONS FOR "F" SERIES SWITCHES

Dimensions in inches



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IN CANADA: AUDIO ELECTRONICS,INC., 8235 MOUNTAINSIGHTS AVENUE, MONTREAL 308, QUEBEC / PHONE: (514) 735-6197

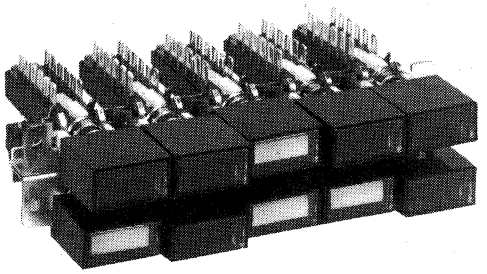
PUSH BUTTON SWITCHES

The Switch Used by Manufacturers of
Home Entertainment Products and Test Equipment

SWITCHES WITH MECHANICAL REFLECTING INDICATOR BUTTONS

MECHANICAL REFLECTING INDICATOR

1. Works on the principle of reflecting ambient light through a clear plastic lens.
2. Not sensitive to vibration or shock. Generates no heat and eliminates costly lamp replacement.
3. Reflects more brightly as ambient light increases. Even in direct sunlight, where conventional lamps are hardly visible, the reflecting indicator button shines brightly.

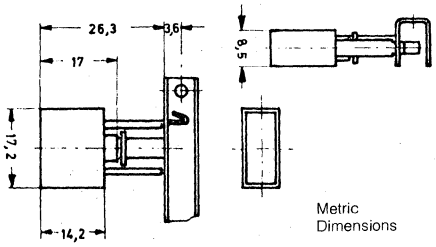


STANDARD BUTTON COLORS: Black, White, Grey, Chrome, Nickel.
STANDARD INDICATOR COLORS: (Button Depressed) Green, Orange, Yellow, Blue. (Button Released) Same colors as standard button colors.

SPECIAL COLORS: 25,000 pcs. minimum order.

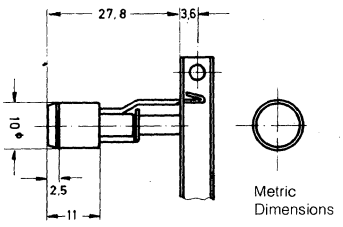
SERIES FA, ZF, AND FL ... are same as F series switches, except for buttons and mountings.

MOUNTING: Single hole .547" (14mm).
FACE PLATE: Black, grey, or chrome.
STANDARD BUTTON COLORS: Black, White, Grey.
INDICATOR COLORS: (Button depressed) Green, Orange, Yellow.



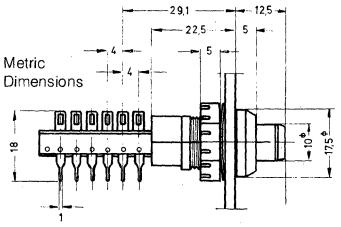
SERIES "FA105" REFLECTING RECTANGULAR BUTTON

Uses 17.5 X 8mm Indicating Button, for use on standard 17.5mm chassis or larger.



SERIES "FA201" REFLECTING ROUND BUTTON

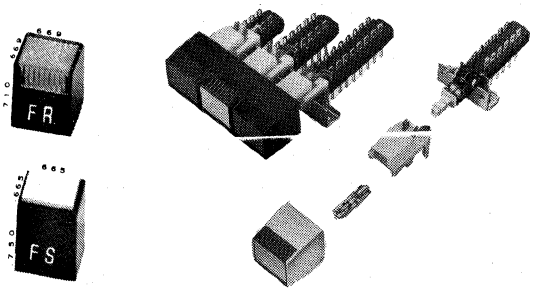
Uses 10mm Round Indicating Button, for use on 12.5 chassis or larger.



SERIES "ZF" REFLECTING ROUND BUTTON THREADED BUSHING MOUNT

WITH FA200 BUTTON

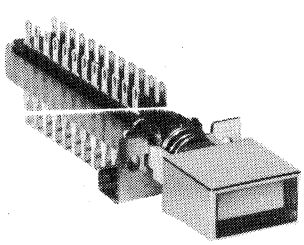
MOUNTING: Single hole .547" (14mm).
FACE PLATE: Black, grey, or chrome.
STANDARD BUTTON COLORS: Black, White, Grey.
INDICATOR COLORS: (Button depressed) Green, Orange, Yellow.



SERIES "FL" MINIATURE ILLUMINATED SWITCHES

Series F switches can be illuminated simply by installing a snap-fit lampholder, a lamp, and an illuminated-type button. Only the basic front dimensions change. The only additional cost is the lampholder, bulb, and the illuminated button.

Illuminated buttons are available with clear or colored front-mounted lens (yellow, red, green, light green, blue, grey, orange), with a white translucent insert behind. The button centerline is for .689" (17.5mm chassis). Lamps are replaceable from front. Uses Albrecht Lamp type: (A-810-3K -- 5V. 60 mA.), (A-812-3K -- 6V. 35 mA.), (A-814-3K -- 12V. 35mA.), (A-816-3K -- 24 V. 35mA.).



SERIES "G" COMPACT MODULAR SWITCH

1. NEW ... **Compact** ... modular push-button switch, where space is a problem.
2. Similar to Series F switch, except shorter ... and terminal spacing is closer ... 0.131" vs 0.157" for Series F.
3. Uses same buttons as Series F ... including the **Mechanical Reflecting Indicator Buttons**.
4. Uses same chassis dimensions.
5. Terminal configuration is same as Series F.

Illustration shows SERIES G
1XGA01-0003-00 FA201/Chrome-Green 8UEE

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PUSH BUTTON SWITCHES

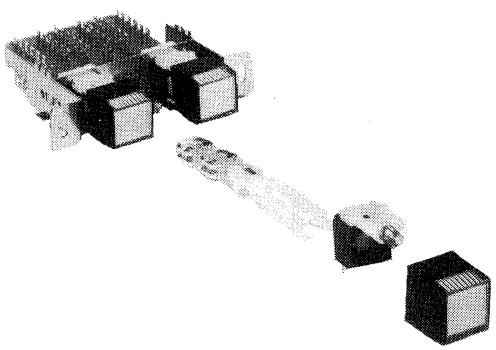
INTERNATIONAL ELECTRO EXCHANGE CORP.

SERIES "C" & "CL" - HIGH QUALITY PUSH-BUTTON SWITCHES

This push-button switch is for use in high quality commercial applications. The sophistication of the Series "C" & "CL" in terms of electrical construction (bifurcated contacts - coil spring loaded) and mechanical actions available will satisfy the most demanding switching requirements.

Tableau or stacked switches available either "C" or "CL" Series, 15 per chassis X 10 high. With the designation Series "CL" this switch is also available with slip-on lamp holder. Use Type 5522 lamp (see lamp table). Key spacing is .689" (17.5 mm) and .886" (22.5 mm).

SERIES "C" - NON-ILLUMINATED
SERIES "CL" - ILLUMINATED



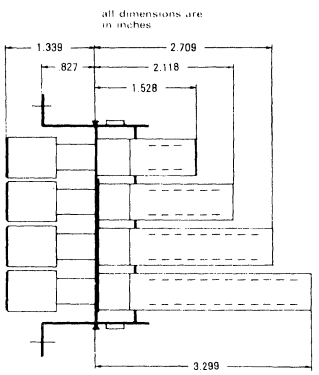
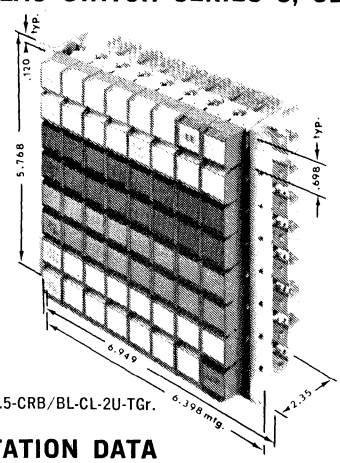


TABLEAU SWITCH SERIES C, CL



8XT8XCL 17.5-CRB/BL-CL-2U-TGr.

MECHANICAL DATA

Key travel = .315" Contact travel = .197"
Life 300,000 cycles depending upon load.
Key pressure — 2 & 4PDT = 35 oz.; 6 & 8PDT = 49 oz.

MECHANICAL ACTIONS AVAILABLE

Gr	= Interlocking.
Gr_1 Gr_2	= Two independent interlocking groups.
o.A.	= Momentary.
A.o.R.	= Momentary release button for interlocking.
EE	= Push to make push to break
Z	= Central release for individual latching.
Sp	= Blocking action only one key down. Switching is delayed to increase margin of safety.
Gr + Sp	= Interlocking with blocking. Maximum 15 button (stations) in one row.
Gr_1 + Sp Gr_2 + Sp	= Two groups of interlocking with blocking. (Group 1 can be blocked independent of Group 2.)
o.A. + VSp	= Momentary action with blocking.
EE + VSp	= Push to engage, push again to release — with blocking. The depressed button must first be released before another button can be depressed.
Gr + VSp + A.o.R.	= Interlocking with blocking and locking of button with one central momentary release button. The depressed button must first be released by central release button or solenoid remote release, before another one button can be depressed.
Gr + RSp + A.o.R.	= Locked — Interlocking with Blocking. A central release button must first be depressed before any of one interlocked buttons can be depressed; this button remains latched after release button is allowed to return. The main circuit can be interrupted, if necessary, through the release button *contacts. In this way, a 4 Amp. circuit can be switched, without current, through standard C-module switch contacts.

CHASSIS AND STATION DATA

Model Number 17.5
Center to center spacing ..... 0.689"
Number of stations ..... 1 - 15
Standard Buttons - Series "C" (Non-illuminated) ....CSX, CB
Standard Buttons - Series "CL" (Illuminated) ... ..CSR, CRR

CONTACT TYPES

Standard: Non-shorting - Solder Terminals Top, P.C. Terminals Bottom.
Shorting: ks — Short PC top, Standard PC bottom: SI
Leading: V — Short PC terminals both sides: SC
Lagging: N — Special cut off terminals either side .036" long.

INSULATION MATERIAL

Contact Plate: Phenolic 20.62.8 Kl.IV
Module: Polycarbonate (Makrolon)
Contact Plunger 2u,4u: Polycarbonate (Makrolon)
Contact Plunger 6u,8u: Polyamid
Outer Plunger: Azetalharz

ELECTRICAL DATA

Voltage Max.: 1000 volts.
Current Max.: 2 amps $\cos\phi = 1$.
Load Max.: 100 watts ac.
Load Max.: 25 watts dc.
Test Voltages: Contact to ground 300 volts ac.
Terminal to terminal: 2000 volts ac.
Auxiliary terminals to outer-terminals: 1000 volts ac.
Lamp holder contacts to ground: 1500 volts ac.
Insulation Resistance: $10^{12}\Omega$ after 96 hours storage in 95-100% humidity.
Contact Resistance: < 5 milli Ω.
Contact Resistance: After 25,000 switching cycles - about 15 milli Ω (depends on load).
Dielectric loss: $tg\partial$ 4 x 10^{-3} (300 kHz).

POWER SWITCH NC17 (UL APPROVED)

Max. Voltage — 250 ac.
Max. Current — 6A ($\cos\phi = 0.75$)
Max. Current — 3A (Inductive load)
Max. Voltage — 250 dc.
Max. Current — 4A dc.
Test voltage between terminals & chassis: 3000V ac.
Test voltage between terminals & contacts: 2000V ac.
Contact Resistance: 50 mΩ (With rated load).

IEE WELCOMES INQUIRIES ... DIMENSIONAL DRAWINGS AND QUOTES UPON REQUEST

INTERNATIONAL ELECTRO EXCHANGE CORP. 8081 WALLACE ROAD, EDEN PRAIRIE, MINNESOTA 55343 / PHONE: (612) 944-1820 TWX 910-576-2469
IN CANADA: AUDIO ELECTRONICS,INC., 8235 MOUNTAINSIGHTS AVENUE, MONTREAL 308, QUEBEC / PHONE: (514) 735-6197

PUSH BUTTON SWITCHES

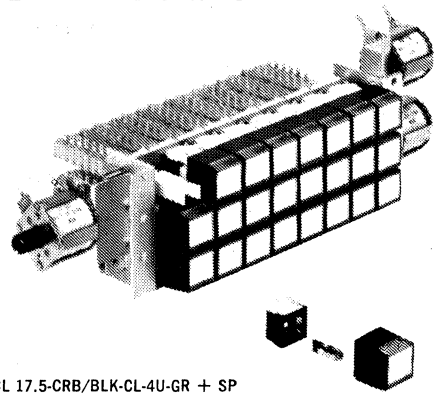
INTERNATIONAL ELECTRO EXCHANGE CORP.

SERIES "CL" - TABLEAU SWITCHES

TABLEAU MECHANICAL FEATURES

- EGr = Interlocking independent of each row.
- EGr + ESp = Interlocking with Blocking independent of each row.
- TGr = Interlocking of several (maximum 10) rows up to 150 buttons without blocking.
- TGr + ESp = Interlocking of all buttons, but blocking of buttons in each individual row of switch banks only.
- TGr + TSp = Interlocking and blocking of all buttons (only one button can be depressed at a time).
- TGr + TVSp + A.o.R. = Central release button, or solenoid release, interlocking with blocking. Only one button can be depressed in entire Tableau until central release button is depressed to release previously depressed button.
- TEE + TVSp = Push to engage - Push to release with blocking of tableau section referred to. The only one depressed button must be depressed again to release before any other one button can be depressed (see yellow button caps).
- TGr + TRSp + A.o.R. = Locked — interlocking with blocking. A central release button must first be depressed and held in its position before any of one interlocked buttons can be depressed. This button remains latched after release button is allowed to return. The main circuit can be interrupted, if necessary, through the release button contacts. In this way 4 amp. can be switched, without current, through the Standard C-Module switch contacts.

TABLEAU — CL SERIES



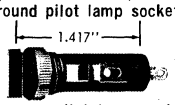
3T8XCL 17.5-CRB/BLK-CL-4U-GR + SP
with 24V DC Solenoid Release Each Row.

- EGr + TRSp + A.o.R. = Central release button in each row (right-hand side) with pre-locking of entire keyboard. Only one button can be depressed in the Tableau, and only in that row, the central release button previously has been depressed. The central release buttons are connected as one lock. Each row of interlocked switch banks are independent of each other.

PILOT LAMPS AND ACCESSORIES

PILOT LAMP SOCKETS

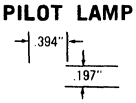
#288.1 Single round pilot lamp socket. Uses 288-4 lens.



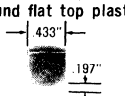
#389.1 Single square pilot lamp socket. Uses 388.3 lens.

Note: All lamp sockets require .402" mounting hole. Use type 5530 lamps.

PILOT LAMP LENSES



#288.4 Round flat top plastic lens.



#388.3 Square flat top plastic lens.

Note: All lenses available in red, green, blue, yellow, clear, and white colors.

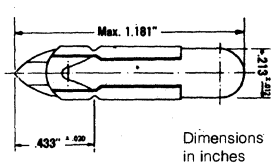
MODULAR LAMP SOCKET

#388.1 Panel lamp indicator assembly. Building block design. Removable colored lenses, square or round. Up to 10 modules may be locked together into one bank. Small space requires only 7/16" x 5" x 1 1/2" (depth) for 10 lamp bank. Two mounting brackets (388.2) are required.

MINIATURE TELECOMMUNICATION LAMPS — Type 5530

6V - 20, 40, 200	mA
12V - 20, 50, 100	mA
18V - 25	mA
24V - 20, 30, 50	mA
30V - 20, 40	mA
36V - 20	mA
48V - 20, 30	mA
60V - 20	mA

THESE LAMPS BY TAUNUSLICHT — GERMANY.

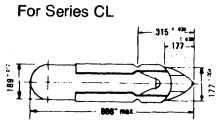


Dimensions in inches

MINIATURE TELECOMMUNICATION LAMPS — Type 5522

6V - 40	mA
12V - 20, 50	mA
24V - 20	mA
30V - 20	mA

For Series CL



LAMP EXTRACTORS

#110 for Type 5530 & 5522 lamps.

WE INVITE REQUESTS FOR QUOTATIONS

SAMPLES SHIPPED WITHIN 48 HOURS - DIMENSIONAL DRAWINGS UPON REQUEST

INTERNATIONAL ELECTRO EXCHANGE CORP.
8081 WALLACE ROAD - EDEN PRAIRIE, MINNESOTA 55343
PHONE: (612) 944-1820 - TWX: 910-576-2469

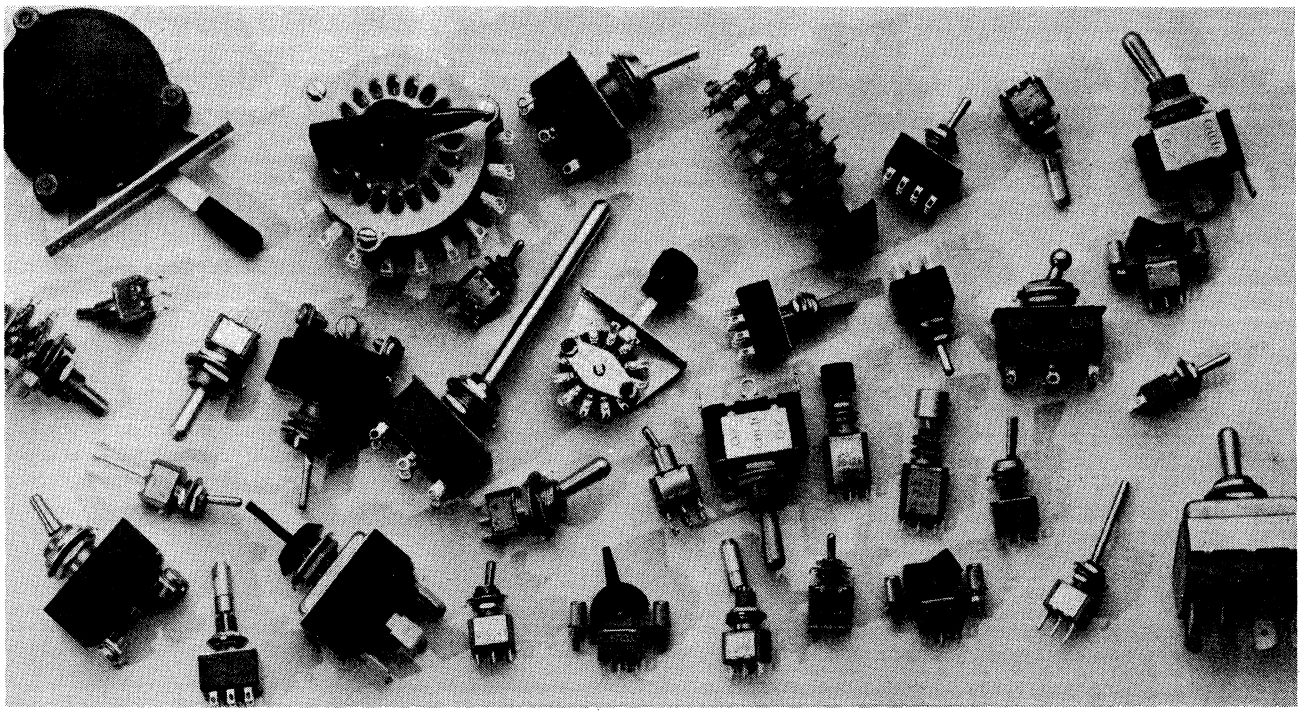
IN CANADA: AUDIO ELECTRONICS,INC., 8235 MOUNTAINSIGHTS AVENUE, MONTREAL 308 QUEBEC - PHONE: (514) 735-6197

J-B-T 34th Year

SWITCHES*

J-B-T INSTRUMENTS, INC.

J-B-T 34th Year



In the J-B-T line of switches are: 1-, 2-, 3-, and 4-pole toggles—rockers and paddle levers—12-, 14-, and 20-position rotary and lever switches—sub-miniature and standard sizes—sealed and not sealed—general purpose and military—with various finishes, configurations and constructions, standard and special. It's a broad line of instrument type switches built in Connecticut to high quality standards.

SUB-MINIATURE TOGGLE, ROCKER AND PADDLE LEVER SWITCHES . . .

. . . Combine drastic reduction in size and weight with trouble-free performance of J-B-T standard size general purpose toggle switches. Distinctive green bodies are only ¼" x ½" for single pole models; 2-, 3-, and 4-pole models are proportionately small. Nominal rating is 5 amp/125 VAC for the series with coin silver switching parts; 0.5 watt, 28 VAC or VDC for series with gold plated brass parts. High torque bushings are standard. Most popular models are UL listed. Choice of lever types, including push-button, rocker and paddle lever types, bushing sizes, terminals, circuit configurations, and finishes. *Catalog MT-40E*

SUB-MINIATURE 12-POSITION ROTARY AND LEVER SWITCHES . . .

. . . 1" nominal size for low current usage where size, weight, and reliability are important. With patented wafer design, Series 7000, 1-6 decks can have full 12 live switching positions per deck; Series 5000, 11 live switching contacts on each side of a dual-duty deck, with a maximum of 8 poles per deck. Lever types, panel sealed types, and MIL variations available as SR05 and SR31 to many performance levels of MIL-S-3786C. *Catalog SM-33E*

STANDARD SIZE TOGGLE SWITCHES — GENERAL PURPOSE, INDUSTRIAL, INSTRUMENT AND MILITARY TYPES . . .

. . . 20 amp rating @ 125 VAC for Group I, SP and DP; and for Group III, 3-pole and 4-pole. General purpose types, UL listed, available with many options in levers, bushings, terminals, finishes and circuit configurations. MIL types to MIL-S-83731 meet or exceed requirements of the specifications.

. . . 6 amp rating @ 125 VAC or VDC for Group II SP and DP fast make-and-break models. Many options available for general purpose use; MIL types meet or exceed requirement of MIL-S-83731. *Catalog TS-7E*

STANDARD SIZE 12-, 14-, AND 20-POSITION ROTARY AND LEVER SWITCHES . . .

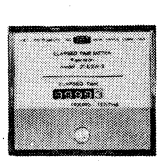
. . . For instruments and test equipment, 14- and 20-position fully enclosed molded and bonded switches provide extra switching capability, up to 4 poles per deck. Lever switches in this series provide up to 5 live positions, 2 circuits per deck. Nominal rating is 1 amp/125 VAC inductive. *Catalog 1172E*

. . . V/M series, 12-position fully enclosed 1 13/16" dia. switch carries 5 amp/125 VAC and breaks 2 amp. Features include adjustable torque, initial contact resistance under .002 ohms, and parasitic emf under 1 microvolt. *Catalog VM-68E*

Model 34-FG
9-Reeds, 60 cps.

J-B-T FREQUENCY AND ELAPSED TIME METERS

. . . J-B-T Vibrating Reed Frequency Meters are made in a wide variety of case styles and sizes, standard and sealed, panel and portable; in many frequency ranges and reed groupings. Permanently accurate within ±0.3% or better, if required. Elapsed Time Meters are cased in styles compatible with other panel instruments in 5- or 6-digit models, reading in hours and tenths @ 60 cps/125 VAC. Variations for other frequencies and voltages available. *Catalog 1172E*



Model 31-EGW-5
0-9,999.9 hours

See J-B-T Catalog Pages in The Radio Electronic Master

J-B-T INSTRUMENTS, INC. • P. O. BOX 1818 • NEW HAVEN, CONN. 06508

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

(203) 772-2220 or 787-5824 TWX 710-465-3165

Janco CORPORATION

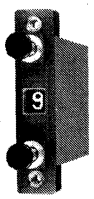
"ADAPTABILITY THROUGH VERSATILITY"

SPACE-SAVER PUSH BUTTON ROTARY SWITCHES

TOTALLY ENCLOSED EXPLOSION PROOF CONSTRUCTION

AVAILABLE IN ALL STANDARD CODED OUTPUTS

BI-DIRECTIONAL



Index	Part No.	Maximum Positions
45°	2808B	8
36°	2810B	10
30°	2812B	12

Electrical Rating:
.125 amp Res. at 28 v dc
.125 amp Res. at 115 v ac
.05 amp Ind. at 28 v dc
Current carrying capacity
3 amps continuous.
Will meet or exceed
the requirements of
MIL-S-22710/18
(For all 3 models)

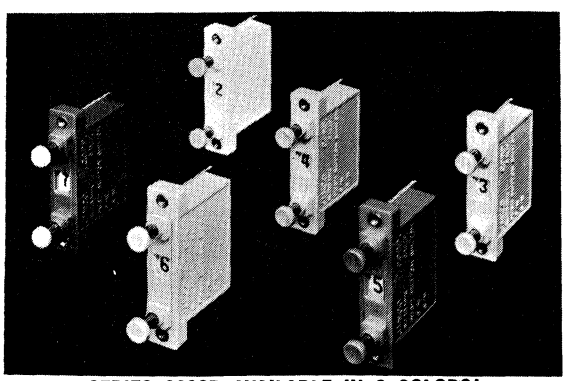
Index	Part No.	Maximum Positions
22½°	2816B*	16
22½°	2816U**	16

*BI-DIRECTIONAL
**UNI-DIRECTIONAL

Electrical Rating:
.125 amp Res. at 28 v dc
.125 amp Res. at 115 v ac
.05 amp Ind. at 28 v dc
Current carrying capacity
3 amps continuous.
Will meet or exceed
the requirements of
MIL-S-22710
(for both models)

Light if required 5 v dc .06 amp.

Life expectancy 100,000 hours. Removable for easy replacement.



SERIES 2800B AVAILABLE IN 6 COLORS!

Series 2800B micro-miniature pushbutton rotary switches (see above) are available in green, red, yellow, blue, white and gray for color coordinating and coding on panel controls. All models also offer replaceable colored pushbutton caps.

Optional features include radio frequency interference shielding, lighted digit positions, and a bezel mount for ease of panel mounting.

UNI-DIRECTIONAL

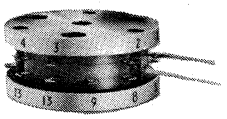
Index	Part No.	Maximum Positions
45°	2908U	8
36°	2910U	10
30°	2912U	12

Electrical Rating:
.125 amp Res. at 28 v dc
.125 amp Res. at 115 v ac
.05 amp Ind. at 28 v dc
Current carrying capacity
3 amps continuous.
Will meet or exceed
the requirements of
MIL-S-22710/23
(For all 3 models)

Index	Part No.	Maximum Positions
45°	2808U	8
36°	2810U	10
30°	2812U	12

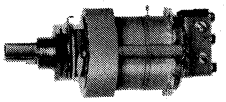
Electrical Rating:
.125 amp Res. at 28 v dc
.125 amp Res. at 115 v ac
.05 amp Ind. at 28 v dc
Current carrying capacity
3 amps continuous.
Will meet or exceed
the requirements of
MIL-S-22710/18
(For all 3 models)

TYPICAL UNIQUE APPLICATIONS OF JANCO ROTARY SWITCHES



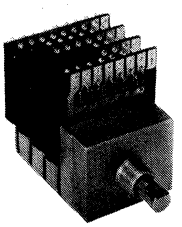
WITHSTANDS HIGH RANDOM VIBRATION LEVELS

This rotary switch is capable of successfully withstanding random vibration characteristics of 10 to 3,000 Hz in excess of 100 G's. Meets shock requirements of 384 G's of sawtooth shock pulses.



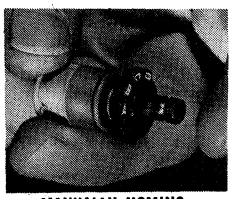
MINIATURE POWER SWITCH CUTS COSTS BY 50%

Janco's line of miniature rotary switches is available with an auxiliary snap action switch affixed to the back. Coupled with an isolated positions feature, it enables the user to switch 10 amps with no danger to the switch. Cost reduction is approximately 50% over conventional power switches.



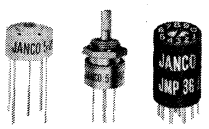
MORE SWITCHING IN LESS SPACE

Circuit board construction is featured in this switch. Offers the same switching capabilities normally associated with switches having 2 to 3 times more decks. Also features isolated positions and custom codes.



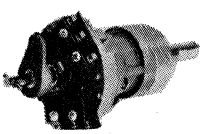
MANUALLY HOMING ROTARY SWITCH

Features instant release button, which automatically returns to predetermined designated home position. Has four positions with visual indicator. Variations available.



MINIATURE PIN-TYPE ROTARY SWITCHES

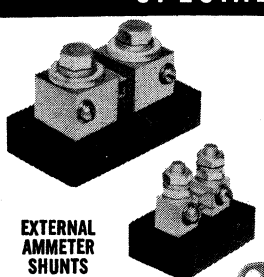
Designed for printed circuit boards and front panel mounting. Available in various numbers of positions and poles.



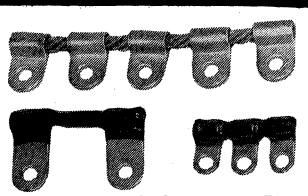
FEATURES UNIQUE ON-OFF OPERATION

Actuated by pulling knob out of "off" position and rotating to "on" positions. While in "on" positions, circuitry cannot be shut off until knob is returned to "off" position and depressed. Number of positions optional.

SPECIAL PRODUCTS

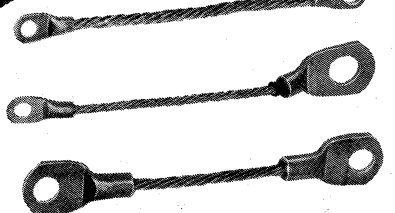


EXTERNAL AMMETER SHUNTS MIL-S-61B



FLEXIBLE BUS ASSEMBLIES

BUS BARS



BONDING JUMPERS

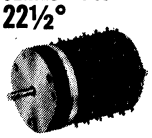
JANCO CORPORATION
Box 3038 • Burbank, CA. 91504 • 3111 Winona Avenue • (213) 849-2107 • (213) 845-7473 • TWX 910-498-2701

ROTARY SELECTOR SWITCHES

TOTALLY ENCLOSED EXPLOSION PROOF CONSTRUCTION

Janco CORPORATION

SERIES 1748
22½°



Max. Pos.: 16
Body Dia.: 3″

Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.

Available only in single pole per deck construction.
Screw terminals only.

SERIES 1749
30°

Max. Pos.: 11 plus off
Body Dia.: 2.180″

Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.

Available in 1 and 3 poles per deck construction.
Screw terminals only.

SERIES 1750
36°

Max. Pos.: 9 plus off
Body Dia.: 2.375″

Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.

Available only in single pole per deck construction.
Screw terminals only.

SERIES 1751
45°

Max. Pos.: 8
Body Dia.: 1.93″

Electrical Rating:
10 amps 115 v ac Res.
10 amps 28 v dc Res.
5 amps 28 v dc Ind.

Available in 1 and 2 poles per deck construction.
Screw terminals only.

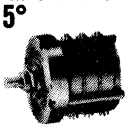
SERIES 1752
90°

Max. Pos.: 4
Body Dia.: 2.125″
Electrical Rating:
1 pole construction
15 amps Res. 115 v ac
15 amps Res. 28 v dc
10 amps Ind. 28 v dc
2 pole construction
7.5 amps Res. 115 v ac
7.5 amps Res. 28 v dc
5 amps Ind. 28 v dc
Screw terminals only.

MINIATURE ROTARY SELECTOR SWITCHES / 3786

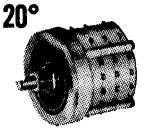
• TOTALLY ENCLOSED
• EXPLOSION PROOF

SERIES 6-1900
15°



Max. Pos.: 24
Body Dia.: 2″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
6-1900 Series 1 pole/deck
6-1912 Series 2 pole/deck
6-1980 Series 3 pole/deck
6-1914 Series 4 pole/deck
6-1913 Series 6 pole/deck

SERIES 12-1900
20°

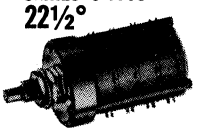


Max. Pos.: 18
Body Dia.: 2″

Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

Available only in single pole per deck construction.

SERIES 3-1900
22½°

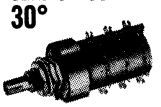


Max. Pos.: 16
Body Dia.: 1.5″

Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.

3-1900 Series 1 pole/deck
3-1912 Series 2 pole/deck
3-1914 Series 4 pole/deck

SERIES 1905
30°

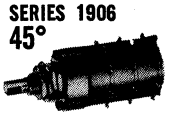


Max. Pos.: 12
Body Dia.: 1.036″
Electrical Rating:
2 amps 115 v ac Res.
1 amp 28 v dc Res.
0.5 amp 28 v dc Ind.
1905 Series 1 pole/deck
1-1909 Series 2 pole/deck
4-1900 Series 3 pole/deck
67-1940 Series 4 pole/deck
67-1900 Series 6 pole/deck

SERIES 1900
36°

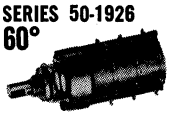
Max. Pos.: 10
Body Dia.: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
1900 Series 1 pole/deck
1960 Series 2 pole/deck

SERIES 1906
45°



Max. Pos.: 8
Body Dia.: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.
1906 Series 1 pole/deck
1-1910 Series 2 pole/deck

SERIES 50-1926
60°



Max. Pos.: 6
Body Dia.: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
3 amps 28 v dc Res.
2 amps 28 v dc Ind.
Available only in single pole per deck construction.

SERIES 51-1921
90°

Max. Pos.: 4
Body Dia.: 1.036″
Electrical Rating:
5 amps 115 v ac Res.
5 amps 28 v dc Res.
2.5 amps 28 v dc Ind.
Available only in single pole per deck construction.

On most of the switches listed, the following features are available:

1. Deck Identification
2. Extended Thru Bolt for Rear Mounting
3. O-ring Shaft and Panel Seal
4. Combination of Decks
   a) Nonshorting and shorting
   b) Shorting, shorting and bridging
   c) Nonshorting and shorting and bridging
5. Bridging contacts
6. Momentary positions
7. Isolated positions
8. Adjustable stops
9. Solenoid driven
10. Keylock
11. Gang switches
12. Concentric shaft switches

For switches that incorporate these features, a unique Janco part number must be assigned at the plant.

GENERAL SPECIFICATIONS

All switches offer maximum protection against radio frequency interference.

ELECTRIC RATING:
Carry 10 amps continuous.
Make & Break—see individual switch data.

VOLTAGE DROP:
0.1 volt or less at rated amperage.
Initial Contact Resistance .003 OHM.

LIFE:
10,000 double cycles make and break rated amperage.

TORQUE:
1 to 3 inch lbs.

SWITCHES DESIGNED AND BUILT IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS:
MIL-S-6807 (rotary switches enclosed)
MIL-S-3786 (rotary switches)
MIL-E-5272 (environmental testing)

MICRO-MINIATURE ROTARY SELECTOR SWITCHES

• **TOTALLY ENCLOSED**
• **EXPLOSION PROOF**
• **UNITIZED CONSTRUCTION**

All switches offer maximum protection against radio frequency interference.

Body Diameter: .623″

Electrical rating continuous:
8 amps at 28 v dc.

Switching rate:
0 to 0.25 amp resistive 0 to 28 v dc.
0 to 0.25 amp resistive 0 to 115 v ac.
0 to 0.12 amp inductive 0 to 28 v dc.

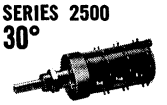
TORQUE: 5 to 9″ ounces.

CONTACT RESISTANCE:
.005 ohms average.

INSULATION RESISTANCE:
100,000 megohms minimum at 100 volts.
10,000 megohms minimum at 500 volts.

DESIGNED AND BUILT to meet the environmental and functional requirements of MIL-S-3786.

SERIES 2500
30°



Max. Pos.: 12

2500 Series 1 pole/deck
2530 Series 2 pole/deck
2531 Series 3 pole/deck

"M" SERIES
2500M Series 1 pole/deck
2530M Series 2 pole/deck
2531M Series 3 pole/deck

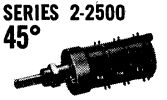
SERIES 1-2500
36°

Max. Pos.: 10

1-2500 Series 1 pole/deck
1-2530 Series 2 pole/deck

"M" SERIES
1-2500M Series 1 pole/deck
1-2530M Series 2 pole/deck

SERIES 2-2500
45°



Max. Pos.: 8

2-2500 Series 1 pole/deck
2-2530 Series 2 pole/deck

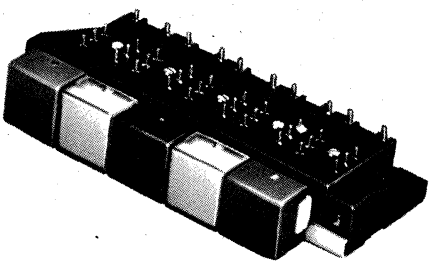
"M" SERIES
2-2500M Series 1 pole/deck
2-2530M Series 2 pole/deck

JANCO CORPORATION
Box 3038 • Burbank, CA. 91504 • 3111 Winona Avenue • (213) 849-2107 • (213) 845-7473 • TWX 910-498-2701

LEDEX

LEDEX INC., 126 WEBSTER STREET, DAYTON, OHIO 45401
phone (513) 224-9891

SWITCHES & SIGNAL LIGHTS
SERIES 1400—ILLUMINATED PUSH BUTTON CONTROLS

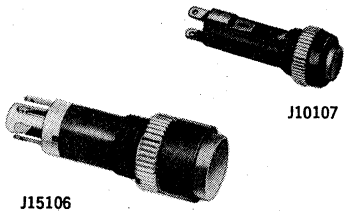


A versatile concept that gives you interrelated switching combinations . . . plus prototypes in 72 hours.

Momentary . . . push/push . . . reciprocal release . . . master release . . . interlock . . . one assembly does the job of several.

DPDT contacts, 2 amps, 250 VAC. Two to 20 stations on a frame. Mount vertically or horizontally. Single button and indicator lights to match.

LIGHTED & UNLIGHTED MINIATURE PUSH BUTTONS



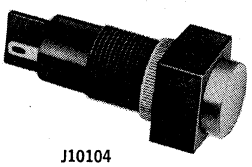
J10107

J15106

Part No. 15106 has double break contacts, with one set NO and one NC. Electrical life is 100,000 operations at contact rating of .1A/24VDC. Built-in lamp life is 10,000 hours.

Part No. J10107 has single throw NO contacts. Push button measures approx. ¼" dia. and has minimum electrical life of 50,000 operations at .1A/24VAC, resistive load.

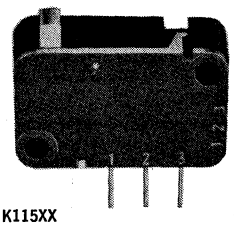
MOMENTARY PUSH BUTTONS



J10104

Round or square bezel 1P1T silver plated contacts, 2A/250VAC. Transparent or opaque caps available for legend display. Other momentary and maintained switches stocked, with a choice of size and colors, ratings up to 10A/250VAC.

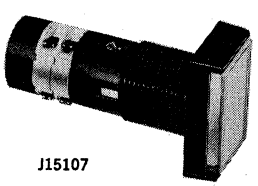
CONTACTLESS SWITCHES



K115XX

Contactless, miniature, push button and keyboard switches for highly reliable solid state operation, with transistor or Schmitt Trigger output, positive or negative logic. Solid state thumbwheel switches also available.

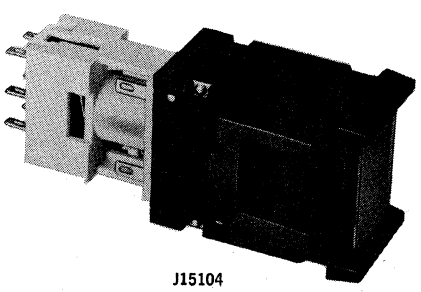
SERIES 1700—ILLUMINATED PUSH BUTTONS



J15107

Lighted momentary and maintained with matching indicating lights, 2A/250VAC, 2 to 4 poles. Square, round or rectangular lens. Bulb, lens, and legend insert easily from front end of panel. Bulb life span 50,000 hours minimum.

DUAL BULB PUSH BUTTONS

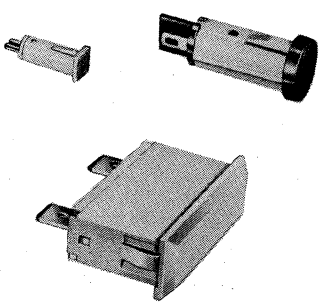


J15104

Lighted dual bulb push buttons with either momentary or maintained action. Available with 1P2T or 2P2T contacts, 6A/115VAC or 2A/250VAC.

License rights by Rafi of West Germany.

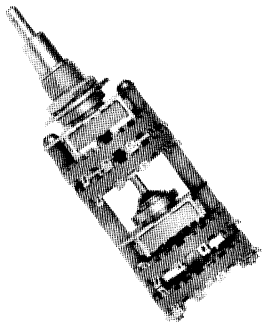
SIGNAL LIGHTS



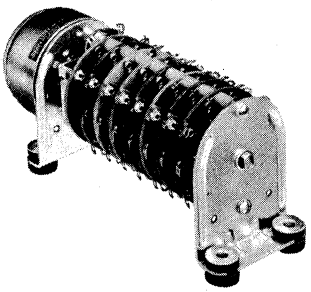
Wide variety of attractively styled lights, from miniature pilot to large signal. Options include opaque or transparent lens, grid patterns, built-in or replaceable bulbs, solder, spade or PC terminals, and ratings from 6 to 220 volts.

LEDEX INC., *126 WEBSTER STREET, DAYTON, OHIO 45401*
phone (513) 224-9891

STEPPING SWITCHES/CIRCUIT SELECTORS



Versatility, Economy, and Reliability are the main benefits offered by Ledex manual rotary switches. Sizes range from ½" diameter multi-deck designs to 24-position switches measuring 2¼" in diameter. For your more complex requirements, switches are available with concentric shafts or as complete switching packages. To simplify wiring and reduce your assembly costs, you can specify designs to include pre-wired components, wiring harnesses, or PC terminals.



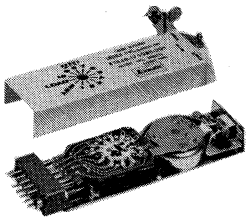
30 Off-The-Shelf Models
Ledex Stepping Switches are used for transfer switching, remote control of predetermined circuit patterns, remote sequencing of complex switching arrangements, or in programming checkout and sequential operations. They are known best for their ability to perform multiple switching functions reliably, in limited space, and under severe operating and environmental conditions. Available in open construction, pre-wired modules or as packaged control solutions.

Ledex Hermetically Sealed Switches are engineered to withstand severe shock and vibration, such as encountered in aircraft, missile and military applications, and to provide added switching reliability in adverse environments. Used extensively in aero/space and underwater guidance controls, as mode selectors, in rocket firing devices, and in a variety of military control functions that demand a high degree of reliability. There are 19 models available from the shelf.

PACKAGED CONTROL SOLUTIONS

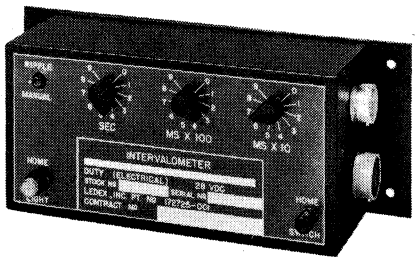
Here are examples of Ledex Stepping Switches designed into compact, reliable control packages that combine the best characteristics of solid state and electromechanical technologies.

Whether your problem involves armament controls or commercial control functions, there's a good chance Ledex has already solved a similar problem. Our Packaged Switches Catalog, B-3252, shows several more detailed examples and also includes specifications for 19 hermetically sealed switches available from the shelf.



Miniaturized Armament Control Intervalometer
Flat, compact, 12-position stepping switch measures only ½" x 1¼" x 4¼", fires 19 rockets, sequentially in pairs. It includes a Ledex pulser to control time intervals over mil-spec. temperature and voltage ranges.

40-position Intervalometer with single or optional 5-speed ripple fire control
40-position intervalometer has 5 adjustable control speeds for rocket firing at intervals of 100, 200, 300, 400 or 500 milliseconds. Hybrid design combines best characteristics of solid state and electromechanical products for optimum performance, minimum weight, maximum reliability and lowest cost. Firing time intervals are maintained at ±5% through a voltage range of 22 to 31 vdc.



Universal Stores Dispenser Intervals Variable on Digital Basis

All solid state and among the most flexible of Ledex intervalometer designs, this one permits the pilot to vary release intervals to any rate ranging from 30 ms to 9.99 seconds in increments of 10 ms. It includes a stepping switch to distribute sequential fire commands. Timing tolerance is ±10% over a voltage range of 22 to 32 volts and temperature to −55°C to +85°C. The package includes built-in suppression to protect solid state circuitry when switching inductive loads.

For engineering assistance and technical literature, write or phone.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
(IN N. Y. STATE CALL COLLECT (516) 294-0990)

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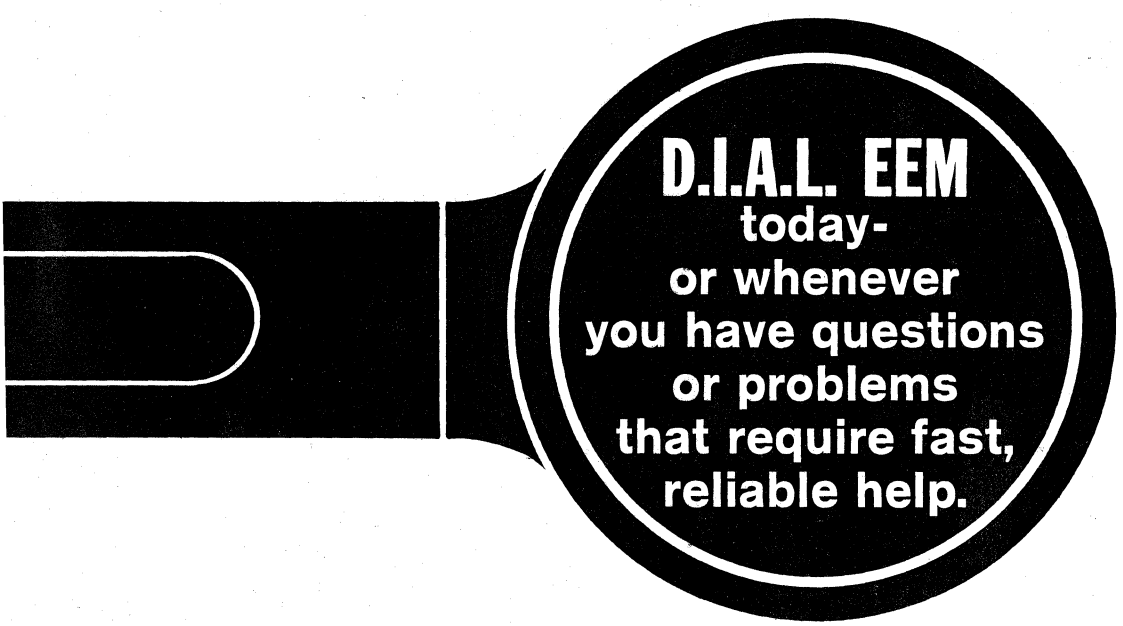

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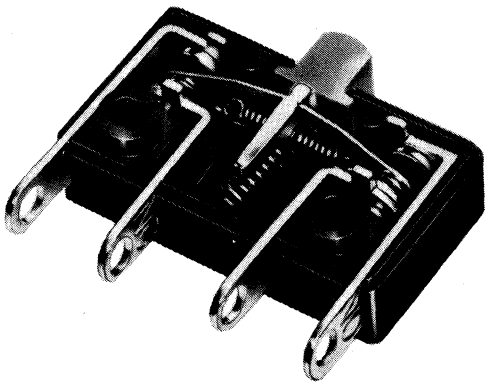
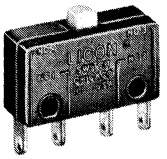
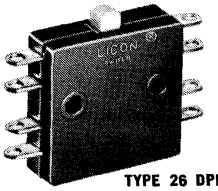
LICON General Information BASIC SWITCH

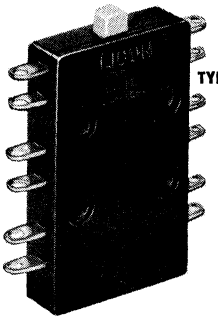




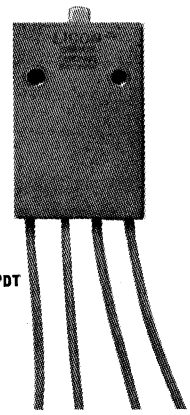
TYPE 16 SPDT



TYPE 26 DPDT



TYPE 36 3PDT



TYPE 16 IWTS-SPDT

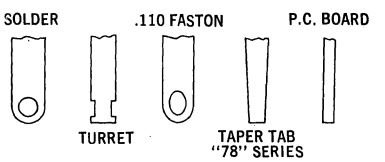
The heart of a lighted pushbutton switch is the basic switch. All Licon® lighted switches employ patented Butterfly® double-break basic switches offering unequaled capability in contact rating, circuitry, performance, and terminal options.

The exclusive Butterfly® double-break switch mechanism consists of a twin blade and spring design which simultaneously makes or breaks a circuit at two points. Double-break action distributes arc heat over twice as many contact surfaces and air gaps as conventional single break switches, resulting in a higher contact rating for a given package size. The A-frame design of the Butterfly® mechanism provides substantial contact wiping action during operation which serves to clean contact surfaces (important in low level applications) and shear minor contact welds (important in power applications). The spring loaded mechanism provides rapid transfer time, positive tactile feel, minimized contact bounce, and excellent resistance to shock and vibration. When compared to stressed blade single break switches, Butterfly® double-break basics offer increased mechanical and electrical life because operating stress is absorbed by the coil springs.

Double break basic switches are available in subminiature single pole (Type 16) double pole (Type 26) and triple pole (Type 36) versions, allowing lighted switch circuitry ranging from one to six poles with minimum behind panel space required. Each pole of a double break switch mechanism has an isolated two circuit handling capacity, for added circuit flexibility.

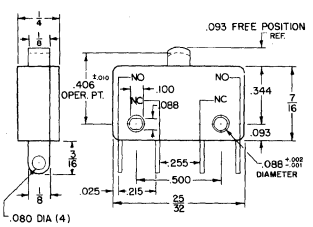
Double-break basics are available with a variety of case and contact materials, and a complete selection of terminal styles, including Integrated Wire Termination Systems (I.W.T.S.) The subminiature double-break basic switches are also offered in military approved versions, under MIL-S-8805. Electrical ratings and physical dimensions are shown on this page.

TERMINATIONS



BASIC SWITCH ■ OUTLINE DIMENSIONS / ELECTRICAL RATINGS

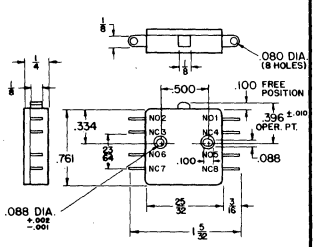
TYPE 16



10 Amps @ 125/250 VAC (U.L. Listed) 28 VDC L/R = .026

CIRCUITRY	LOAD	SEA LEVEL
Form X or Y Single Circuit	Res. Ind. Lamp	10 Amps 7.5 Amps 4 Amps
Form Z Two Circuit	Res. Ind. Lamp	10 Amps 5 Amps 3 Amps
Form C	Res. Ind.	10 Amps 3 Amps

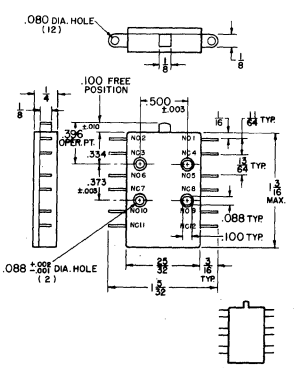
TYPE 26



8 Amps @ 125/250 VAC (U.L. Listed) 28 VDC L/R = .026

CIRCUITRY	LOAD	SEA LEVEL
Form XXX or YYY	Res. Ind.	10 Amps 7.5 Amps
Form ZZZ	Res. Ind.	10 Amps 5 Amps

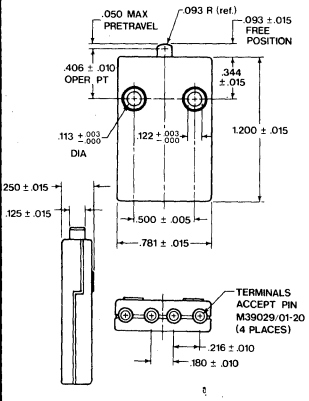
TYPE 36



8 Amps @ 125/250 VAC
28 VDC L/R = .026

CIRCUITRY	LOAD	SEA LEVEL
Form XX or YY	Res. Ind.	8 Amps 7.5 Amps
Form ZZ	Res. Ind.	8 Amps 5 Amps

TYPE 16 I.W.T.S.



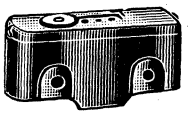
Ratings apply to use with 20 gauge wire.

CIRCUITRY	LOAD	SEA LEVEL	
		28 VDC	115 VAC 60 Hz
Form Z (SPDT double-break)	Res.	7.5 Amps	5.0 Amps
	Ind.	5.0 Amps	5.0 Amps
	Lamp	3.0 Amps	1.5 Amps

LICON Switches

TYPE 10 BASIC SWITCHES

Type 10—Highly sensitive switch utilizes one-piece mechanism. Assures long life with excellent repeatability and positive snap action. Wide choice of actuators. Rated 15 amps, 125, 250, 460 VAC; ½ amp, 125 VDC. ⅓ hp, 125 VAC; ½ hp, 250 VAC. Size, 2″ x 1″ x 1 1/16″; 1″ mtg. centers. UL Listed; CSA Approved.



Licon Number	Description	Microswitch Equivalent	List Price*
10-122	Pin plunger, .020″ gap	BZ-2RT	$2.15
10-127	Pin plunger, .070″ gap	BZ-R31	2.10
10-222	Spring plunger	BZ-2RST	2.65
10-322	Panel mount plunger	BZ-2RQIT	4.50
10-422	Leaf spring	BZ-2RLT	2.30
10-522	Roller leaf spring	BZ-2RL2T	3.15
10-622	Pivoted lever	.....	2.65
10-722	Pivoted roller lever	BZ-2RW82T	3.30
10-822	Compact plunger	BZ-2RDT	2.70
10-922	Roller plunger	BZ-2RQ18T	8.00
10-72207	One way roller	.....	3.95

Also available in Type 08 heavy duty 22.5 amp version. Write for information and prices.

TYPE 11 MINIATURE TWO-CIRCUIT BASIC SWITCH

Type 11—High capacity two-circuit basic switch combines long life and high electrical rating into a compact package. Rated 10 amps, 125, 250 VAC or 30 VDC. ½ hp, 125 VAC; ¾ hp, 250 VAC. Tested to 20 million operations. Choice of actuators. Reset models available in all terminal styles. Size, 1¼″ x ½″ x ½″. UL Listed; CSA Approved.

Licon Number	Description	Microswitch Equivalent	List Price*
11-104	End solder terminal	1TB2	$1.65
11-204	End screw terminal	1TB1	1.80
11-304	Side solder terminal	1TB3	1.75
11-504	¼″ quick-disconnect end	.....	1.70
11-114	Reset-end solder term.	.....	2.00
11-214	Reset-end screw term.	.....	2.10
11-314	Reset-side solder term.	.....	2.05

MS PART NUMBERS FOR TYPE 11

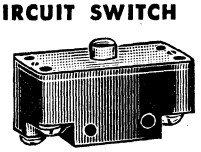
Licon Number	Description	List Price*
11-188051	MS25342-1	$2.90
11-288051	MS25344-1	2.90
11-388051	MS25343-1	2.90

AUXILIARY ACTUATORS ONLY FOR TYPE 11

Licon Number	Actuator Type	No. of Poles	List Price*
71-1030	Rigid lever	1	$0.45
71-1040	Rigid roller lever	1	.95
71-2010	Overtravel plunger	1	1.50
71-2077	Straight-line plunger	2	2.55
71-2657	Pushbutton (½″ dia.)	1	2.30

TYPE 14 HEAVY DUTY TWO-CIRCUIT SWITCH

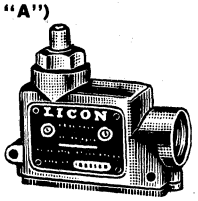
Type 14—Heavy-duty industrial limit switch. Uses double break mechanism for high electrical rating. Nylon button reduces mechanical wear. Well-spaced electrical terminals. Horizontal mounting holes permit multiple side mounting. Rated 20 amps, 125/250 VAC. Size, 1 3/16″ x 1 13/16″ x 1 1/16″. UL Listed; CSA Approved.



Licon Number	Description	List Price*
14-12403	Basic switch, vertical mounting	$3.20
14-124	Basic switch, horizontal mounting	3.00
14-1241	Reset switch	3.50
14-12804	Heavy duty, vertical mounting	3.20
14-324	Overtravel plunger actuator switch	4.60
14-624	Pivoted lever actuator switch	3.60
14-724	Pivoted roller lever actuator	4.10
14-72403	Pivoted roller, vertical mounting	4.30

TYPE 30 DIECAST ENCLOSED SWITCH
(DISCOUNT SCHEDULE "A")

Type 30—Offers versatility for wide applications. Superior mounting and variety of infinitely adjustable actuators. Aluminum housing is rugged permits adequate wiring room; has ½-14 internal tap conduit hub. Rated 15 amps, 125, 250 and 480 VAC; ½ amp, 115 VDC. Size, 3 1/64″ x 1″ x 2½″.



DIECAST HOUSINGS

Licon No.	Description	List Pr.*
30-100	Overtravel plunger, side mount	$5.55
30-120	Overtravel plunger, base mount	5.55
30-200	Internal sealed O.T. plunger, side mount	7.30
30-220	Internal sealed O.T. plunger, base mount	7.30
30-300	Roller lever actuator, side mount	9.95
30-320	Roller lever actuator, base mount	9.95
30-400	Internal sealed roller lever, side mount	11.25
30-420	Internal sealed roller lever, base mount	11.25
30-500	Roller plunger actuator, side mount	9.95
30-520	Roller plunger actuator, base mount	9.95
30-600	Palm button actuator, side mount	11.85
30-620	Palm button actuator, base mount	11.85
30-700	Internal sealed roller plunger, side mt.	10.80
30-720	Internal sealed roller plunger, base mt.	10.80
30-800	Internal sealed 1-way roller, side mount	13.05
30-820	Internal sealed 1-way roller, base mount	13.05
30-900	One-way roller, side mount	11.85
30-920	One-way roller, base mount	11.85
30-200010	Sealed O.T. plunger with external boot seal, side mount	8.70
30-220010	Sealed O.T. plunger, seal, base mount	8.70

SPLIT HOUSINGS

30-140	Overtravel plunger, side mount	$5.65
30-150	Overtravel plunger, base mount	5.65
30-240	Internal sealed O.T. plunger, side mount	7.35
30-250	Internal sealed O.T. plunger, base mount	7.35
30-340	Roller lever actuator, side mount	9.95
30-350	Roller lever actuator, base mount	9.95
30-440	Internal sealed roller lever, side mount	11.25
30-450	Internal sealed roller lever, base mount	11.25
30-540	Roller plunger actuator, side mount	9.95
30-550	Roller plunger actuator, base mount	9.95
30-640	Palm button actuator, side mount	11.85
30-650	Palm button actuator, base mount	11.85
30-740	Internal sealed roller plunger, side mt.	10.80
30-750	Internal sealed roller plunger, base mt.	10.80
30-840	Internal sealed 1-way roller, side mount	13.05
30-850	Internal sealed 1-way roller, base mount	13.05
30-940	One-way roller, side mount	11.85
30-950	One-way roller, base mount	11.85

INDIVIDUAL COMPONENTS FOR TYPE 30

73-1900	Roller lever actuator (alone)	$3.90
73-1910	Palm button actuator (alone)	4.45
73-1920	One-way roller actuator (alone)	5.50
80-300610	Split case housing bottom half, base mt.	.85
80-300609	Split case housing bottom half, side mt.	.85
80-300502	Die cast housing bottom plate, side mt.	.55
80-300508	Die cast housing bottom plate, base mt.	.55
30-030	Die cast terminal enclosure, side mount	2.15

★QUANTITY DISCOUNT SCHEDULE "A"

These discounts apply to all items on this page.

Quantity	Discount	Multiplier	Quantity	Discount	Multiplier
1–24	0%	None	100–199	35%	.65
25–49	20%	.80	200–499	37%	.63
50–99	30%	.70			

Write for additional discounts on larger quantities.

LICON/DIVISION ILLINOIS TOOL WORKS, INC. 6615 WEST IRVING PARK ROAD / CHICAGO, ILLINOIS 60634 / (312) 282-4040 / TWX 910-221-0275

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

LICON Switches

TYPE 16 SUBMINIATURE TWO-CIRCUIT BASIC SWITCH

Type 16—Two-circuit subminiature. Double break mechanism tested over 20 million mechanical cycles. Rated 10 amps 125/250 VAC or 30 VDC. Exceptional shock and vibration resistance. Solder, screw or taper tab terminals extending from various unit faces. Auxiliary actuators include levers, roller levers and toggles. Size, 25/32″ x 7/16″ x 1/4″. UL Listed; CSA Approved.

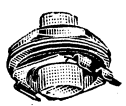
Licon Number	Description	Circuit	List Price*
16-104	End solder terminal	SPDT, Form Z	$2.50
16-304	Side solder terminal	SPDT, Form Z	2.50
16-404	Bottom solder terminal	SPDT, Form Z	2.50
16-114	Reset-end solder term.	SPDT, Form Z	2.75
16-504	Bottom taper tab term.	SPDT, Form Z	2.50
16-204	Screw end terminal	SPDT, Form Z	2.50
16-4042	Hi-temperature case	SPDT, Form Z	2.90
16-40401	Gold-plated contacts	SPDT, Form Z	3.00
16-40421	Hi-temp case, gold-plated contacts	SPDT, Form Z	3.40
16-188051	MS25476-1	SPDT, Form Z	3.60
16-388051	MS27217-2	SPDT, Form Z	3.60
16-488051	MS27217-1	SPDT, Form Z	3.60

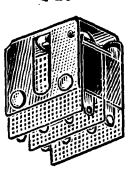
AUXILIARY ACTUATORS ONLY FOR TYPE 16

76-1200	Rigid roller lever	1 pole	$1.00
76-1210	Rigid lever	1 pole	.55
76-3200	Spring lever	1 pole	.40
76-3210	Spring roller lever	1 pole	.85
76-2190	Pushbutton	2 pole	2.35
76-2220	Pushbutton	1 pole	2.20
76-2260	Overtravel pushbutton	1 pole	2.30
76-4210	Two-position toggle	2 pole	4.95
76-4220	Two-position toggle	3 pole	5.25
76-2100	Maintained pushbutton	2 pole	4.00

TYPE 76 SNAP-TOGETHER PUSHBUTTON SWITCHES

Non-lighted, snap-together pushbutton design offers choice of 3/8″ or 15/16″ bushings, four button colors and a wide variety of snap-on switch modules with high performance, 10-amp subminiature double break switches. Unit price includes the three individual components.





SWITCH MODULES

Licon Number	Actuator Type	No. of Poles	Contact Form	List Price*
76-2711	Maintained	1	C	$4.35
76-2713	Maintained	1	Z	4.60
76-2721	Maintained	2	C	5.30
76-2723	Maintained	2	Z	5.85
76-2751	Momentary	1	C	2.80
76-2753	Momentary	1	Z	3.05
76-2761	Momentary	2	C	3.55
76-2763	Momentary	2	Z	4.10

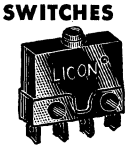
BUSHINGS

Licon No.	O.D.	List Price*	Licon No.	O.D.	List Price*
76-2530	15/16″	$1.20	76-2550	3/8″	$1.40

PUSHBUTTONS

Licon No.	Color	List Pr.*	Licon No.	Color	List Pr.*
80-700903	White	$0.25	80-700909	Green	$0.25
80-700908	Red	.25	80-700910	Black	.25

TYPE 18 SUB-SUBMINIATURE SWITCHES

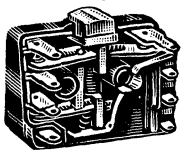


Type 18—Double-break switch has same reliability and precision performance of Type 16 switches. Features big switch rating. Rated 7 amps, 125/250 VAC. Size, .200″ x .500″ x .350″. UL Listed.

Licon Number	Description	List Price
18-40121	SPST-NC-DB, solder terminals	$3.35
18-40221	SPST-NO-DB, solder terminals	3.35
18-40421	SPDT-DB, solder terminals	3.35
18-488051	MS27257-1(B)	3.75

ALWAYS SPECIFY LICON PRECISION, SNAP-ACTION SWITCHES—MADE TO MEET MIL RELIABILITY, CAPACITY AND LIFE REQUIREMENTS.

TYPE 22 FOUR-CIRCUIT BASIC SWITCH



Type 22—Features high current interruption, tested to over 10 million cycles mechanical life. DPDT, 4 independent circuits permit simultaneous multiple circuit control without complicated mechanisms. Rated 10 amps, 125, 250 VAC or 30 VDC. 1/2 hp, 125 VAC; 3/4 hp, 250 VAC. Size, 7/8″ x 1 1/4″ x 1/2″. UL Listed.

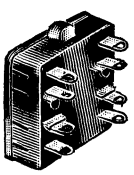
BASIC SWITCH

Licon Number	Description	Microswitch Equivalent	List Price*
22-304	DPDT—side solder terminal	41TB5-3	$5.30
22-114	DPDT—side solder terminal—reset	.....	5.50
22-204	DPDT—screw end	.....	5.45
22-104	DPDT—solder end	.....	5.30
22-504	DPDT—1/4″ quick-disconnect term.	.....	5.30
22-188051	MS25348-1	.....	7.55
22-388051	MS25349-1	.....	7.55

AUXILIARY ACTUATORS FOR TYPE 22

72-1150	Rigid lever	.....	$0.60
72-1160	Rigid roller lever	.....	1.25
72-2080	Overtravel plunger	.....	1.75

TYPE 26 DOUBLE POLE SUBMINIATURE SWITCHES



Type 26—Subminiature double pole switch utilizes two Licon Butterfly® double-break mechanisms. Simultaneity of operation of both poles insured by special linkage between mechanisms. Switch eliminates need for dual components and actuating mechanism; requires less space than two single pole miniature switches. Type 76 actuators fit type 26 switches. Pushbutton and toggle actuators fit 26-800 switch series only. Rated 8 amps, 125/250 VAC; 10 amps resistive, 5 amps inductive, 28 VDC. Size, 25/32″ x .761″ x 1/4″. UL Listed.

Licon Number	Description	List Price*
26-801	DPST-NC-DB, end solder terminals	$6.05
26-802	DPST-NO-DB, end solder terminals	6.05
26-804	DPDT-DB, end solder terminals	6.05
26-80401	Same, but non-simultaneous	5.00
26-8042	DPDT-DB, hi-temp., end solder	6.80
26-80421	Same, but non-simultaneous	5.80
26-901	DPST-NC-DB, side solder terminals	6.05
26-902	DPST-NO-DB, side solder terminals	6.05
26-904	DPDT-DB, side solder terminals	6.05
26-90401	Same, but non-simultaneous	5.00
26-9042	DPDT-DB, hi-temp., side solder	6.80
26-90421	Same, but non-simultaneous	5.80
26-888051	M8805/77-001	7.80
26-988051	M8805/77-002	7.80

TYPE 36 TRIPLE-POLE SUBMINIATURE SWITCHES

Type 36—Utilizes three Licon Butterfly® double-break mechanisms with simultaneous operation. Greatly reduces space requirements. Uses same actuators as Types 16 and 26. Contacts 3PDT-DB, momentary action; rated 10 amps resistive, 5 amps inductive (8 amps, U/L Listed) at 125/250 VAC or 28 VDC. Size, 25/32″ x 1 3/16″ x 1/4″, excluding terminals.

Licon No.	Description	List*
36-604	End solder terminals, simultaneous action	$9.20
36-704	Side solder terminals, simultaneous	9.20
36-60401	End solder terminals, non-simultaneous	8.15
36-70401	Side solder terminals, non-simultaneous	8.15
36-688051	M8805/78-001	11.50
36-788051	M8805/78-002	11.50

★QUANTITY DISCOUNT SCHEDULE "A"

These discounts apply to all items on this page.

Quantity	Discount	Multiplier	Quantity	Discount	Multiplier
1–24	0%	None	100–199	35%	.65
25–49	20%	.80	200–499	37%	.63
50–99	30%	.70			

Write for additional discounts on larger quantities.

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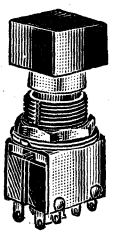
LICON Switches

TYPE 01 LIGHTED PUSHBUTTON SWITCH WITH SINGLE LAMP INDICATOR

(DISCOUNT SCHEDULE "B")



Type 01 pushbutton switch combines single bulb panel indicator with multi-pole pushbutton switch. For original equipment or replacement of toggles with color-lit or legend-coded button. Provides a visual reminder that a circuit is on or off at a glance. Available in red, white, yellow, green, or blue pushbutton, 5/8" and 3/4" round or square, and 1 1/8" diameter round lens caps; solid or projected color illumination. **Order lens cap separately.** Available in one and two-pole form C or form Z contact arrangement. Switch rated at 10 amps, 250 VAC or 30 VDC. Momentary, maintained, solenoid held and indicator models. One hole mounting with choice of 15/32" or 5/8" bushing. Uses T-1 3/4 lamp with screw or flange base (not included in price). Overall size: 1 29/32" x 5/8" x 25/32". UL Listed.

Licon Number	Unit Type	Bushing	Lamp Base	No. of Poles	Contact Form	List Price*
01-145000	Indicator	15/32-32	Screw	.....	.....	$4.00
01-365000	Indicator	5/8-24	Flange	.....	.....	4.00
01-145510	Momentary	15/32-32	Screw	1	C	5.90
01-145530	Momentary	15/32-32	Screw	1	Z	6.15
01-365510	Momentary	5/8-24	Flange	1	C	5.90
01-365530	Momentary	5/8-24	Flange	1	Z	6.15
01-145610	Momentary	15/32-32	Screw	2	C	7.95
01-145630	Momentary	15/32-32	Screw	2	Z	8.50
01-365610	Momentary	5/8-24	Flange	2	C	7.95
01-365630	Momentary	5/8-24	Flange	2	Z	8.50
01-145110	Maintained	15/32-32	Screw	1	C	8.60
01-145130	Maintained	15/32-32	Screw	1	Z	8.95
01-365110	Maintained	5/8-24	Flange	1	C	8.60
01-365130	Maintained	5/8-24	Flange	1	Z	8.95
01-145210	Maintained	15/32-32	Screw	2	C	10.65
01-145230	Maintained	15/32-32	Screw	2	Z	11.25
01-365210	Maintained	5/8-24	Flange	2	C	10.65
01-365230	Maintained	5/8-24	Flange	2	Z	11.25
01-145531	Solenoid held, 28 V	15/32-32	Screw	1	Z	13.15
01-365531		5/8-24	Flange	1	Z	13.15
01-145631		15/32-32	Flange	2	Z	15.30
01-365631		5/8-24	Flange	2	Z	15.30

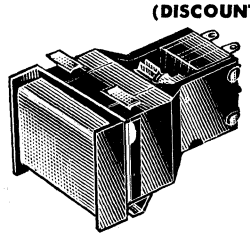
*LENS CAP (SOLID COLOR) ORDERING INFORMATION

Licon Number	Cap Shape	Cap Size	For Bushing	List Price*	Cap Color Indication
01-93131X	Round	5/8"	15/32-32	$0.45	Add proper suffix to replace **X** for cap color indication. **White:** Suffix **1** **Red:** Suffix **2** **Green:** Suffix **3** **Blue:** Suffix **4** **Yellow:** Suffix **5** **Example:** 01-931311 White cap, solid color
01-94131X	Round	5/8"	5/8-24	.45	
01-93141X	Round	3/4"	15/32-32	.55	
01-94141X	Round	3/4"	5/8-24	.55	
01-93181X	Round	1 1/8"	15/32-32	.75	
01-94181X	Round	1 1/8"	5/8-24	.75	
01-91131X	Square	5/8"	15/32-32	.45	
01-92131X	Square	5/8"	5/8-24	.45	
01-91141X	Square	3/4"	15/32-32	.55	
01-92141X	Square	3/4"	5/8-24	.55	

*Solid color; projected color types on request.

TYPE 01-800 SNAP-IN ILLUMINATED MATRIX MOUNTING SWITCH—WITH SINGLE LAMP INDICATOR

(DISCOUNT SCHEDULE "B")



Type 01-800 single-lamp lighted pushbutton switch offers time-saving snap-in front mounting on panels. Combination bezel-barrier eliminates misguided actuation. Choice of screen colors with solid or projected illumination. Choice of momentary or maintained contact types in Form C (SPDT) and Form Z (SPDT, double break); or, indicator-only units. Switch rated 10 amps, 125/250 VAC; UL Listed. Uses T-1 3/4 flange bulbs (not included in price); simple front-panel lamp servicing without tools. Compact 1 1/8" x 7/8" lens cap gives ample space for engraving or hot stamping.

Indicator Licon Number	Switch Modules Description	Switch Modules List Price*	Lens Caps* Licon Number	Lens Caps* Color	Lens Caps* List Price*
01-865000	Indicator only	$2.15	01-951911	White	$0.70
01-865130	1-pole, maintained	5.80	01-951912	Red	.70
01-865230	2-pole, maintained	7.50	01-951913	Green	.70
01-865530	1-pole, momentary	3.85	01-951914	Blue	.70
01-865630	2-pole, momentary	5.55	01-951915	Yellow	.70
			01-951916	Amber	.70
			01-951917	Orange	.70

*Solid color; projected color types on request.

●QUANTITY DISCOUNT SCHEDULE "B"

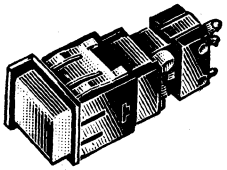
Quantity	Discount	Multiplier	Quantity	Discount	Multiplier
1–49	0%	None	100–499	15%	.85
50–99	10%	.90	500–999	26%	.74

★QUANTITY DISCOUNT SCHEDULE "D"

Quantity	Discount	Multiplier	Quantity	Discount	Multiplier
1–49	0%	None	500–999	26%	.74
50–99	10%	.90	1000–1999	30%	.70
100–499	18%	.82			

TYPE 01-600 SWITCH HOUSING (FOR USE WITH TYPE 01-748 LIGHTED SWITCH)

(DISCOUNT SCHEDULE "D")



Type 01-600—Easy-to-install, snap-in housing for use with Type 01-748 switch (listed below, under 01-700 series). Complete lighted switch offers versatility and flexibility at low cost. Available in bezel, single barrier or double barrier design. Individual or matrix mounting is possible with a single panel cutout. Uses lens cap 01-91141X as listed in Type 01 lens cap section. Panel cutout, .875" sq.

Licon No.	Description	List*
01-600001	Vertical row mtg., vert. barrier	$1.20
01-600002	Horizontal row mtg., vert. barrier	1.20
01-600003	Vertical row mtg., single vert. barrier	1.20
01-600004	Horizontal row mtg., single vert. barrier	1.20
01-600005	Vertical row mtg., no barrier	1.20
01-600006	Horizontal row mtg., no barrier	1.20

TYPE 01-700 ONE-LITE PUSHBUTTON SWITCHES

(DISCOUNT SCHEDULE "D")

Type 01-700—Low cost, momentary or maintained, lighted pushbutton combines long life, double-break switch and lamp base in one plastic housing. Choice of cylindrical, translucent lens caps or regular 01 Series lens caps (if plunger converter is used). Bulb replaceable from front of panel; uses screw-base T-1 3/4 lamp, not supplied. Switch mechanism is one or two-pole momentary with SPDT (Form Z or C) contact. UL Listed at 10 A, 125/250 VAC.

SWITCHES WITHOUT LENS CAPS

Licon Number	Actuator	No. Poles	Contact Form	List Price*
01-745000	Indicator only (no switch)			$1.80
01-745510	Momentary	1	C	3.10
01-745530	Momentary	1	Z	3.30
01-745610	Momentary	2	C	3.80
01-745630	Momentary	2	Z	4.20
01-745110	Maintained	1	C	4.10
01-745130	Maintained	1	Z	4.30
01-745210	Maintained	2	C	4.80
01-745230	Maintained	2	Z	5.20

PLUNGER CONVERTER INSTALLED

For use with 01 Series lens caps. 15/32" bushing only.

Licon Number	Actuator	No. of Poles	Contact Form	List Price*
01-748000	Indicator only (no switch)			$2.00
01-748510	Momentary	1	C	3.30
01-748530	Momentary	1	Z	3.50
01-748610	Momentary	2	C	4.00
01-748630	Momentary	2	Z	4.40
01-748110	Maintained	1	C	4.40
01-748130	Maintained	1	Z	4.60
01-748210	Maintained	2	C	5.10
01-748230	Maintained	2	Z	5.50

TRANSLUCENT LENS CAPS

Momentary—Specify number. List Price.....20c*

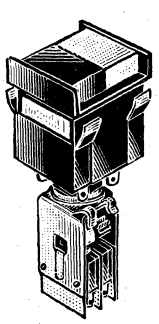
Licon No.	Color	Licon No.	Color	Licon No.	Color
80-010764	Green	80-010766	Yellow	80-010768	White
80-010765	Red	80-010767	Blue		

Maintained—Specify number. List Price.....20c*

86-010890	Green	86-010892	Yellow	86-010580	White
86-010891	Red	86-010893	Blue		

TYPE 02-800 TWO-LIGHT SWITCH

(DISCOUNT SCHEDULE "B")



Economical two-light version of the 01-800 with efficient snap-in mounting and attractive bezel barrier appearance. Size, 1 1/8" x 7/8". Employs 76-27XX series snap-on switch module. To order complete unit, select a lens cap, housing, and switch module (76-27XX, as shown in 04 section).

LENS CAPS

Licon No.*	Description	List*
02-61XX	Full screen†	$0.70
02-62XX	Vertical split†	1.25
02-63XX	Horizontal split†	1.25
02-64XX	Full proj. color	1.25
02-65XX	Vert proj. color	1.80
02-66XX	Horiz. proj. color	1.80

*Indicate desired colors by substituting appropriate numbers for XX in Licon No.: **1**=white, **2**=red, **3**=green, **4**=blue, **5**=yellow, **6**=amber, **7**=orange. †Solid color.

HOUSINGS

02-73	Snap-in, flange base lamp sockets	$1.95
02-76	Indicator only	1.95

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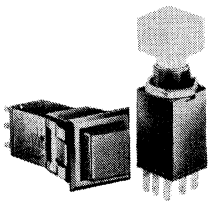
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

LICON Switches

TYPE 03 — THE CONVERTIBLE III LIGHTED PUSHBUTTON SWITCH



Licon's 03 series lighted pushbutton switches offer both momentary and alternate action in one switch. Mode choice is made by sliding a selector tab located between the terminals.

In momentary action, depressing the lens cap actuates the switch. When the cap is released, switch resets immediately and the cap returns to its rest position. Alternate action requires a press to actuate and a second press to release. Either action in the same compact size.

This low-cost switch features thermoplastic housing and accepts T1¾ base lamps. Lamps are easily replaced by pulling out lens cap, inserting new lamp, and snapping cap back on.

Small in size (2⅛ x ⅝ inch square), the switch's symmetry makes it ideal for matrix mounting and PC board applications. Available with standard .110 in. Faston quick connect terminals.

Switch can be panel mounted from either rear or front with bezel or bezel barrier time saving snap in mounting.

ALL UNITS BELOW, 5 AMPS 125/250 VAC

Licon Number	Description	Poles	List Price
03-100010	Indicator only, bushing mount		$1.10
03-113110	Momentary bushing mount soft touch	1	1.65
03-123110	Momentary bushing mount, soft touch	2	2.00
03-112110	Alternate action bushing mount, tactile feel	1	1.90
03-122110	Alternate action bushing mount, tactile feel	2	2.25
03-115110	Convertible actuator bushing mount, tactile feel	1	1.90
03-125110	Convertible actuator bushing mount, tactile feel	2	2.25

ALL UNITS BELOW, GOLD LOW LEVEL (1 AMP 125 VAC RESISTIVE MAX.)

03-113210	Momentary bushing mount soft touch	1	1.79
03-123210	Momentary bushing mount soft touch	2	2.28
03-112210	Alternate action bushing mount, tactile feel	1	2.04
03-122210	Alternate action bushing mount, tactile feel	2	2.53
03-115210	Convertible actuator bushing mount, tactile feel	1	2.04
03-125210	Convertible actuator bushing mount, tactile feel	2	2.53

LENS CAPS

Licon Number	Button Size	List Price
03-911X1	⅝ sq. Flat top	$.38
03-912X1	⅝ x ¾ Flat top	.38

Above lens caps solid color. (X) indicate color by listing the following numbers: (1) white, (2) red, (3) green, (4) blue, (5) yellow, (6) amber, (7) orange. For engraving consult factory.

BEZELS AND BARRIERS

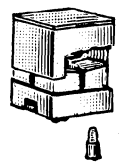
Licon Number	Description	List Price
03-600001	Bezel mount ⅝ sq. button	$.60
03-600002	Single barrier ⅝ sq. button	.60
03-600003	Double barrier ⅝ sq. button	.60
03-600004	Bezel mount ⅝ x ¾ button	.60
03-600005	Single barrier ⅝ x ¾ button	.60
03-600006	Double barrier ⅝ x ¾ button	.60

TYPE 65 SUBMIN. SEALED SWITCH (DISCOUNT SCHEDULE "A")

Type 65—Dependable, environment-free snap-action switching with ratings up to 10 amps, 30 VDC. SPDT 2-Circuit configuration. Solder terminals and potted leads available on special order. Size, .850″ x .875″ x .375″ mtg. centers, ½″. UL Listed.

Licon No.	Description	List Pr.*
65-101	Rigid lever	$9.20
65-201	Pin plunger	7.95
65-301	Roller lever	9.85
65-401	Overtravel plung.	11.15

TYPE 04 LIGHTED PUSHBUTTON SWITCH—WITH FOUR-LAMP INDICATOR

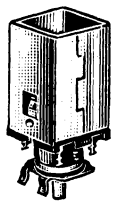


Type 04 illuminated pushbutton switches combine four-bulb panel indicator ⅞″ square with multipole switching. Choice of full or split screens: Projected or solid color illumination. Four different styles: Momentary or maintained contact; solenoid held switch models, with form C or form Z contact arrangements; and indicator-only units. Switch rated at 10 amps, 250 VAC or 30 VDC. Uses T-1¾ flange bulbs (not included in price). Simple front of panel lamp servicing without tools. Choice of flange, barrier, bezel or bezel barrier mounts. **Order each module individually.** A light module, a housing module and a switch module make a complete assembly. A light module and a housing only makes an indicator only.

LIGHT MODULE (FIG. A) (DISCOUNT "B"—SEE PREVIOUS PAGE)

Licon Number	Screen Split or Full	Color (Specify)	For Unit	List Price*
04-601*	Full	Proj.	Indicator-switch	$2.75
04-602*	Vert. split	Proj.	Indicator-switch	3.15
04-603*	Horiz. split	Proj.	Indicator-switch	3.15
04-604*	Full	Solid	Indicator-switch	2.75
04-631*	Full	Proj.	Indic. only	2.75
04-634*	Full	Solid	Indic. only	2.75

*Indicate color filter combination for projected color module by listing color designating letters (R = red, G = green, A = amber, Y = yellow, W = white, B = blue, O = orange) clockwise in accordance with Color Key figure at right e.g., 04-602 RGGR.



HOUSING MODULE (FIG. B) (DISCOUNT "B"—SEE PREVIOUS PAGE)

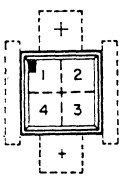
Flush and protruding barriers also available.

Licon Number	Description	List Price*
04-71	Flange mount, ⅛″ panel	$4.15
04-72	Flange mount, ¼″ panel	4.15
04-73	Flange mount, ⅜″ panel	4.15
04-74	Flange mount, ½″ panel	4.15
04-75	Barrier mount	3.90
04-76	Bezel, black	4.15
04-77	Bezel, clear	4.15
04-78	Bezel barrier, black	4.15
04-79	Bezel barrier, clear	4.15

Type 04 Indicator/Switch

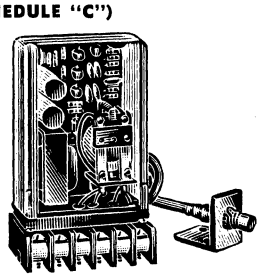
SWITCH MODULE (FIG. C) (DISCOUNT SCHEDULE "A")

Licon Number	Unit Type	No. of Poles	Contact Form	List Price*
76-2711	Maintained	1	C	$4.35
76-2713	Maintained	1	Z	4.60
76-2721	Maintained	2	C	5.30
76-2723	Maintained	2	Z	5.85
76-2751	Momentary	1	C	2.80
76-2753	Momentary	1	Z	3.05
76-2761	Momentary	2	C	3.55
76-2763	Momentary	2	Z	4.10



Color Key

TYPE 70-700 PROXIMITY SWITCH (DISCOUNT SCHEDULE "C")



Ultra compact switch for precision control without physical contact. Consists of a control module (2.53″ x 3.75″ x 1.35″) which contains a 10 amp DPDT relay, plug-in terminal block (2.19″ x 2.66″ x .84″), potted sensor with 20′ cable, and potentiometer for sensitivity control. Senses both ferrous and non-ferrous metals. Up to 1000 operations per minute possible. Sensing range for .665″ dia. sensor is .110″ to .261″; for .440″ dia. sensor, .048″ to .148″ (sensing ranges based on .235″ dia. stainless steel target).

Licon No.	Description	List Pr.*
31-11001	Component, Controls Module	$60.00
31-12001	Component, Terminal Block	6.50
31-13001	Component, Potentiometer	5.50
31-14001	Component, .440″ Dia. Sensor	18.00
31-14002	Component, .665″ Dia. Sensor	25.00
31-14003	Hollow Coil Sensor	50.00
31-9002	NEMA Class 1 Enclosure	14.00

■QUANTITY DISCOUNT SCHEDULE "C"

Quantity	Discount	Multiplier	Quantity	Discount	Multiplier
1–2	0%	None	10–24	20%	.80
3–5	5%	.95	25–49	25%	.75
6–9	10%	.90			

▲QUANTITY DISCOUNT SCHEDULE "E"

1–4	0%	None	50–99	33%	.67
5–19	18%	.82	100–499	38%	.62
20–49	27%	.73	500–990	40%	.60

LICON/DIVISION ILLINOIS TOOL WORKS, INC. 6615 WEST IRVING PARK ROAD / CHICAGO, ILLINOIS 60634 / (312) 282-4040 / TWX 910-221-0275

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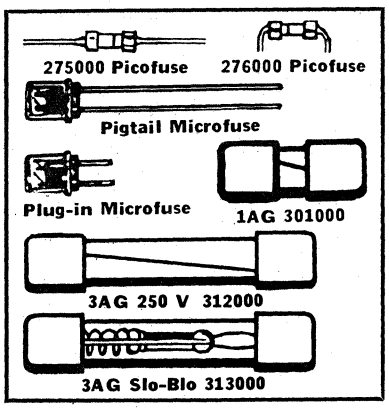
LITTELFUSE Quality Fuses



SUBMINIATURE FUSES

A must for servicing European electronic equipment. **Size:** 20 mm x 5 mm (.8" x .2").

FAST ACTING (250 V) TYPE F

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
212.100	1/10	$1.89	$31.50	$25.20
212.125	1/8	1.89	31.50	25.20
212.200	2/10	1.50	25.00	20.00
212.250	1/4	1.50	25.00	20.00
212.300	3/10	1.50	25.00	20.00
212.400	4/10	1.50	25.00	20.00
212.500	1/2	1.50	25.00	20.00
212.600	6/10	1.50	25.00	20.00
212.700	7/10	1.50	25.00	20.00
212.800	8/10	1.50	25.00	20.00
212001	1	1.20	20.00	16.00
2121.25	1-1/4	1.20	20.00	16.00
21201.6	1-6/10	1.20	20.00	16.00
212002	2	1.20	20.00	16.00
21202.5	2-1/2	1.20	20.00	16.00
212003	3	1.20	20.00	16.00
212004	4	1.20	20.00	16.00
212005	5	1.20	20.00	16.00
212006	6	1.20	20.00	16.00

MEDIUM ACTING (250 V) TYPE M

Net per 5 ..... $ 1.53
Net per 100: 100 ... $25.50; 500 ... 20.40

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
211.020	1/50	211.500	1/2	211003	3
211.031	1/32	211.600	6/10	211004	4
211.100	1/10	211.800	8/10	211005	5
211.200	2/10	211001	1		
211.250	1/4	2111.25	1-1/4		
211.300	3/10	21101.6	1-6/10		
211.400	4/10	211002	2		

SLO BLO FUSES (250 V) TYPE T

Net per 5 ..... $ 1.53
Net per 100: 100 ... $25.50; 500 ... 20.40

213.100	1/10	213.600	6/10	21302.5	2-1/2
213.125	1/8	213.700	7/10	213003	3
213.200	2/10	213.800	8/10	213004	4
213.250	1/4	213001	1	213005	5
213.300	3/10	2131.25	1-1/4	213006	6
213.400	4/10	21301.6	1-6/10		
213.500	1/2	213002	2		

SUBMINIATURE (125 V MAX.)

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
271.500	1/2	$1.50	$25.00	$20.00
27101.5	1-1/2	1.20	20.00	16.00

SUBMINIATURE PICOFUSES (125 V)

High accuracy in blowing time at 300% of rating and higher is ideal for sequential switching or in circuits requiring redundancy. Blow time 4 hours min. at 100% of rating; 5 secs. max. at 200%. Amperage printed on body; can be color-coded at additional cost. Ceramic body only 7/32" lg. x 5/64" dia.; tin-coated copper leads .025" dia. Order **275** (prefix) for axial leads 1 9/16" long for diode clip or in-circuit mounting; **276** for radial leads 1 3/8" long for use in printed circuits or receptacles.

275.062 thru **275.500**—Net per 5 ... $ 2.34
Net per 100: 100 ... $39.00; 500 ... 31.20
275.750 thru **275010**—Net per 5 ... 2.07
Net per 100: 100 ... $34.50; 500 ... 27.60
275015—Net per 5 ... 2.46
Net per 100: 100 ... $41.00; 500 ... 32.80

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
275.062	1/16	275001	1	275005	5
275.125	1/8	27501.5	1-1/2	275007	7
275.250	1/4	275002	2	275010	10
275.375	3/8	275003	3	275015	15
275.500	1/2	27503.5	3-1/2		
275.750	3/4	275004	4		

MICROFUSE SUBMINIATURE FUSES

For PC and other min. space uses. Plug-in types use holder (listed on another page); pigtail types for soldering. Short circuit interrupting capacity 125 V, 10,000 amps DC. **Blow Specs:** 100%, 4-hour min.; 200%, 5-sec. max. **Size:** 1/4" dia. x 1 1/32" (fuse body). Plug-in, transparent cap type listed. Use prefix **272** for plug-in, metal cap; prefix **279** for pigtail, transparent cap; prefix **278** for pigtail, metal cap.

Plug-In L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
273.002	1/500	$5.13	$85.50	$68.40
273.005	1/200	5.13	85.50	68.40
273.010	1/100	5.13	85.50	68.40
273.015	1/64	5.13	85.50	68.40
273.031	1/32	5.13	85.50	68.40
273.050	1/20	4.29	71.50	57.20
273.062	1/16	4.29	71.50	57.20
273.100	1/10	4.29	71.50	57.20
273.125	1/8	4.29	71.50	57.20
273.200	2/10	4.29	71.50	57.20
273.250	1/4	4.29	71.50	57.20
273.300	3/10	4.29	71.50	57.20
273.400	4/10	4.29	71.50	57.20
273.500	1/2	4.29	71.50	57.20
273.600	6/10	4.29	71.50	57.20
273.700	7/10	4.29	71.50	57.20
273.750	3/4	4.29	71.50	57.20
273.800	8/10	4.29	71.50	57.20
273001	1	4.29	71.50	57.20
27301.5	1-1/2	4.29	71.50	57.20
273002	2	4.29	71.50	57.20
273003	3	4.29	71.50	57.20
273004	4	4.29	71.50	57.20
273005	5	4.29	71.50	57.20

HIGH RELIABILITY MICROFUSES

For zero defect programs. Hermetically sealed; gold-plated terminals for soldered or plug-in connections. Fuse rating identified on each fuse. Test data and traceability records are supplied and maintained. Rating 125 V, blow time same as 273 series; time/current characteristics certified to 1% AQL per MIL-Std-105, Inspection Level II. Short circuit interrupting capacity at 125 V, 10,000 amps DC. **Size:** Fuse cap and body, .290" lg., leads for 262 "plug-in" series .170". Pigtail on 268 series 1.0". Use prefix **268** for pigtail type (e.g., **268.002**).

Net per 5 ..... $ 15.00
Net per 100: 100 .. $300.00; 500 .. 300.00

Plug-In L.F. No.	Amp Rating	Plug-In L.F. No.	Amp Rating
262.002	1/500	262.400	4/10
262.005	1/200	262.500	1/2
262.010	1/100	262.600	6/10
262.015	1/64	262.700	7/10
262.031	1/32	262.750	3/4
262.050	1/20	262.800	8/10
262.062	1/16	262001	1
262.100	1/10	26201.5	1-1/2
262.125	1/8	262002	2
262.200	2/10	262003	3
262.250	1/4	262004	4
262.300	3/10	262005	5

HIGH RELIABILITY PICOFUSES

For soldering into circuits or insertion into diode type clips and mtgs. Fuses rated at 125 V or less and will interrupt short circuit currents to 300 amps at 125 VDC. Non-hygroscopic ceramic bodies. Withstands 5-lb. axial pull test. Blow time 4 hours min., 100% rating; 5 secs. max., 200% rating. Insulation resistance is 1 meg min. measured with 100 V supply. **Size:** Body 7/32" lg., .078" dia. Leads are .025" dia., 1 9/16" lg., gold-plated copper.

Net per 5 ..... $ 15.00
Net per 100: 100 .. $300.00; 500 .. 300.00

L.F. No.	Amp Rating	L.F. No.	Amp Rating
265.125	1/8	265002	2
265.250	1/4	265003	3
265.375	3/8	265004	4
265.500	1/2	265005	5
265.750	3/4	265007	7
265001	1	265010	10
26501.5	1-1/2	265015	15

7AG FUSES (32 V OR LESS)

Blow Time: 110%, 4-hr. min.; 135%, 1 hr. max.; 200%, 20-sec. max. Lg. 7/8", dia. 1/4".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
303001	1	$0.45	$7.50	$6.00
30302.5	2-1/2	.45	7.50	6.00
303003	3	.45	7.50	6.00
303004	4	.45	7.50	6.00
303005	5	.33	5.50	4.40
303006	6	.33	5.50	4.40
303015	15	.33	5.50	4.40
303020	20	.33	5.50	4.40
303030	30	.33	5.50	4.40

1AG FUSES (32 V OR LESS)

Blow Time: 110%, 4-hr. min.; 135%, 1 hr. max.; 200%, 20-sec. max. Lg. 7/8", dia. 1/4".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
301001	1	$0.45	$7.50	$6.00
30101.5	1-1/2	.45	7.50	6.00
301002	2	.45	7.50	6.00
30102.5	2-1/2	.45	7.50	6.00
301003	3	.45	7.50	6.00
301005	5	.33	5.50	4.40
301006	6	.33	5.50	4.40
30107.5	7-1/2	.33	5.50	4.40
301010	10	.33	5.50	4.40
301015	15	.33	5.50	4.40
301020	20	.33	5.50	4.40
301025	25	.33	5.50	4.40
301030	30	.33	5.50	4.40

3AG FUSES (32 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 20-sec. max. Length 1 1/4", dia. 1/4".

311004	4	$0.45	$7.50	$6.00
311005	5	.33	5.50	4.40
311006	6	.33	5.50	4.40
31107.5	7-1/2	.33	5.50	4.40
311008	8	.33	5.50	4.40
311010	10	.33	5.50	4.40
311015	15	.33	5.50	4.40
311025	25	.33	5.50	4.40
311030	30	.33	5.50	4.40
311035	35	.45	7.50	6.00

3AG FUSES (250 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 10-sec. max. Length 1 1/4", dia. 1/4". UL Listed thru 8 amps.

312.010	1/100	$2.49	$41.50	$33.20
312.031	1/32	2.19	36.50	29.20
312.062	1/16	.99	16.50	13.20
312.100	1/10	.99	16.50	13.20
312.125	1/8	.99	16.50	13.20
312.150	15/100	.99	16.50	13.20
312.175	.175	.99	16.50	13.20
312.187	3/16	.99	16.50	13.20
312.200	2/10	.99	16.50	13.20
312.250	1/4	.63	10.50	8.40
312.300	3/10	.63	10.50	8.40
312.375	3/8	.63	10.50	8.40
312.500	1/2	.63	10.50	8.40
312.600	6/10	.63	10.50	8.40
312.750	3/4	.63	10.50	8.40
312001	1	.45	7.50	6.00
3121.25	1-1/4	.45	7.50	6.00
31201.5	1-1/2	.45	7.50	6.00
31201.6	1-6/10	.45	7.50	6.00
312002	2	.45	7.50	6.00
31202.5	2-1/2	.45	7.50	6.00
312003	3	.45	7.50	6.00
312004	4	.54	9.00	7.20
312005	5	.54	9.00	7.20
312006	6	.54	9.00	7.20
312007	7	.54	9.00	7.20
312008	8	.81	13.50	10.80
312010	10	.81	13.50	10.80

3AG SLO BLO FUSES

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. min. Length 1 1/4", dia. 1/4". UL Listed thru 5 amps.

313.010	1/100	$1.89	$31.50	$25.20
313.031	1/32	1.89	31.50	25.20
313.062	1/16	1.38	23.00	18.40
313.100	1/10	1.38	23.00	18.40
313.125	1/8	1.38	23.00	18.40
313.150	15/100	1.38	23.00	18.40
313.175	.175	1.38	23.00	18.40
313.187	3/16	1.38	23.00	18.40
313.200	2/10	1.38	23.00	18.40
313.250	1/4	1.38	23.00	18.40
313.300	3/10	1.38	23.00	18.40
313.375	3/8	1.38	23.00	18.40
313.400	4/10	1.38	23.00	18.40
313.500	1/2	1.38	23.00	18.40
313.600	6/10	1.38	23.00	18.40
313.700	7/10	1.38	23.00	18.40
313.750	3/4	1.38	23.00	18.40
313.800	8/10	1.38	23.00	18.40
313001	1	1.38	23.00	18.40
31301.2	1-2/10	1.29	21.50	17.20
3131.25	1-1/4	1.29	21.50	17.20
31301.5	1-1/2	1.29	21.50	17.20
31301.6	1-6/10	1.29	21.50	17.20
313002	2	1.29	21.50	17.20
31302.5	2-1/2	.99	16.50	13.20
31302.8	2-8/10	.99	16.50	13.20
313003	3	.99	16.50	13.20
31303.2	3-2/10	.99	16.50	13.20
313004	4	.99	16.50	13.20
313005	5	.99	16.50	13.20
3136.25	6-1/4	.99	16.50	13.20
313007	7	.99	16.50	13.20
313008	8	.99	16.50	13.20
313010	10	.99	16.50	13.20
313015	15	.99	16.50	13.20
313020	20	.99	16.50	13.20
313025	25	.99	16.50	13.20
313030	30	.99	16.50	13.20

LITTELFUSE Quality Fuses

3AG SLO BLO PIGTAIL FUSES (125 V)

Blow Time: 110%, 4-hr. min.; 135%, 1 hr. max.; 200%, 5-sec. min. Lg. 1¼", dia. ¼", 1½" pigtails. UL Listed thru 5 amps.

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
315.010	1/100	$2.28	$38.00	$30.40
315.031	1/32	2.28	38.00	30.40
315.062	1/16	1.80	28.00	22.40
315.100	1/10	1.80	28.00	22.40
315.125	1/8	1.80	28.00	22.40
315.150	15/100	1.80	28.00	22.40
315.175	.175	1.80	28.00	22.40
315.187	3/16	1.80	28.00	22.40
315.200	2/10	1.80	28.00	22.40
315.250	1/4	1.80	28.00	22.40
315.300	3/10	1.80	28.00	22.40
315.375	3/8	1.80	28.00	22.40
315.400	4/10	1.80	28.00	22.40
315.500	1/2	1.80	28.00	22.40
315.600	6/10	1.80	28.00	22.40
315.700	7/10	1.80	28.00	22.40
315.750	3/4	1.80	28.00	22.40
315.800	8/10	1.80	28.00	22.40
315001	1	1.80	28.00	22.40
31501.2	1–2/10	1.59	26.50	21.20
3151.25	1–1/4	1.59	26.50	21.20
31501.5	1–1/2	1.59	26.50	21.20
31501.6	1–6/10	1.59	26.50	21.20
315002	2	1.59	26.50	21.20
31502.5	2–1/2	1.38	23.00	18.40
31502.8	2–8/10	1.38	23.00	18.40
315003	3	1.38	23.00	18.40
31503.2	3–2/10	1.38	23.00	18.40
315004	4	1.38	23.00	18.40
315005	5	1.38	23.00	18.40

3AG PIGTAIL FUSES (250 V)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. max. Length 1¼" dia. ¼", 1½" pigtails.

318.010	1/100	$3.03	$50.50	$40.40
318.031	1/32	2.79	46.50	37.20
318.062	1/16	1.68	28.00	22.40
318.100	1/10	1.68	28.00	22.40
318.125	1/8	1.68	28.00	22.40
318.150	15/100	1.68	28.00	22.40
318.175	.175	1.68	28.00	22.40
318.187	3/16	1.68	28.00	22.40
318.200	2/10	1.68	28.00	22.40
318.250	1/4	.99	16.50	13.20
318.300	3/10	.99	16.50	13.20
318.375	3/8	.99	16.50	13.20
318.500	1/2	.99	16.50	13.20
318.750	3/4	.99	16.50	13.20
318001	1	.81	13.50	10.80
3181.25	1–1/4	.81	13.50	10.80
31801.5	1–1/2	.81	13.50	10.80
31801.6	1–6/10	.81	13.50	10.80
318002	2	.81	13.50	10.80
31802.5	2–1/2	.81	13.50	10.80
318003	3	.81	13.50	10.80
318004	4	.84	14.00	11.20
318005	5	.84	14.00	11.20
318006	6	.84	14.00	11.20
318007	7†	.84	14.00	11.20
318008	8†	.99	16.50	13.20

3AG INDICATING FUSES (125 V)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max. Length 1¼", dia. ¼".

334.750	3/4	$2.67	$44.50	$35.60
334001	1	2.10	35.00	28.00
33401.5	1–1/2	2.10	35.00	28.00
334002	2	2.10	35.00	28.00
334003	3	2.10	35.00	28.00
334004	4	2.10	35.00	28.00
334005	5	2.10	35.00	28.00
334006	6*	2.88	48.00	38.40
334008	8*	2.88	48.00	38.40
334010	10*	2.88	48.00	38.40
334012	12*	2.88	48.00	38.40
334015	15*	2.88	48.00	38.40
334020	20*	2.88	48.00	38.40

*32 volt. †125 volt.

3AB TINY MIGHTY (250 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 30-sec. max. Length 1¼", dia. ¼". UL Listed thru 15 A.

314.125	1/8	$0.87	$14.50	$11.60
314.250	1/4	.87	14.50	11.60
314.375	3/8	.87	14.50	11.60
314.500	1/2	.87	14.50	11.60
314.750	3/4	.87	14.50	11.60
314001	1	.87	14.50	11.60
314002	2	.87	14.50	11.60
314003	3	.87	14.50	11.60
314004	4	.87	14.50	11.60
314005	5	.78	13.00	10.40
314006	6	.78	13.00	10.40
314007	7	.78	13.00	10.40
314008	8	.78	13.00	10.40
314010	10	.78	13.00	10.40
314012	12	.87	14.50	11.60
314015	15	.87	14.50	11.60
314020	20	.87	14.50	11.60
314025	25	1.08	18.00	14.40
314030	30	1.08	18.00	14.40

3AB SLO BLO FUSES (250 V) CERAMIC

Blow Time: 110%, 4-hr. min.; 135%, 1 hr. max.; 200%, 5-sec. min. Lg., 1¼", dia., ¼".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
323.010	1/100	$2.40	$40.00	$32.00
323.031	1/32	2.40	40.00	32.00
323.062	1/16	1.98	33.00	26.40
323.100	1/10	1.98	33.00	26.40
323.125	1/8	1.98	33.00	26.40
323.150	15/100	1.98	33.00	26.40
323.175	.175	1.98	33.00	26.40
323.187	3/16	1.98	33.00	26.40
323.200	2/10	1.98	33.00	26.40
323.250	1/4	1.98	33.00	26.40
323.300	3/10	1.98	33.00	26.40
323.375	3/8	1.98	33.00	26.40
323.400	4/10	1.98	33.00	26.40
323.500	1/2	1.98	33.00	26.40
323.600	6/10	1.98	33.00	26.40
323.700	7/10	1.98	33.00	26.40
323.750	3/4	1.98	33.00	26.40
323.800	8/10	1.98	33.00	26.40
323.001	1	1.98	33.00	26.40
32301.2	1-2/10	1.98	33.00	26.40
3231.25	1-1/4	1.98	33.00	26.40
32301.5	1-1/2	1.98	33.00	26.40
32301.6	1-6/10	1.98	33.00	26.40
323002	2	1.98	33.00	26.40
32302.8	2-8/10	1.38	23.00	18.40
323003	3	1.38	23.00	18.40
32303.2	3-2/10 *	1.38	23.00	18.40
323004	4*	1.38	23.00	18.40
323005	5*	1.38	23.00	18.40
3236.25	6-1/4*	1.38	23.00	18.40
323007	7*	1.38	23.00	18.40
323008	8†	1.38	23.00	18.40
323010	10†	1.38	23.00	18.40
323015	15†	1.38	23.00	18.40
323020	20†	1.38	23.00	18.40
323025	25†	1.38	23.00	18.40
323030	30†	1.38	23.00	18.40

*125 volt; †32 volt.

LIMITED CURRENT (250 V) TYPE C

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. max. Prices for applicable **fuse holders** upon request.

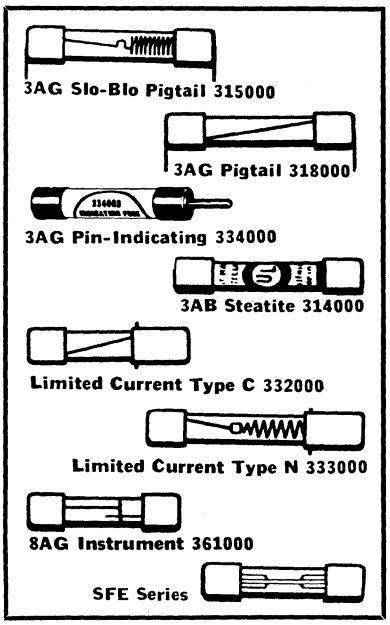
332.031	1/32	$2.10	$35.00	$28.00
332.062	1/16	1.38	23.00	18.40
332.125	1/8	.99	16.50	13.20
332.187	3/16	.99	16.50	13.20
332.250	1/4	.84	14.00	11.20
332.300	3/10	.84	14.00	11.20
332.375	3/8	.84	14.00	11.20
332.400	4/10	.84	14.00	11.20
332.500	1/2	.84	14.00	11.20
332.700	7/10	.84	14.00	11.20
332.750	3/4	.84	14.00	11.20
332001	1	.51	8.50	6.80
3321.25	1–1/4	.51	8.50	6.80
33201.5	1–1/2	.51	8.50	6.80
3321.75	1–3/4	.51	8.50	6.80
332002	2	.51	8.50	6.80
33202.5	2–1/2	.51	8.50	6.80
332003	3	.51	8.50	6.80
33203.5	3–1/2	.57	9.50	7.60
332004	4	.57	9.50	7.60
332005	5	.57	9.50	7.60
332006	6	.57	9.50	7.60
332007	7*	.57	9.50	7.60
332008	8*	.87	14.50	11.60
332010	10*	.87	14.50	11.60

*125 volt.

LC SLO BLO (125 V) TYPE N

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. min. Prices for applicable **fuse holders** upon request.

333.010	1/100	$1.89	$31.50	$25.20
333.031	1/32	1.89	31.50	25.20
333.062	1/16	1.38	23.00	18.40
333.100	1/10	1.38	23.00	18.40
333.150	15/100	1.38	23.00	18.40
333.200	2/10	1.38	23.00	18.40
333.250	1/4	1.38	23.00	18.40
333.300	3/10	1.38	23.00	18.40
333.400	4/10	1.38	23.00	18.40
333.500	1/2	1.38	23.00	18.40
333.600	6/10	1.38	23.00	18.40
333.700	7/10	1.38	23.00	18.40
333.750	3/4	1.38	23.00	18.40
333.800	8/10	1.38	23.00	18.40
333001	1	1.38	23.00	18.40
3331.25	1–1/4	1.38	23.00	18.40
33301.6	1-6/10	1.38	23.00	18.40
3331.75	1-3/4	1.38	23.00	18.40
333002	2	1.38	23.00	18.40
33302.5	2–1/2	1.38	23.00	18.40
33302.8	2-8/10	1.38	23.00	18.40
333003	3	1.38	23.00	18.40
33303.2	3-2/10	1.38	23.00	18.40
33303.5	3–1/2	1.38	23.00	18.40
333004	4	1.38	23.00	18.40
333005	5	1.38	23.00	18.40
3336.25	6–1/4	1.38	23.00	18.40
333007	7	1.38	23.00	18.40



SFE AUTO FUSES (32 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 0–1 hour; 150%, 20 amps or less 0–15 sec., 30 amps 0–30 sec. Dia. ¼".

L.F. No.	Amp Rating	Lgth. In.	Net per 5	Net per 100	
				100	500
307004	4	5/8	$0.33	$5.50	$4.40
307006	6	3/4	.33	5.50	4.40
30707.5	7–1/2	7/8	.33	5.50	4.40
307009	9	7/8	.33	5.50	4.40
307014	14	1 1/16	.33	5.50	4.40
307020	20	1¼	.33	5.50	4.40
307030	30	1 1/16	.33	5.50	4.40

8AG FUSES

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 10-sec. max. Length 1", dia. ¼". UL Listed thru 5 amps.

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
362.125	1/8	$0.99	$16.50	$13.20
362.250	1/4	.63	10.50	8.40
362.375	3/8	.63	10.50	8.40
362.500	1/2	.63	10.50	8.40
362.750	3/4	.63	10.50	8.40
362001	1	.45	7.50	6.00
36201.5	1–1/2	.45	7.50	6.00
362002	2	.45	7.50	6.00
36202.5	2–1/2	.45	7.50	6.00
362003	3	.45	7.50	6.00
362005	5	.33	5.50	4.40
362006	6	.33	5.50	4.40
362008	8	.33	5.50	4.40
362010	10	.33	5.50	4.40
362012	12	.33	5.50	4.40
362015	15	.33	5.50	4.40
362020	20	.33	5.50	4.40
362025	25	.33	5.50	4.40
362030	30	.33	5.50	4.40

8AG INSTRUMENT FUSES

Blow Time: 100%, 4-hour min.; 200%, 5-sec. max. Length 1", dia. ¼".

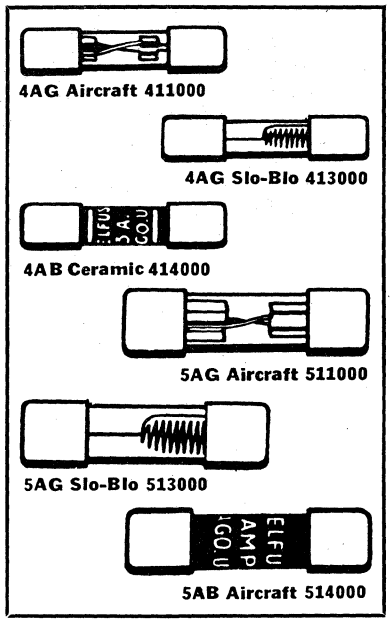
361.002	1/500	$6.75	$112.50	$90.00
361.005	1/200	2.88	48.00	38.40
361.010	1/100	2.49	41.50	33.20
361.031	1/32	2.19	36.50	29.20
361.062	1/16	1.38	23.00	18.40
361.100	1/10	.99	16.50	13.20
361.125	1/8	.99	16.50	13.20
361.187	3/16	.99	16.50	13.20
361.200	2/10	.99	16.50	13.20
361.250	1/4	.63	10.50	8.40
361.375	3/8	.63	10.50	8.40
361.400	4/10	.63	10.50	8.40
361.500	1/2	.63	10.50	8.40
361.750	3/4	.63	10.50	8.40
361001	1	.45	7.50	6.00
36101.5	1–1/2	.45	7.50	6.00
361002	2	.45	7.50	6.00
361003	3	.45	7.50	6.00
361004	4	.45	7.50	6.00
361005	5	.45	7.50	6.00

9AG FUSES (32 V OR LESS)

Blow Time: 100%, 4-hour min.; 125%, 0–1 hour; 200%, 0–25 seconds. Lg. 1 7/16", dia. ¼".

306050	50	$0.63	$10.50	$8.40

LITTELFUSE Quality Fuses



4AG QUICK-ACTING FUSES (250 V)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. max. Length 1¼", dia. 9/32".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
412.062	1/16	$1.98	$33.00	$26.40
412.125	1/8	1.50	25.00	20.00
412.150	15/100	1.50	25.00	20.00
412.250	1/4	.69	11.50	9.20
412.500	1/2	.69	11.50	9.20
412001	1	.66	11.00	8.80
41201.5	1–1/2	.66	11.00	8.80
412002	2	.66	11.00	8.80
41202.5	2–1/2	.66	11.00	8.80
412003	3	.66	11.00	8.80
412005	5	.57	9.50	7.60
412008	8*	.57	9.50	7.60

*125 volt.

4AG SLO BLO AIRCRAFT FUSES (125 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. max. Length 1¼", dia. 9/32".

413.062	1/16	$1.80	$30.00	$24.00
413.100	1/10	1.80	30.00	24.00
413.125	1/8	1.80	30.00	24.00
413.150	15/100	1.80	30.00	24.00
413.200	2/10	1.80	30.00	24.00
413.250	1/4	1.80	30.00	24.00
413.300	3/10	1.80	30.00	24.00
413.400	4/10	1.80	30.00	24.00
413.500	1/2	1.80	30.00	24.00
413.600	6/10	1.80	30.00	24.00
413.750	3/4	1.80	30.00	24.00
413.800	8/10	1.80	30.00	24.00
413001	1	1.80	30.00	24.00
4131.25	1–1/4	1.80	30.00	24.00
41301.5	1–1/2	1.80	30.00	24.00
41301.6	1–6/10	1.80	30.00	24.00
413002	2	1.80	30.00	24.00
41302.5	2–1/2	1.38	23.00	18.40
413003	3	1.38	23.00	18.40
41303.2	3–2/10	1.38	23.00	18.40
413004	4	1.38	23.00	18.40
413005	5	1.38	23.00	18.40
4136.25	6–1/4	1.38	23.00	18.40
413008	8*	1.38	23.00	18.40
413010	10*	1.38	23.00	18.40
413015	15*	1.38	23.00	18.40
413020	20*	1.38	23.00	18.40
413025	25*	1.38	23.00	18.40
413030	30*	1.38	23.00	18.40

*32 volt.

4AG AIRCRAFT FUSES (32 V)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 10-sec. max. Length 1¼", dia. 9/32".

411010	10	$0.57	$ 9.50	$7.60
411015	15	.57	9.50	7.60
411020	20	.57	9.50	7.60
411025	25	.57	9.50	7.60
411030	30	.57	9.50	7.60
411035	35	.66	11.00	8.80
411040	40	.66	11.00	8.80

4AB FUSES (250 V) CERAMIC

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 15-sec. max. Length 1¼", dia. 9/32".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
414001	1	$1.38	$23.00	$18.40
414002	2	1.38	23.00	18.40
414003	3	1.38	23.00	18.40
414005	5	1.29	21.50	17.20
414006	6	1.29	21.50	17.20
414008	8	1.29	21.50	17.20
414010	10	1.29	21.50	17.20
414015	15	1.29	21.50	17.20
414020	20	1.29	21.50	17.20
414025	25*	1.29	21.50	17.20
414030	30*	1.29	21.50	17.20
414035	35†	1.38	23.00	18.40
414040	40†	1.38	23.00	18.40

*125 V; †32 V.

4AB SLO BLO FUSES (250 V) CERAMIC

Blow Time: 110%, 4-hr. max.; 135%, 1 hr. max.; 200%, 5-sec. min. Lg., 1½", dia. 9/32".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
423.062	1/16	$2.10	$35.00	$28.00
423.100	1/10	2.10	35.00	28.00
423.125	1/8	2.10	35.00	28.00
423.150	15/100	2.10	35.00	28.00
423.200	2/10	2.10	35.00	28.00
423.250	1/4	2.10	35.00	28.00
423.300	3/10	2.10	35.00	28.00
423.400	4/10	2.10	35.00	28.00
423.500	1/2	2.10	35.00	28.00
423.600	6/10	2.10	35.00	28.00
423.750	3/4	2.10	35.00	28.00
423.800	8/10	2.10	35.00	28.00
423001	1	2.10	35.00	28.00
4231.25	1–1/4	2.10	35.00	28.00
42301.5	1–1/2	2.10	35.00	28.00
42301.6	1–6/10	2.10	35.00	28.00
423002	2	2.10	35.00	28.00
42302.5	2–1/2	1.50	25.00	20.00
423003	3	1.50	25.00	20.00
42303.2	3–2/10*	1.50	25.00	20.00
423004	4*	1.50	25.00	20.00
423005	5*	1.50	25.00	20.00
4236.25	6–1/4*	1.50	25.00	20.00
423008	8†	1.50	25.00	20.00
423010	10†	1.50	25.00	20.00
423015	15†	1.50	25.00	20.00
423020	20†	1.50	25.00	20.00
423025	25†	1.50	25.00	20.00
423030	30†	1.50	25.00	20.00

*125 volt; †32 volt.

5AG AIRCRAFT FUSES

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 20-sec. max. Length 1½", dia. 13/32".

L.F. No.	Amp Rating	Net per 5	Net per 100	
			100	500
511010	10	$0.84	$14.00	$11.20
511015	15	.84	14.00	11.20
511020	20	.84	14.00	11.20
511025	25	.84	14.00	11.20
511030	30	.84	14.00	11.20
511035	35	.84	14.00	11.20
511040	40	.84	14.00	11.20
511050	50	.84	14.00	11.20
511060	60	.84	14.00	11.20

5AG QUICK-ACTING FUSES (250 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 10-sec. max. Length 1½", dia. 13/32".

512001	1	$0.84	$14.00	$11.20
512002	2	.84	14.00	11.20
512003	3	.84	14.00	11.20
512004	4	.84	14.00	11.20
512005	5	.84	14.00	11.20
512008	8*	.84	14.00	11.20

*125 volt.

5AG SLO BLO FUSES (250 V OR LESS)

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 5-sec. min. Length 1½", dia. 13/32".

513.500	1/2	$2.19	$36.50	$29.20
513001	1	2.19	36.50	29.20
513002	2	2.19	36.50	29.20
513003	3	1.80	30.00	24.00
513004	4	1.80	30.00	24.00
513005	5	1.80	30.00	24.00
513010	10	1.80	30.00	24.00
513015	15	1.80	30.00	24.00
513020	20	1.80	30.00	24.00
513025	25	1.98	33.00	26.40
513030	30	1.98	33.00	26.40

5AB AIRCRAFT FUSES

Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 30-sec. max. Length 1½", dia. 13/32".

Net per 5 . . . . . $ 0.99
Net per 100: 100 . . . $16.50; 500 . . . 13.20

L.F. No.	Amp Rtg.	L.F. No.	Amp Rtg.
514001	1	514007	7
514002	2	514008	8
514003	3	514010	10
51403.5	3–1/2	514015	15
514005	5	514020	20
514006	6	514025	25
5146.25	6–1/4	514030	30

5AB SLO BLO FUSES (CERAMIC)

Blow Time: 110%, 4-hr. min.; 135%, 1 hr. max.; 200%; 5 sec. min. Lg. 1½", dia. 13/32". Voltage rating 250 V except as noted.

Net per 5 . . . . . $ 2.94
Net per 100: 100 . . . $49.00; 500 . . . 39.20

523.100	1/10	523003	3
523.150	15/100	52303.2	3–2/10
523.200	2/10	52303.5	3–1/2
523.300	3/10	523004	4
523.400	4/10	52304.5	4–1/2
523.500	1/2	523005	5
523.600	6/10	52305.6	5–6/10
523.800	8/10	5236.25	6–1/4
523001	1	523007	7
5231.12	1–1/8	523008	8
5231.25	1–1/4	523009	9
52301.4	1–4/10	523010	10
52301.6	1–6/10	523012	12*
52301.8	1–8/10	523015	15*
523002	2	523020	20†
5232.25	2–1/4	523025	25†
52302.5	2–1/2	523030	30†
52302.8	2–8/10		

*125 volt. †32 volt.

HIGH VOLTAGE FUSES

Designed for use in aircraft radio equipment, transmitting equipment, X-ray apparatus, high voltage rectifiers, etc. For use in circuits rated up to 20 kW DC or 30 kVA AC. Fuses are fiber enclosed with cadmium plated end caps; 612000–623000 caps are nickel plated. Two principles of arc suppression are employed: (1) Multi-break fuse wire which blows at each half inch of its length; (2) Ceramic baffles break the arc into several parts and quench it.
Blow Time: 110%, 4-hour min.; 135%, 1 hour max.; 200%, 10 sec. max.

1000-VOLT (3" x 13/32")

L.F. No.	Amp Rating	L.F. No.	Amp Rating
621.375	3/8	621001	1
621.500	1/2	62101.5	1–1/2
621.750	3/4	621002	2

2500-VOLT (4½" x 13/32")

622.500	1/2	62201.5	1–1/2
622.750	3/4	622002	2
622001	1		

3000-VOLT (5½" x 13/32")

623.500	1/2	62301.5	1–1/2
623.750	3/4	623002	2
623001	1		

1000-VOLT (3" x 13/16")

701.062	1/16	701.750	3/4
701.125	1/8	701001	1
701.250	1/4	70101.5	1–1/2
701.375	3/8	701002	2
701.500	1/2		

5000-VOLT (5" x 13/16")

702.062	1/16	702001	1
702.125	1/8	70201.5	1–1/2
702.250	1/4	702002	2
702.375	3/8	70202.5	2–1/2
702.500	1/2	702003	3
702.750	3/4		

10,000-VOLT (10" x 13/16")

703.062	1/16	703.750	3/4
703.125	1/8	703001	1
703.250	1/4	70301.5	1–1/2
703.375	3/8	703002	2
703.500	1/2	703003	3

HIGH VOLTAGE FUSE PRICING

L.F. No.	Net Each	Net per 100	
		100	500
621000 Series	$0.35	$ 29.50	$ 23.60
622000 Series	.50	42.00	33.60
623000 Series	.77	64.00	51.20
701000 Series	.94	78.00	62.40
702000 Series	.94	78.50	62.80
703000 Series	1.86	155.00	124.00

LITTELFUSE

CIRCUIT BREAKERS, MOUNTINGS AND CLIPS

MOUNTINGS, FUSE CLIPS AND FUSE HOLDERS

MOUNTINGS FOR RECTIFIERS

L.F. No.	Description	Net Each, Lots of 5	Net per 100	
			100	500
099062	Single pole, 3/16" base	$0.22	$18.00	$14.40
099063	Double pole, 3/16" base	.40	33.00	26.20
099065	Double pole, 1/16" base	.28	23.00	18.40
099065-3	1/16" Bakelite insulator	.03	2.20	1.80
099067	Single pole 1/16" base	.13	11.00	8.80
099067-3	1/16" Bakelite insulator	.02	1.50	1.20

3AG MOUNTINGS

351009	Hinged can cover, 2 pole	$1.93	$160.50	$128.40
351010	Spare, 1 pole	.22	18.00	14.40
352001	Through panel, 1 pole	.37	31.00	24.80
353001	Panel, 1 pole	.64	53.50	42.80

3AG MOUNTINGS WITH SCREW TERMINALS—TYPE T

L.F. No.	Description	Net Ea. Lots of 5	Net per 100	
			100	500
356001	1 pole	$0.42	$ 35.00	$ 28.00
356002	2 pole	.82	68.00	54.40
356003	3 pole	1.23	102.50	82.00
356004	4 pole	1.69	141.00	112.80
356005	5 pole	2.11	176.00	140.80
356006	6 pole	2.53	211.00	168.80
356007	7 pole	2.94	245.00	196.00
356008	8 pole	3.38	282.00	225.60
356009	9 pole	3.80	317.00	253.60
356010	10 pole	4.21	351.00	280.80
356011	11 pole	4.63	386.00	308.80
356012	12 pole	5.05	421.00	336.80

3AG MOUNTINGS WITH SOLDER TERMINALS—TYPE S

357001	1 pole	$0.22	$ 18.00	$ 14.40
357002	2 pole	.40	33.00	26.40
357003	3 pole	.62	51.50	41.20
357004	4 pole	.78	65.00	52.00
357005	5 pole	.96	80.00	64.00
357006	6 pole	1.12	93.00	74.40
357007	7 pole	1.27	106.00	84.80
357008	8 pole	1.44	120.00	96.00
357009	9 pole	1.63	136.00	108.80
357010	10 pole	1.81	151.00	120.80
357011	11 pole	1.99	166.00	132.80
357012	12 pole	2.17	181.00	144.80

8AG MOUNTINGS

383001	1 pole*	$0.64	$53.50	$42.80
383002	1 pole†	.43	36.00	28.80

*Thru-panel. †Meter back.

8AG MOUNTINGS WITH SOLDER TERMINALS—TYPE S

L.F. No.	Description	Net Ea. Lots of 5	Net per 100	
			100	500
387001	1 pole	$0.22	$ 18.00	$ 14.40
387002	2 pole	.40	33.00	26.40
387003	3 pole	.62	51.50	41.20
387004	4 pole	.78	65.00	52.00
387005	5 pole	.96	80.00	64.00
387006	6 pole	1.12	93.00	74.40
387007	7 pole	1.27	106.00	84.80
387008	8 pole	1.44	120.00	96.00
387009	9 pole	1.63	136.00	108.80
387010	10 pole	1.81	151.00	120.80
387011	11 pole	1.99	166.00	132.80
387012	12 pole	2.17	181.00	144.80

4AG FUSE MOUNTINGS WITH SCREW TERMINALS—TYPE T

L.F. No.	Description	Net Ea. Lots of 5	Net per 100	
			100	500
456001	1 pole	$0.58	$ 48.00	$ 38.40
456002	2 pole	1.06	88.00	70.40
456003	3 pole	1.55	129.00	103.20
456004	4 pole	2.65	220.50	176.40
456005	5 pole	3.32	277.00	221.60
456006	6 pole	3.93	327.50	262.00
456007	7 pole	4.62	385.00	308.00
456008	8 pole	5.26	438.50	350.80
456009	9 pole	5.90	492.00	393.60
456010	10 pole	6.55	545.50	436.40
456011	11 pole	7.16	597.00	477.60
456012	12 pole	7.73	644.00	515.20

5AG MOUNTINGS WITH SCREW TERMINALS—TYPE T

556001	1 pole	$0.64	$ 53.00	$ 42.40
556002	2 pole	1.24	103.00	82.40
556003	3 pole	1.80	150.00	120.00
556004	4 pole	3.22	268.00	214.40
556005	5 pole	4.00	333.50	266.80
556006	6 pole	4.75	395.50	316.40
556007	7 pole	5.57	464.50	371.60
556008	8 pole	6.35	529.00	423.20
556009	9 pole	7.13	594.50	475.60
556010	10 pole	7.87	656.00	524.80
556011	11 pole	8.64	720.00	576.00
556012	12 pole	9.29	774.50	619.60

HIGH VOLTAGE FUSE HOLDERS

For 701000 Series Fuses.

L.F. No.	Size, In. L. x H.	Net Each	Net per 100	
			100	500
711001	2½ x 1⅝	$2.26	$188.00	$150.40
For 702000 Series Fuses.				
711002	6½ x 1⅝	$2.35	$196.00	$156.80
For 703000 Series Fuses.				
711003	12 x 3	$6.04	$503.00	$402.40
For 621000 Series Fuses.				
631001	4 x 1 9/64	$1.15	$96.00	$76.80
For 622000 Series Fuses.				
631002	5¼ x 1 9/64	$1.69	$141.00	$112.80
For 623000 Series Fuses.				
631003	6¼ x 1 9/64	$1.95	$162.50	$130.00

TV SNAP-ON FUSE HOLDERS

094025	10 holders*	$2.47	.....	.....
350130	Holders†	.21	$17.00	$14.00

*In plastic box of 10. †Bulk.

STANDARD FUSE CLIPS (PHOSPHOR BRONZE, NICKEL PLATED)

L.F. No.	Fuse Adaptation	Type	Net Each, Lots of 5	Net per 100	
				100	500
101001	SFE, 3AG, 8AG, 3AB	Ear	$0.03	$ 2.65	$ 2.12
101002	SFE, 3AG, 8AG, 3AB	Earless	.04	3.00	2.40
101003*	SFE, 3AG, 8AG, 3AB	Lug	.04	3.50	2.80
103001	4AG, 4AB	Ear	.05	4.45	3.56
104002	4AG, 4AB	Earless	.05	4.45	3.56
105001	5AG	Ear	.07	5.50	4.40
105002	5AG	Earless	.05	4.45	3.56
107001	9/16" dia.	Ear	.08	7.00	5.60
107002	9/16" dia.	Earless	.09	7.50	6.00
109001	13/16" dia.	Ear	.32	27.00	21.60
109002	13/16" dia.	Earless	.32	27.00	21.60

*Unplated, bright dip.

STANDARD FUSE CLIPS (BERYLLIUM COPPER, SILVER PLATED)

121001	SFE, 3AG, 8AG, 3AB	Ear	$0.06	$ 5.00	$ 4.00
121002	SFE, 3AG, 8AG, 3AB	Earless	.07	6.00	4.80
121004	SFE, 3AG, 8AG, 3AB	Lug	.19	15.50	12.40
123001	4AG, 4AB	Ear	.11	9.00	7.20
123002	4AG, 4AB	Earless	.11	9.00	7.20
125001	5AG, hi-volt	Ear	.16	13.50	10.80
125002	5AG, hi-volt	Earless	.16	13.50	10.80
127001	9/16" dia.	Ear	.40	33.50	26.80
127002	9/16" dia.	Earless	.40	33.50	26.80
129001	13/16" dia.	Ear	.94	78.50	62.80
129002	13/16" dia.	Earless	.94	78.50	62.80

PC BOARD FUSE CLIPS (SPRING BRONZE)

102068	1AG, 3AG, 8AG	Ear	$0.05	$4.50	$3.60
102069	1AG, 3AG, 8AG	Earless	.05	4.50	3.60

MANUAL RESET CIRCUIT BREAKERS

Exact replacement protector for TV circuits. Ideal for current overload protection for model railroads, toy transformers, hair dryers, small appliances, tools, wiring, etc. For 125 VAC. Size, 1¾" x 1 3/16" x ½".
Net Each, Skin Pack*..... **$0.84**
Bulk Pkg., Box of 5..... **3.90**

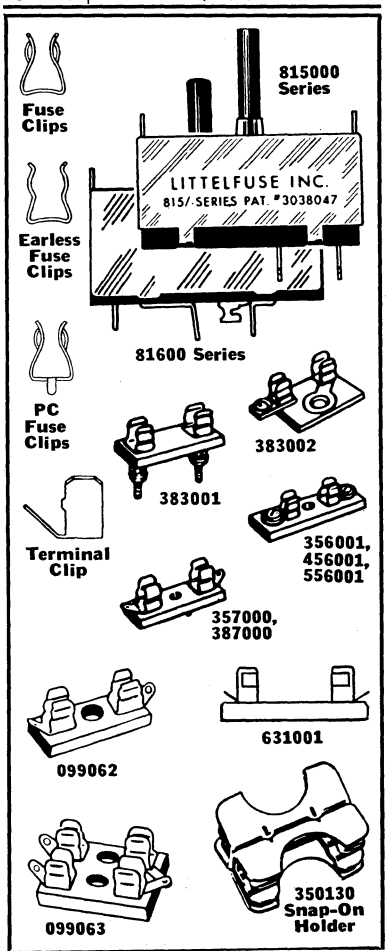
L.F. No.*	Trip Rating Amps	L.F. No.*	Trip Rating Amps
815.650	.650	815003†	3
815.800	.800	8153.25†	3.25
815001	1	81503.5	3.5
8151.25	1.25	8153.75	3.75
81501.5	1.5	815004†	4
8151.75†	1.75	81504.5†	4.5
815002†	2	851005	5
8152.25†	2.25	815006	6
81502.5†	2.5	815007†	7
8152.75†	2.75		

*Add **C** to L.F. No. for Skin Pack (815002**C**).
L.F. No. 094084 Bulk Assortment—Ten circuit breakers from the above listing as indicated by (†). Net Each..... **$7.80**
L.F. No. 094085 Card Assortment—Same, but card packaging. Net Each.... **$8.40**
L.F. No. 094073 Card Assortment for Color TV—One each 8151.75, 8152.25, 8152.75, 815003, 815007; two 81504.5, three 8153.25. Net Each..... **$9.30**
L.F. No. 094074 Bulk Assortment for Color TV—Same, but bulk packaging. Net Each..... **$8.70**
L.F. No. 815(000) PA-Circuit Breaker Adapter Plate—Net Each **$0.18**; 100 Net: **$15.00** ($100 lots); **$12.00** ($500 lots).

DUAL CIRCUIT BREAKERS

Exact replacements for RCA.
Net per bubble packed card..... **$1.42**

L.F. No.	RCA No.	Term. 1 and 2 Hold	Term. 3 and 4 Hold
816100	120784	1.30 A	.375 A
816101	121719	.900 A	.325 A
816102	1471912-4	.950 A	.400 A
816103	130077	.175 A	.400 A



LITTELFUSE Fuses, Holders

PLUG FUSES

ECON TIME-DELAY PLUG FUSES

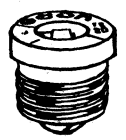
Dual-element plug type fuses provide additional protection against blowing during motor starting cycle. UL Recognized. For 125-volt operation.

L.F. No.	Amp Rating	Net per Box of 4	Net per 100
TE3/10	3/10	$0.92	$20.00
TE4/10	4/10	.92	20.00
TE8/10	8/10	.92	20.00
TE1	1	.92	20.00
TE1-1/8	1-1/8	.92	20.00
TE1-1/4	1-1/4	.92	20.00
TE1-4/10	1-4/10	.92	20.00
TE1-6/10	1-6/10	.92	20.00
TE1-8/10	1-8/10	.92	20.00
TE2	2	.92	20.00
TE2-1/4	2-1/4	.92	20.00
TE2-1/2	2-1/2	.92	20.00
TE3-2/10	3-2/10	.92	20.00
TE3-1/2	3-1/2	.92	20.00
TE4	4	.92	20.00
TE4-1/2	4-1/2	.92	20.00
TE5	5	.92	20.00
TE5-6/10	5-6/10	.92	20.00
TE6-1/4	6-1/4	.92	20.00
TE7	7	.92	20.00
TE8	8	.92	20.00
TE9	9	.92	20.00
TE10	10	.92	20.00
TE12	12	.92	20.00
TE14	14	.92	20.00
TE15	15	.52	11.00
TE20	20	.52	11.00
TE25	25	.52	11.00
TE30	30	.52	11.00

CLEARSITE ONE-TIME PLUG HOUSE FUSES

For 125 VAC or DC. UL Listed. Use with standard Edison base fuse holders.

L.F. No.	Amp Rating	Net per Box of 5	Net per 100
CP10	10	$0.55	$10.00
CP15	15	.50	9.00
CP20	20	.50	9.00
CP25	25	.50	9.00
CP30	30	.50	9.00


Econ Plug Fuse

Clearsite Fuse

FUSE HOLDERS, RETAINERS

MICROFUSE HOLDERS

For mounting of 273000 Series Microfuse. Type 281006 is front panel mounting; 281005 ideal PC board mtg.; 284000 Series front panel mtg. with indicator bulb.

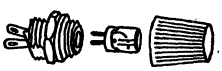
L.F. No.	Voltage Range	Net Each	Net per 100	
			100	500
281001	.....	$0.29	$ 24.00	$ 19.20
281005	.....	.26	21.50	17.20
281006	.....	.77	64.00	51.20
282001	.....	1.31	109.00	87.20
282002	.....	1.24	103.00	82.40
284004	2½–7	2.21	184.00	147.20
284005	7–16	2.21	184.00	147.20
284006	16–32	2.21	184.00	147.20
284003	100–125	1.55	129.00	103.20

Microfuse Holders

281001

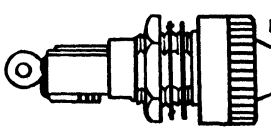
281005

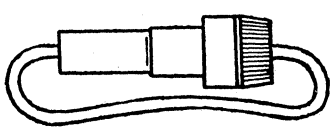
284000 Indicating


281006

MICROFUSE INDICATING HOLDERS—RF SHIELDED

284121	2½–7 V	$7.82	$651.50	$521.20
284122	7–16 V	7.82	651.50	521.20
284107	12–22 V	7.82	651.50	521.20
284108	23–33 V	8.83	735.50	588.40
284109	34–45 V	8.83	735.50	588.40
284110	46–60 V	8.83	735.50	588.40
284111	61–80 V	8.83	735.50	588.40
284112	81–90 V	8.83	735.50	588.40
284113	90–125 V	6.07	505.50	404.40

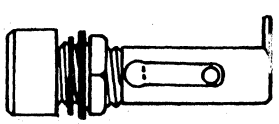

Indicating Fuse Post 344000

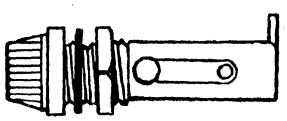

Bakelite In-Line Fuse Retainer Assembled With Lead

3AG FUSE EXTRACTOR POSTS

L.F. No.	Type	Net Each	Net per 100	
			100	500
340255A	R/F shld'd (FHN26G2)	$5.35	$445.50	$356.40
340256A	R/F shld'd (FHN20G)	5.35	445.50	356.40
341001A	Screw	.64	53.00	42.40
342001A	Finger	.64	53.00	42.40
342004A	Miniature	.53	44.50	35.60
342005A	Miniature*	.64	53.00	42.40
342006	Watertight	2.60	216.50	173.20
342012A	Miniature	.46	38.00	30.40
342013A	Miniature*	.54	45.00	36.00
342014A	Miniature	.46	38.00	30.40
342015A	Miniature*	.54	45.00	36.00
342021A	FHN 26W	3.20	266.50	213.20
342022A	Miniature	.53	44.50	35.60
342023A	Miniature*	.64	53.00	42.40
342024A	FHN 26G2	1.32	110.00	88.00
342025A	FHN 20G	1.36	113.50	90.80

*Dust-proof.


3AG Fuse Extractor Post 341001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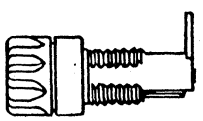
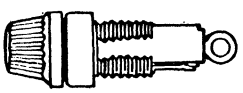

3AG Fuse Extractor Post 342004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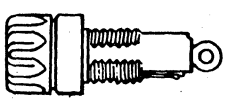
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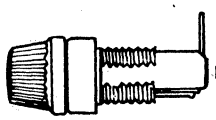
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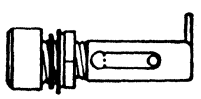
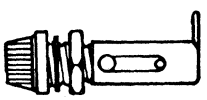
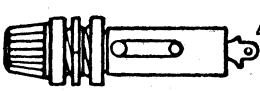

8AG Fuse Extractor Post 371001


8AG Fuse Extractor Post 372001


4AG Fuse Extractor Post 442001

8AG FUSE EXTRACTOR POSTS

371001A	Screw	$0.68	$ 56.50	$ 45.20
372001A	Finger	.68	56.50	45.20
372003	FHN31G2	2.65	221.00	176.80

4AG FUSE EXTRACTOR POSTS

442001A	Finger	$1.38	$115.00	$ 92.00
442006	Watertight	2.60	216.50	173.20
442008A	Watertight	3.20	266.50	213.20

5AG FUSE EXTRACTOR POSTS

570001	Non-watertight	$1.34	$111.50	$89.20
571004	Watertight	1.46	122.00	97.60

3AG QUICK-CONNECT POSTS

L.F. No.	Description	Net Each	Net per 100	
			100	500
342028A	3/16" terminals	$0.53	$44.50	$35.60
342038A	3/16" terminals	.53	44.50	35.60
342048A	3/16" terminals	.53	44.50	35.60
342058A	3/16" terminals	.53	44.50	35.60

3AG INDICATING FUSE POSTS

L.F. No.	Voltage	Net Each	Net per 100	
			100	500
344006A	2½–7 V	$3.14	$261.50	$209.20
344012A	7–16 V	3.14	261.50	209.20
344024A	16–32 V	3.14	261.50	209.20
344125A	100–125 V	1.93	160.50	128.40
344250A	200–250 V	1.93	160.50	128.40

SERIES 346000 LIMITED CURRENT FUSE HOLDERS

For use with regular and Slo-Blo Type C and N limited current fuses. Specify amperage when ordering. **$16.00**

Net per 100 ..... **$64.00**

UNIVERSAL FUSE RETAINER

Comes with three different length springs for fuse sizes 7½ SFE thru 3AG. **46¢**

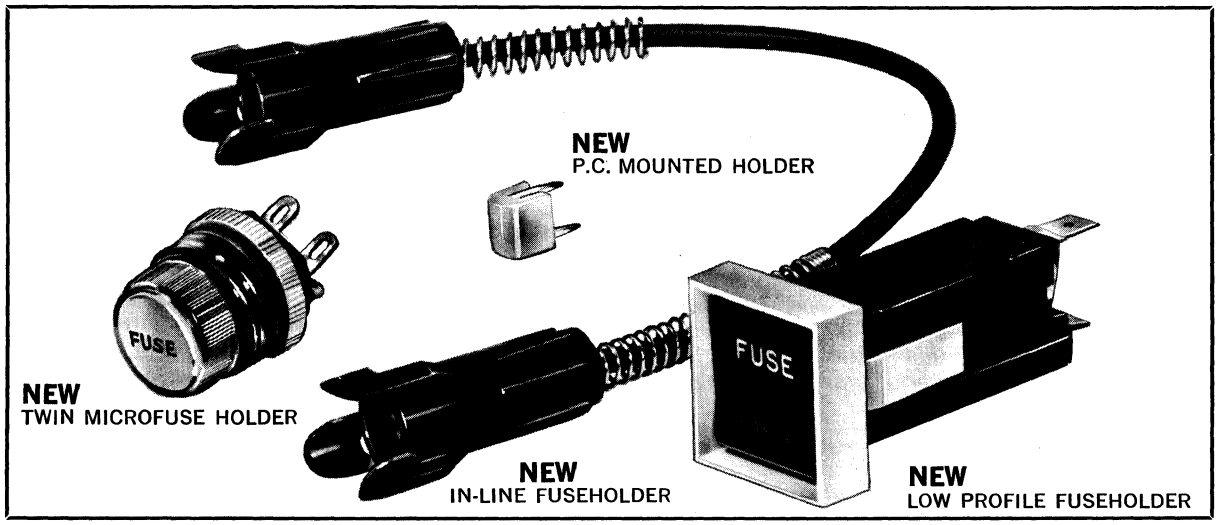
L.F. No. 150145—Net Each ..... Net 100 . . **$38.00**; Lots 500, Net 100 . **$30.40**

BAKELITE® IN-LINE FUSE RETAINERS ASSEMBLED WITH 19" LEAD

L.F. No.	Use with Fuses	Net Ea., Lots of 5	Net per 100	
			100	500
155004A	SFE 4, 1AG	$0.46	$38.00	$30.40
155006A	SFE 6	.46	38.00	30.40
15507.5A	SFE 7½	.46	38.00	30.40
155009A	SFE 9, 7AG	.46	38.00	30.40
155014A	SFE 14	.46	38.00	30.40
155020A	SFE 20, 3AG	.46	38.00	30.40

®Bakelite Corp.

LITTELFUSE FUSEHOLDERS



LOW PROFILE FUSEHOLDER

Square cap fuseholder snaps into chassis, eliminating need for mounting hardware. The cap snaps open for quick and easy fuse insertion and removal. Aesthetically styled to complement modern instrument panels, the holder is available in several color combinations.

HOW TO ORDER LOW PROFILE FUSEHOLDERS

Six digit number is a coded description of fuseholder

348 (A) **6** (B) **4** (C) **5** (D)

(A) Series Number **348** for 3AG Standard fuses, **347** for Pin Indicating.

(B) Terminal Style: **6,** 3/16" w. quick-connect and solder type; **8,** 1/4" w. quick-connect and solder type.

(C) Bezel Color: Specify **1,** red; **2,** green; **3,** yellow; **4,** blue; **5,** white; **7,** black; **9,** gray.

(D) Cap Color: Specify **1,** red; **2,** green; **3,** yellow; **4,** blue; **5,** white; **7,** black; **9,** gray.

NOTE: To order a cap assembly **only** for 3AG Standard fuses, use **348** series number and insert a **0** in the terminal style and bezel color locations (348 **0 0** 1). To order a cap assembly for 3AG Pin Indicating fuses, use **347** series number and insert a **0** in the terminal style and bezel color locations (347 **0 0** 1). To order a body assembly only, use **348** (for 3AG fuses) and insert a **0** in the cap color location (348 8 5 **0**). The body assembly only for 3AG Pin Indicating fuses is identical to 348 series.

LOW PROFILE FUSEHOLDERS— INDIVIDUALLY CARDED

L.F. No.	Description	Net Each	Net per 100	
			100	500
347 Series	3AG Pin Indicating	**$0.73**	**$61.00**	**$49.00**
348 Series	3AG Standard	**.71**	**59.00**	**47.00**

LOW PROFILE ASSEMBLIES AND CAPS— BULK 50 PER PACK

L.F. No.	Description	Net Each	Net per 100	
			100	500
348__0	3AG Body Assembly	**$0.42**	**$35.00**	**$28.00**
34700_	3AG Pin Indicating Cap Assembly	**.16**	**14.00**	**11.20**
34800_	3AG Cap Assembly	**.14**	**12.00**	**9.60**

IN-LINE FUSEHOLDER— No. 155100

A low-cost holder with "twist-lock" allowing easy fuse extraction and replacement. Accepts all 1/4" x 1 1/4" fuses and SFE fuses to 20 amps. Available in black, transparent or six other standard colors. Universal in-line fuseholder No. 155100 is assembled with 8" lead and two springs to accommodate any 1/4" diameter fuses. Fuseholders No. 155104A thru 155120A are assembled with 19" lead and fuse as indicated.

L.F. No.	Fuse	Net Ea. Lots of 5	Net per 100	
			100	500
155104A	SFE 4	**$0.42**	**$34.50**	**$27.60**
155106A	SFE 6	**.42**	**34.50**	**27.60**
15517.5A	SFE 7 1/2	**.42**	**34.50**	**27.60**
155109A	SFE 9	**.42**	**34.50**	**27.60**
155114A	SFE 14	**.42**	**34.50**	**27.60**
155120A	SFE 20	**.42**	**34.50**	**27.60**
155100	—	**.32**	**26.50**	**21.20**

TWIN MICROFUSE HOLDER— No. 280021

A versatile twin or single circuit holder for space-tight applications. Accepts two microfuses or a combination of micro and picofuse. Rated at 5 amps to 125 volts.

Net Each.....**$0.98;** Net per 100.....**$82.00**
Net per 500..... **65.60**

P.C. MOUNTED HOLDER— No. 281007

A low-profile, plug-in fuseholder accommodating Littelfuse picofuses and microfuses. Edge-mounted, the holder permits easy and rapid fuse removal and replacement. Rated at 5 amps to 125 volts.

Net Each.....**$0.26;** Net per 100.....**$21.15**
Net per 500..... **17.20**

LITTELFUSE
SUBSIDIARY OF TRACOR
800 E. NORTHWEST HIGHWAY • DES PLAINES, ILLINOIS 60016
PHONE: (312) 824-1188

Magic Dot™

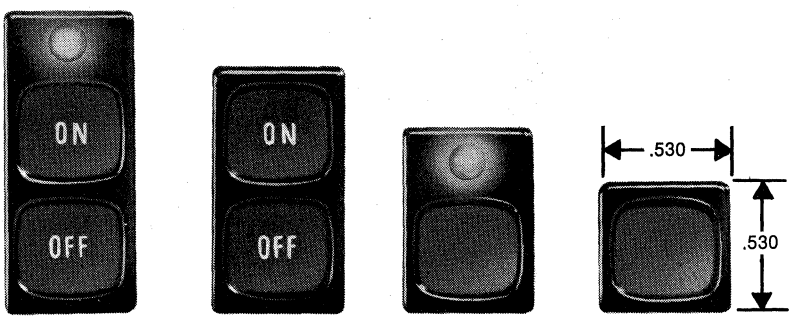
innovative, high-reliability switching technology

Magic Dot solid-state lifetime switches utilize integrated circuits and hybrid technology to provide a practical 'touch operated' switch with a TOTAL ABSENCE OF MOVING PARTS. Series 200 switches are currently available in momentary, latching and touch-on/touch-off (toggle) configurations with and without LED visual indication, in both standard and customer-specific designs.

These 'person sensors' offer unique design and operational advantages not available with even the finest electromechanical switches.

Magic Dot switches function on a truly modern concept that permits the touch of an operator's finger to trigger an NPN transistor and effect switching. Electrical and physical advantages are unparalleled.

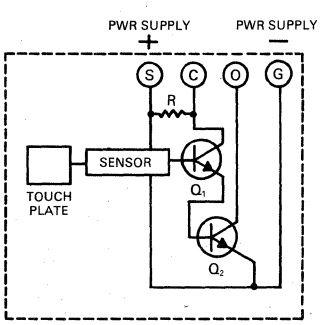
SERIES 200 SOLID-STATE LIFETIME SWITCHES



Momentary or Latching | Lighted Momentary or Latching | Toggle | Lighted Toggle

Typical Characteristics

Activation	Touch Operable
Life Expectancy (MTBF)	Hundreds of Millions of cycles
Current-On (I_c)	50 Ma. Maximum
Operating Voltage	5 to 30 VDC
Bounce	Absolutely Zero
Noise Immunity	Excellent
Voltage Drop (V_{sat}) $I_c = 50$ Ma.	.4 Volts
Current-Off (I_{ceo})	100 nanoamps Max.
Switch Breakdown Voltage (V_{ceo})	30 VDC
Operating Temperature Range	−55 to +125°C.



BASIC MAGIC DOT SWITCH CONFIGURATION

Applications

Magic Dot switches are suited to a full range of modern applications in Communications, Instrumentation & Control, Consumer & Industrial Electronics Equipment and Data Processing. Totally-sealed construction permits reliable long-term operation even in difficult contaminated environments where most electromechanical switches are subject to a high failure rate.

Other Innovations...

Magic Dot's concept is being successfully applied to a wide spectrum of other state-of-the-art products such as the sealed, encoded and lowprofile keyboard shown to the right. It also permits designs with enlarged remote touch plates for photo processing laboratories, machine shops, hand-held probes and other emergency disable applications.

For complete technical and applications information on Magic Dot solid-state lifetime switches write or telephone Magic Dot today!

MAGIC DOT, INC. 40 Washington Avenue South, Minneapolis, Minnesota 55401. Tel: 612-333-8161

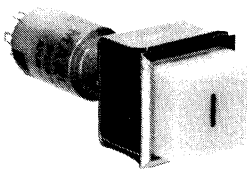
MARCO-OAK

Marco-Oak, a leader in the design and production of illuminated pushbutton switches and indicators for more than a quarter-century, recommends evaluating the switch in your circuit before you buy. This switch selection guide is only an outline. Please request our free catalog, or call upon our sales or engineering services whenever you require switch or indicator products.

Marco-Oak illuminated pushbutton switches are offered in a variety of styles: friction caps, low profile, snap-in, Rainbow, water-tight, splashproof, and EMI suppressed. The Presslite switch offers the convenience of a toggle switch combined with light indication abilities. Switch bases, mounting hardware, and cap sizes, shapes and colors are designed in modular units . . . more than 25,000 variations are possible.

SWITCH SELECTION GUIDE

Friction Cap Presslites



MATCHING INDICATOR BASES	
DESCRIPTION	**TYPE**
General Purpose	332,* 532,* 534
Press-to-Test	533, 535

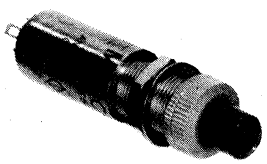
MOMENTARY ACTION SWITCH BASES	
DESCRIPTION	**TYPE**
½ Amp reed, single pole form A	830, 860
Low level S.P.D.T. 2 circuit form Z	545
	546
	567
	568
3 Amp S.P.D.T. 2 circuit form Z	542*
	543* **
	562
	563
5 Amp S.P.D.T. form C	318,518* **
5 Amp D.P.D.T. form C	321,521* **
10.5 amp S.P.S.T.—N.O. form X	585
10.5 Amp S.P.D.T. 2 circuit form Z	581
10.5 Amp D.P.S.T.—N.O. form X	586
10.5 Amp D.P.D.T. 2 circuit form Z	582
15 Amp S.P.D.T. form C	319, 519**

ALTERNATE ACTION SWITCH BASES	
DESCRIPTION	**TYPE**
5 Amp S.P.D.T. form C	316,516* **
5 Amp D.P.D.T. form C	320,520* **
10.5 Amp S.P.S.T.—N.O. form X	575
10.5 Amp S.P.D.T. 2 circuit form Z	571
10.5 Amp D.P.S.T.—N.O. form X	576
10.5 Amp D.P.D.T. 2 circuit form Z	572
15 Amp S.P.D.T. form C	317, 517**

PUSHBUTTONS
DESCRIPTION
Round, square, and rectangular. Various styles and colors

MOUNTING HARDWARE
DESCRIPTION
Surface or recess mounting.

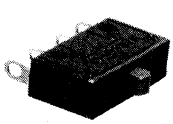
Low Profile Presslites



MOMENTARY ACTION	
DESCRIPTION	**TYPE**
3 Amp S.P.D.T. 2 circuit form Z	565, 566
5 Amp S.P.D.T. form C	418,* 618*
10.5 Amp S.P.S.T.—N.O. form X	685
10.5 Amp S.P.D.T. 2 circuit form Z	681
10.5 Amp D.P.S.T.—N.O. form X	686
10.5 Amp D.P.D.T. 2 circuit form Z	682

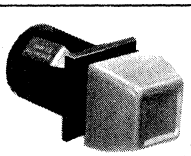
ALTERNATE ACTION	
DESCRIPTION	**TYPE**
5 Amp S.P.D.T. form C	416,* 616*
10.5 Amp S.P.S.T.—N.O. form X	675
10.5 Amp S.P.D.T. 2 circuit form Z	671
10.5 Amp D.P.S.T.—N.O. form X	676
10.5 Amp D.P.D.T. 2 circuit form Z	672

Snipe(TM) Switches



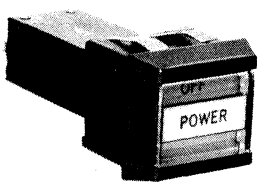
MOMENTARY ACTION	
DESCRIPTION	**TYPE**
10.5 Amp single pole form X	669
10.5 Amp single pole, 2 circuit form Z	670

Snap-in Presslites



MOMENTARY ACTION SWITCH	
DESCRIPTION	**TYPE**
½ Amp S.P.S.T.—N.O. form X	590
	591
Matching indicators	592
	593

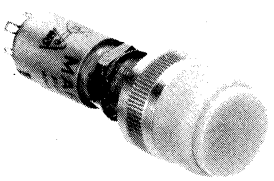
Rainbow(TM) Presslites



MOMENTARY ACTION	
DESCRIPTION	**TYPE**
10.5 Amp S.P.S.T.—N.O. form X	1113, 2113
10.5 Amp S.P.D.T. 2 circuit form Z	1111, 2111
10.5 Amp D.P.S.T.—N.O. form X	1114, 2114
10.5 Amp D.P.D.T. 2 circuit form Z	1112, 2112

ALTERNATE ACTION	
DESCRIPTION	**TYPE**
10.5 Amp S.P.S.T.—N.O. form X	1123, 2123
10.5 Amp S.P.D.T. 2 circuit form Z	1121, 2121
10.5 Amp D.P.S.T.—N.O. form X	1124, 2124
10.5 Amp D.P.D.T. 2 circuit form Z	1122, 2122

Watertight and E.M.I. Suppressed Presslites



MOMENTARY ACTION	
DESCRIPTION	**TYPE**
Watertight, 3 Amp S.P.D.T. 2 circuit	643**

WATERTIGHT ADAPTERS FOR MOMENTARY OR ALTERNATE ACTION
DESCRIPTION
Splashproof or oiltight
Splashproof and E.M.I. suppressed

**UL Recognized.*

*** QPL 22885 Listed. Switches vary slightly from those shown to conform to MIL-S-22885*

MARCO-OAK
A Subsidiary of OAK Industries Inc.

P.O. Box 4011 207 S. Helena Street, Anaheim, Calif. 92803
Tel. (714) 535-6037 • TWX — 910-591-1185

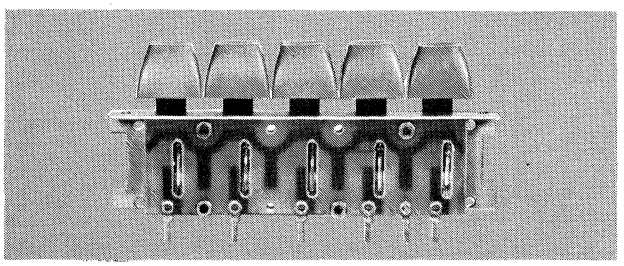
FOR INDICATORS — SEE MARCO-OAK'S INDICATOR SELECTION GUIDE, EEM Vol.2•519

Maxi-SWITCH KEYSTRIPS AND KEYBOARDS

The Maxi-Switch Company is a leading producer of pushbutton switch components and switch assemblies for the computer, photo-copy, business machine, automation and peripheral equipment industries.

The Maxi-Switch Keystrip construction technique facilitates the design and production of custom keyboards. Individual push-button stations may be purchased singly, in Keystrips, numeric blocks, or as completed Keyboards, with or without encoding circuitry. The wide range of features, options and accessories complement Keyboard adaptability. (Maxi-Switch Bulletin 1600/1800.)

1600 & 1800 KEYSTRIPS

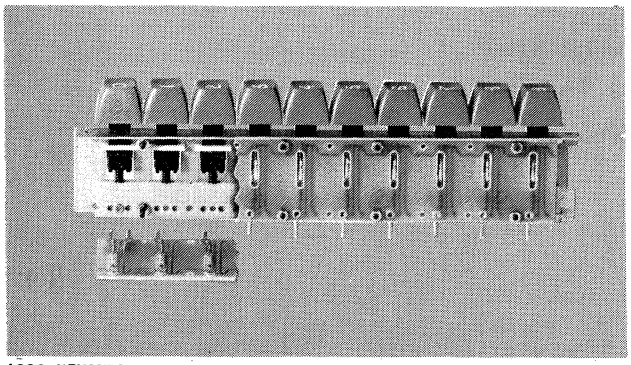


1800 KEYSTRIP

Maxi-Switch Keystrips present an unique approach to switch construction. These modular units offer long mechanical life and high quality in readily available, off-the-shelf assemblies. Combinations of different contact types, contact forms and plunger actions may be used within a single Keystrip. Up to 20 or more stations may be accommodated per Keystrip with standard spacing of ⅝ or ¾ inch between stations. Other spacings are optionally available.

Standard Series 1600 and Series 1800 switches are equipped with glass reed contacts, and differ only in frame height and available options (1600 — 1.5″ high, 1800 — 1.1″ high). Contact options (1600 only) include cross-bar palladium leaf contacts and 15 ampere snap-action power contacts. Reset and lockout solenoids may also be used with Series 1600 Keystrips.

Individual reeds may be tied to a common bus on one side, or brought out to seperate terminals, depending on the requirements of the application. The common bus feature saves component and mother-board space, and requires fewer solder connections.



1600 KEYSTRIP

SPECIFICATIONS

BUTTONS:

A variety of lighted and unlighted buttons available in several colors. Ask for Maxi-Switch Bulletin MS 2500 for information on buttons and Keystrip/Keyboard illumination.

TERMINALS:

Printed circuit, pierced solder lug, plug-in male/female contacts, wire-wrap, .110 quick connect.

CONTACTS:

Glass Reed, form A or B, single or dual station. 28 VDC @ 250 Ma.

Cross-Bar Palladium leaf contacts, Form A, B or C (1600 only). 3 Ampere @ 28 VDC, 3 Ampere @ 115 VAC.

Snap-Action Power Contacts (1600 only). 10 Ampere @ 250 VAC, ½ Ampere @ 125 VDC; or 15 Ampere @ 250 VAC, ½ Ampere @ 125 VDC.

PLUNGER ACTIONS:

Momentary Contact (standard)

Alternate Action (push-push)

Interlatch and Lockout

Lockout Only

Key Motion Sensing

Cross-Bank Interlatch and Lockout (between Keystrips).

KEYBOARDS

KEYBOARD ASSEMBLY

Maxi-Switch offers three different keyboard construction methods.

Keyboards can be constructed using Keystrips mounted on a precision-fabricated steel frame. Spacing is precise, with no possibility of cocked or twisted buttons, or switch misalignment. Keyboard orientation may be flat, stepped or sloped.

Keyboards also are available constructed from our new 2700 Series Reed Switch and 3100 Mechanical Switch modules. Series 2700 switches feature pre-tested reeds that are machine adjusted for consistent operation. Series 3100 mechanical switches feature simplicity and long life in a low cost switch that incorporates contact wiping action as the switch is operated.

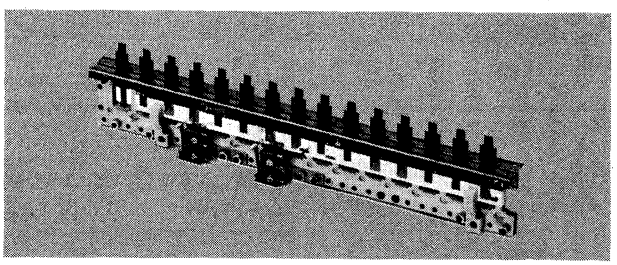
Maxi-Switch encoded keyboards may be ordered with either USASCII or EBCDIC standard formats. Encoding may be modified to meet special customer requirements. Output is compatible with DTL/TTL or MOS logic circuits, and is transmitted in up to 9 bits.

1200/1400 KEYSTRIPS

Series 1200 and 1400 Keystrips feature two-piece steel frames as the basic structure, with push-button components mounted between two frame halves. Precision tooling and the highest quality materials are used in Maxi-Switch construction for long life and trouble-free operation. Careful attention to tolerances gives smooth action with low operating force. These Keystrips may be supplied as completed individual keystrips, assemblies of several keystrips, or in custom panel assemblies, wired and tested.

Series 1200 and 1400 Keystrips may be lighted with one or two lamps per switch station (form A lamp contact not available on 1400 switches with more than 3 bits). Both midget groove and midget flange T-1¾ bulbs are available. Lamp sockets may be furnished with solder lugs, AMP 78 Series taper tabs, 3-inch pigtail lead wires, or with common bussing.

1400 BINARY KEYSTRIPS

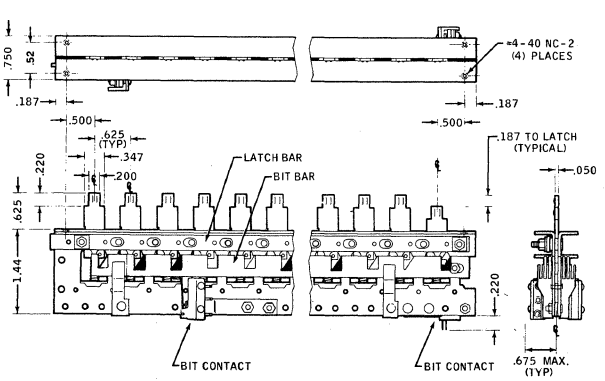


1400 KEYSTRIP

Maxi-Switch offers the newest concept in binary coded decimal switching. Series 1400 switches represent a significant advancement in the development of simplified mechanical encoding techniques, eliminating the maze of contacts, diodes, and interconnections normally associated with switch encoding. Wiring, bussing and solder connections are reduced to a minimum, with appearance and reliability enhanced by simplified construction. Up to 20 buttons can be accommodated on a single 1400 Keystrip.

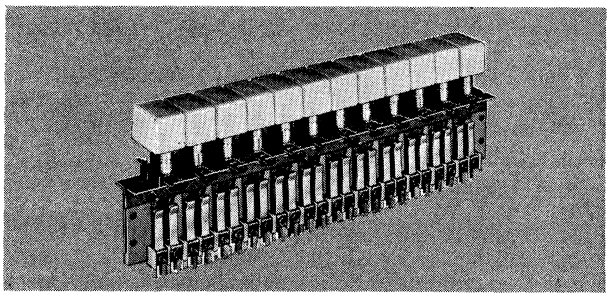
BCD encoding is accomplished by means of movable bit bars fitted with snap-in acetyl resin coding cams. These cams cause the bit bars to close the proper contacts for a discrete code when a button is depressed. Coding may be modified in the field or by the customer simply by repositioning the bit cams.

The Maxi Binary Switch will provide 3, 4, 5 or 6-bit binary output through snap-action contacts rated at 3 amperes, 300 watts, form "A" (SPST/NO) or form "C" (SPDT).

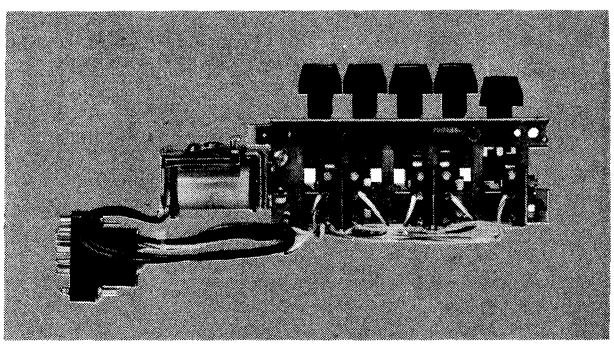


FOR BUTTON DIMENSIONS SEE TECHNICAL BULLETIN MS2500

1200 KEYSTRIPS



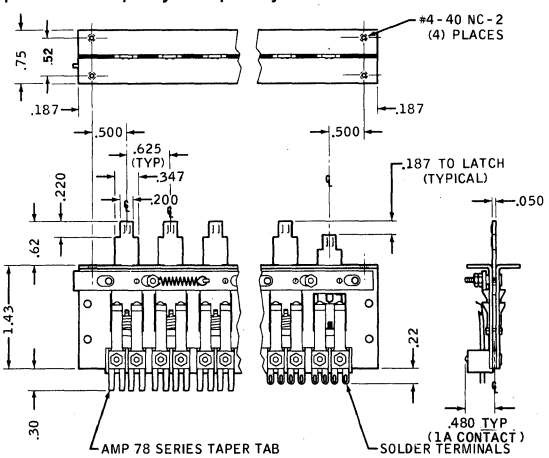
1200 KEYSTRIP



1200 KEYSTRIP

Series 1200 Keystrips provide circuit switching of up to 20 positions per keystrip. Many action options are available, and variations of standard design may be quickly accomplished using basic shelf stock for fast prototype and production service. Maxi Keystrip construction is strong and durable. The heavy duty frame members eliminate problems of cocked or twisted buttons and imperfect spacing. Our Keystrips add a touch of lasting quality to the appearance of any equipment.

The range of available contact forms (A, AA, B, C or F), plunger actions, terminals and buttons allow the designer to specify switches which are exactly suited to the application. With Maxi-Switch there need be no compromise with quality or capability.



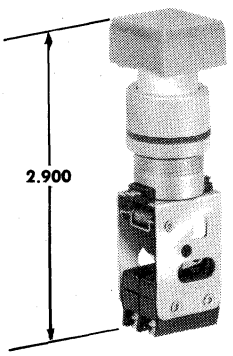
THE Maxi-SWITCH CO.
3121 WASHINGTON AVE. NO. • MINNEAPOLIS, MINNESOTA 55411
612-529-7601
612-529-7515

MICRO SWITCH LIGHTED PUSHBUTTONS

LIGHTED PUSHBUTTONS AND INDICATORS FEATURING. . .

- **FRONT OF PANEL MOUNTING AND RELAMPING**
- **DISTINCTIVE ILLUMINATED DISPLAY IN TRANSMITTED OR PROJECTED COLORS**
- **MOMENTARY OR ALTERNATE ACTION**
- **PRECISION SNAP-ACTION SPDT BASIC SWITCHES**

SERIES 1



- **Bushing Mounting Simplifies Installation**
- **Panel Seal Option**
- **Precision Switching Reliability**
- **Stationary Lamp Socket Protects Filaments During Actuation**
- **Front Of Panel Relamping**

Series 1 pushbutton switches are available with square displays in a choice of five colors with or without hot stamp legending. Switching modules for 1, 2, 3, or 4-pole double-throw contact arrangements. Heavy duty (5 amps) and low energy (1 amp) ratings; momentary and alternate action; and solder or quick-connect termination.

TYPICAL CATALOG LISTINGS:

1B100-2 - Sealed, 1-pole momentary action-switch with silver contacts and a 28 volt lamp.
1B026-2 - Sealed, 2-pole alternate action-switch with silver contacts and a 28 volt lamp.
1C005-1 - Unsealed, 3-pole momentary action-switch with silver contacts and a 6 volt lamp.
1B001-1 - Sealed, 2-pole momentary action-switch with gold contacts and a 6 volt lamp.

Request Product Sheet Series 1

SERIES 2

- **Up To Four Lamps**
- **Round Or Rectangular Display**
- **Wide Choice Of Switch Modules —Up To 4 SPDT Circuits**

Rectangular or round displays available with snap-in flange or barrier mounting. Up to four lamp capability and a wide choice of switch modules including 1, 2, 3, or 4-pole double-throw and twin break contact arrangements. Heavy duty (5 amp), and low energy (1 amp) ratings; momentary and alternate action; solder, screw or quick-connect terminals.

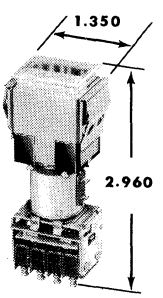
CATALOG LISTINGS FOR COMPONENTS OF A TYPICAL RECTANGULAR DISPLAY PUSHBUTTON:

2C3— Rectangular lighted pushbutton housing, barrier mount, 4 lamp sockets.
2C200— Same as above, but with "no-tool" relamping.
2B10— White barrier.
2A1— Red, one-piece display screen.
2D9— Type SM switch module, with four SPDT circuits.

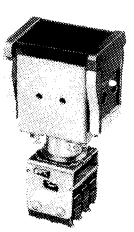
CATALOG LISTINGS FOR COMPONENTS OF A TYPICAL ROUND DISPLAY INDICATOR:

2R1— Round, lighted indicator housing, snap-in mount, with 2 lamp sockets.
2J12— Green 3-piece display screen, relegendable.
2K4— Black guard ring.

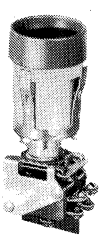
Request Catalog 51



FLANGE MOUNT



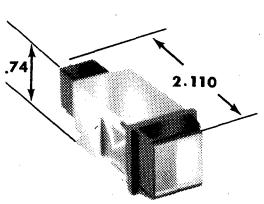
BARRIER MOUNT



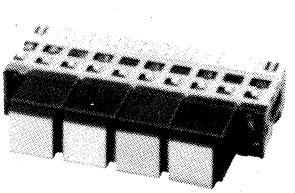
ROUND DISPLAY

SERIES 3

- **One Or Two Lamps**
- **Up To 2 SPDT Circuits**
- **Individual, Strip Or Matrix Mounting**



INDIVIDUAL MOUNT SWITCH



SWITCHES ASSEMBLED IN MOUNTING HARDWARE

Lighted pushbutton switches with five display colors and momentary or 2-level alternate-action. Wide circuit design flexibility from 5 amp power switches with Form X, Y, and Z as well as electronic duty Form A reed switches.

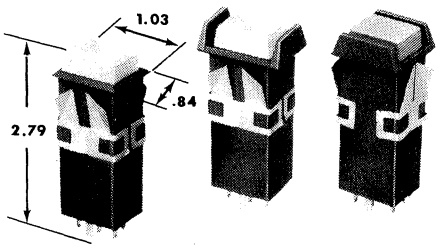
TYPICAL CATALOG LISTINGS:

3A11F— Powerswitch, matrix or strip mount, momentary action, 2 lamp sockets, SPNO, black barriers.
3J10A— Indicator, individual or strip mount, 2 lamp circuits, black bezel.
3B40G— Reed switch, matrix or strip mount, alternate action, 2 lamp circuits, 2-pole NO, red barriers.

Request Catalog 51

MICRO SWITCH SERIES 4 PUSHBUTTONS

DESCRIPTION



Series 4 pushbutton switches and indicators feature low installed cost, easy wiring, precise switching, distinctive display and vivid colors. Units can be furnished assembled, ready for installation, or as separate components. The unit, when assembled, allows simple re-lamping from the panel front.

Switches and indicators can be ordered from the chart shown on page 1110, and an ordering guide for buttons is illustrated on page 1109, in EEM Vol. 2.

Within this section covering Series 4, items are arranged as shown on the ordering guide, i.e. housing style, color, illumination, button details, etc. Adjacent to each drawing or discussion is the appropriate ordering symbol for each item.

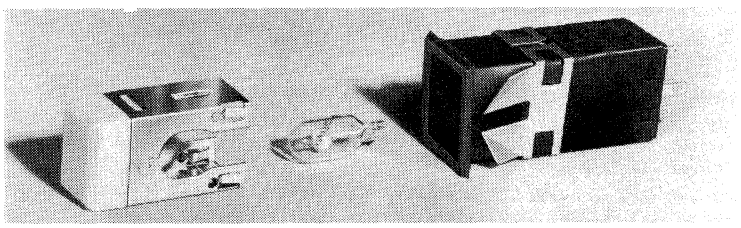
FEATURES

- **LOW INSTALLED COST—**
  Snap-in mounting for panels up to .200″ thick. Standard price includes assembled product, with lamp. Front of panel mounting and relamping.
- **EASY WIRING—**
  Lead wires are readily attached to 110 QC terminals. Lamp and switch terminals are on same level.
- **PRECISION SWITCHING RELIABILITY—**
  Long life dependability assured by time-proven SM basic switches. UL listed low energy (1 amp, 250 vac) versions.
- **DISTINCTIVE LIGHTED DISPLAY COLORS—**
  Transmitted color, projected color, and hidden legend/hidden color options.
- **MATCHING INDICATORS—**
  Indicators feature the same buttons and housing styles as the pushbutton switches.

ASSEMBLY

Assembled units are furnished, ready to install in your panels, with choice of button color, lamp and housing style.

Indicators are identical in appearance, but have no provision for switching.



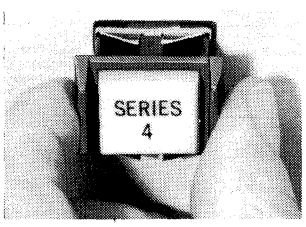
Pushbutton—Choice of transmitted color, projected color, and hidden legend/hidden color.

Lamp—T-3¼ wedge base lamp available in choice of 6.3, 14 and 28 voltages.

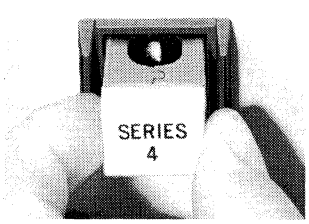
Housing—Choice of bezel or barrier styles, momentary or alternate action. Contains lamp socket and one or two SPDT switches.

MOUNTING AND RELAMPING

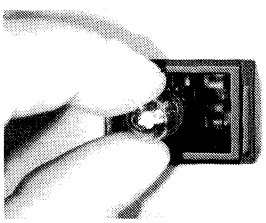
Indicators or switches are mounted, and lamps replaced, from the panel front. Lamps are replaced by simply removing the button and inserting a new lamp.



1. Snap-in mounting. Switch or indicator is easily inserted into the cutout. Mounting clips grip the panel. No tools are needed.



2. Lamps and legends can be changed from panel front. When button is removed, lamp is extracted from its socket and retained in button.



3. Ease of lamp replacement. After the inoperative lamp is automatically removed with the button, the new lamp is inserted without the use of tools.

TERMINALS

Terminals are .110″ wide by .020″ thick quick-connect type. Slot size is .130″ long by .048″ wide. Terminals are plated to permit soldering.

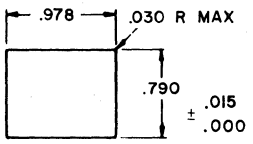
SERIES 4 lighted pushbutton switches (4A) and indicators (4C)

PANEL ARRANGEMENT AND CUTOUTS

PANEL THICKNESS .040" - .200"

Switches and indicators can be arranged either horizontally or vertically to take advantage of optimum space and human engineering requirements. Housing styles have been designed to allow maximum flexibility in arrangement, and visual and physical isolation of the button.

Panel Cutout for Individual Mount (any housing style)



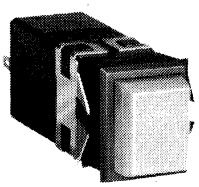
Panel Cutout for Strip Mount

HOUSING STYLES	HOUSING WIDTH	DIMENSIONS (INCHES)* LENGTH	
Short Sides Abutting	Bezel	.790	(No. of units x 1.032)—.054
	Short Barrier	.790	(No. of units x 1.094)—.116
Long Sides Abutting	Bezel	.978	(No. of units x .844)—.054
	Long Barrier	.978	(No. of units x .906)—.116

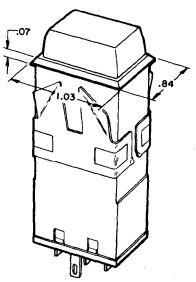
*+.015—.000

HOUSING STYLES

BEZEL ON ALL SIDES

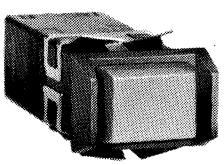


11, 12

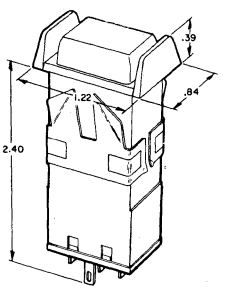


BEZEL TYPE housings can be top-of-panel or subpanel mounted, individually or in strips. A bezel surrounds four sides.

BARRIERS ON SHORT SIDES

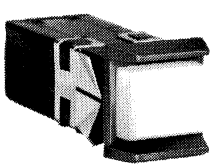


21, 22

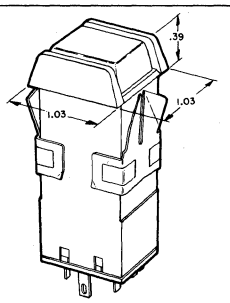


BARRIER TYPE HOUSINGS are normally mounted top-of-panel in strips, but can also be individually mounted. Barriers are on either the short or long sides.

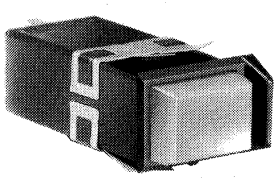
BARRIERS ON LONG SIDES



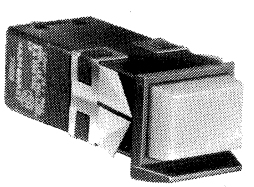
31, 32



BARRIER ON ONE SIDE

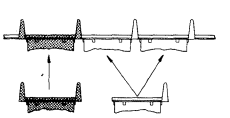


23, 24 Short Side



33, 34 Long Side

The drawing below shows how housings with a barrier on one side are used in a strip of two or more units. The first has a barrier on two sides, and all other units have a barrier on one side and butt against each other.

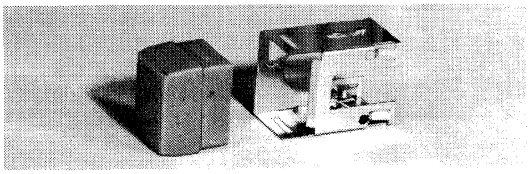


BARRIERS ON BOTH SIDES

BARRIERS ON ONE SIDE

MICRO SWITCH SERIES 4 PUSHBUTTONS

ILLUMINATION

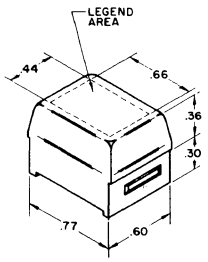


BUTTON METAL SHELL

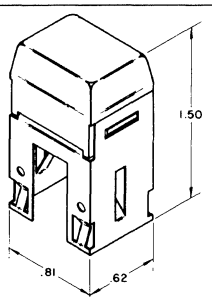
Series 4 has vivid color lighted buttons, featuring a choice of six button types which can be used to meet your individual display requirements.

The button assembly consists of a plastic button which snaps into a metal shell. The shell acts as a lamp removal tool and provides a heat sink for the lamp. Construction details of the various button types are shown below. The A through F button type designations correspond to the code letters in the ordering guides.

TYPE A (5 sides lighted)



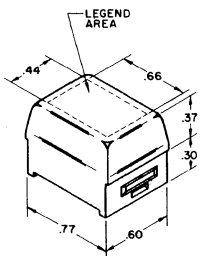
TRANSLUCENT COLORED BUTTON



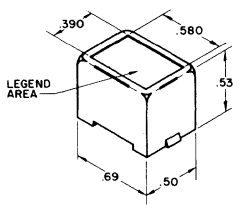
BUTTON ASSEMBLED TO METAL SHELL

Type A button may be used with transmitted color. The display can be distinguished whether the lamp is ON or OFF. Type A is a one-piece colored button with all five sides lighted.

TYPE B (5 sides lighted)



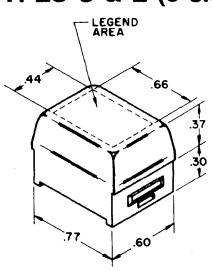
TRANSLUCENT WHITE BUTTON



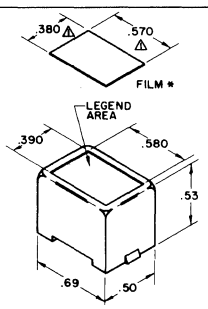
TRANSPARENT COLORED INSERT

Type B button is for use with projected color. The white button with color inserts appears white when the lamp is OFF and colored when illuminated. All five sides are lighted.

TYPES C & E (5 sides lighted)



TRANSPARENT BUTTON
TYPE C - BLACK TYPE E - COLORLESS

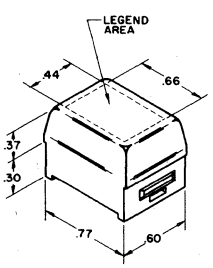


TRANSLUCENT COLORED INSERT

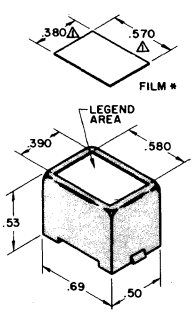
Type C button appears black when lamp is OFF. Legend and color appear when illuminated. This effect is achieved with a transparent black (smoke gray) button and color insert. All five sides are lighted. Type E is a water-clear colorless transparent button, with smooth face and matte finish sides, and has a color insert. All five sides are lighted.

TYPE D & F (only face lighted)

TRANSPARENT BUTTON
TYPE D - BLACK TYPE F - COLORLESS



OPAQUE BLACK INSERT WITH
TRANSLUCENT COLORED FACE



Type D button is similar to type C button except only the face is lighted. Type F button is a water-clear colorless transparent button, with smooth face and matte finish sides, and has a color insert. Only the face is lighted.

SERIES 4 lighted pushbutton switches (4A) and indicators (4C)

LAMPS

T-3¼ wedge base lamps are available in 6.3, 14, and 28 volt versions. The life figures shown in the specification chart are conservative values provided by lamp manufacturers. Lamp manufacturers should be consulted if additional performance data is desired.

HOW TO ORDER LAMPS

Lamps can be ordered from MICRO SWITCH, using 4Z designations. Lamps are subject to Discount R. However, quantities of different lamp listings cannot be combined for discounting. Minimum Schedule Quantity is 10 pieces.

LISTING CODE	INDUSTRY LAMP NO.	CATALOG LISTING	DESIGN VOLTS	SOCKET VOLTS	AMPS	MSCP	RATED LIFE HOURS AVG.
12	259	4Z212	6.3	6.3	.25	.65	9,000
				6.0	.24	.52	16,000
				5.5	.225	.39	44,500
				5.0	.21	.29	50,000
13	159	4Z213	6.3	6.3	.15	.34	9,000
				6.0	.14	.27	16,500
				5.5	.135	.24	28,000
				5.0	.12	.17	28,000
21	161	4Z221	14	14	.19	1.0	4,000
				12	.17	.60	25,000
				11	.16	.4	26,500
				10	.15	.3	28,000
31	656	4Z231	28	28	.06	.65	5,000
				27	.057	.52	7,500
				26	.054	.49	10,000
				24	.05	.39	10,000

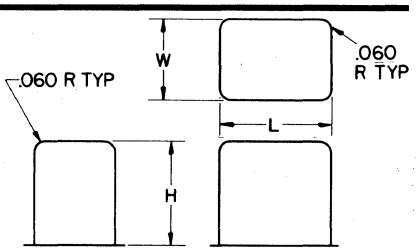
LEGENDING

HOT STAMP LEGENDS

Use the Legend Order Sheet FO-63039 to specify hot stamp legending from MICRO SWITCH. Request a pad of forms from our branch office nearest you. Legends are oversprayed for maximum durability.

The drawing at right provides information to build a simple holding fixture (horn) if you prefer to do your own legending of buttons or inserts, by hot stamp or engraving.

FIXTURE FOR HOLDING BUTTONS AND INSERTS WHILE HOT STAMPING OR ENGRAVING LEGENDS



DIMENSIONS (IN.)±.005

	H	L	W
INSERT	.550	.640	.425
BUTTON TYPE A	.620	.668	.480
BUTTON TYPES B, C, & D	.620	.688	.500

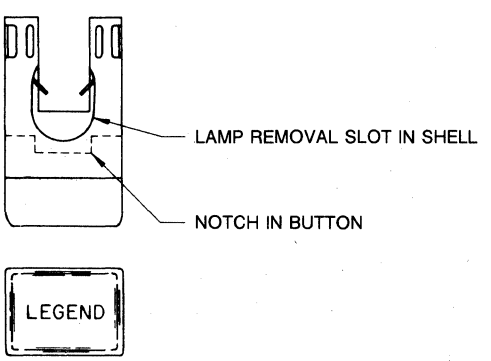
FILM LEGENDS

Film legends are not supplied by MICRO SWITCH. However, this service is readily available from commercial photographic or contact printing sources. Films offer the flexibility of using either a positive or negative approach, and enable special characters to be easily produced. The film should be polyester type to withstand lamp heat and must be precision cut, per the dimensions shown on the previous page, to insure proper alignment.

The film fits into a shallow undercut on the face of the button insert. The film is held securely when the outer button and insert are snapped together. (Note: It is difficult to disassemble for legend changes without damaging the parts.) Button and insert should be snapped together prior to being assembled to the button shell.

BUTTON ORIENTATION

The legended button should be assembled to the button in the orientation shown below, with the button notch keyed to the lamp removal slot in the metal shell. This will reduce the possibility of lamp droppage when the button is removed from the housing. All buttons are legended by MICRO SWITCH in this manner.



MICRO SWITCH SERIES 4 BUTTONS (4B)

HOW TO ORDER

4B buttons may be ordered with or without the metal shell, assembled or unassembled, and with or without legending. When type B, C, D, E, or F buttons are ordered unassembled, the insert is also unassembled.

PRICING

The list price of an item is determined by whether or not the button shell is provided and which option is selected in the "Display Color" and "Legend" columns.

QUANTITY DISCOUNT

Type 4A and 4C items are combinable for quantity discount. Check with your nearest MICRO SWITCH Branch Office or Authorized Distributor (Listed in the Yellow Pages under Switches, Electric).

EXAMPLE:

4B	2	B	R	U	4B2BRU
BUTTON CATEGORY	BUTTON AND METAL SHELL PROVIDED	PROJECTED COLOR	STD. RED	NO LEGEND BUTTON UNASSEMBLED	COMPLETE LISTING:

WITH OR WITHOUT METAL SHELL	BUTTON TYPE	DISPLAY COLOR	LEGEND (Legend Order Sheet must accompany all orders for legended buttons)
1 Button only (without metal shell) **2** Both button and metal shell provided.	**A** Transmitted color, 5 sides lighted 1-piece translucent button. **E** Transmitted color 5 sides lighted. Transparent colorless button & translucent color insert. **F** Transmitted color. Only face lighted. Transparent colorless button & color insert. **B** Projected color, 5 sides lighted. Translucent white button & color insert. **C** Hidden color/ hidden legend. 5 sides lighted. Transparent black button & translucent color insert. **D** Hidden color/ hidden legend. Only face lighted. Transparent black button & translucent color insert.	**B** Std. Blue **G** Std. Green **R** Std. Red **Y** Std. Yellow **W** Std. White	**U** No legend, button unassembled. (For customer who does his own legending.) Use with any button except 4B1A—. **N** No legend, button assembled. (For applications not requiring legends.) Use with any button **L** Legend on button only, button assembled. (For customer who prefers to have MICRO SWITCH provide legending.) Use with any button. **K** Legend on insert only, button assembled. (For C, D, E and F button types.) **J** Legends on both *button and insert,* button assembled. Use with C & D button types.

MICRO SWITCH SERIES 4 PUSHBUTTONS

HOW TO ORDER

(1) COMPLETELY ASSEMBLED 4A PUSHBUTTON SWITCH. Follow all steps, as shown in the example at top of the chart, to determine the complete catalog listing.

(2) 4A SWITCH HOUSING ONLY. When you have entered the code number from the "Illumination" column, you have a complete listing for a switch housing, less button and shell.

(3) COMPLETELY ASSEMBLED 4C INDICATOR. Follow the steps shown in the example below, but *do not enter a letter code from the "Switching Element"* column.

(4) 4C INDICATOR HOUSING ONLY. Listing is complete when you have entered the "Illumination" code number. *Do not enter a letter code from the "Switching Element"* column. Unit is supplied less button and shell.

PRICING

(1) 4A COMPLETELY ASSEMBLED PUSHBUTTON SWITCHES AND SWITCH HOUSINGS ONLY.

(2) 4C COMPLETELY ASSEMBLED INDICATORS AND INDICATOR HOUSINGS ONLY. Apply additions for "Illumination," "Button Type," and "Legend," where applicable.

QUANTITY DISCOUNT

Type 4A and 4C items are combinable for quantity discount. Check with your nearest MICRO SWITCH Branch Office or Authorized Distributor (Listed in the Yellow Pages under Switches, Electric).

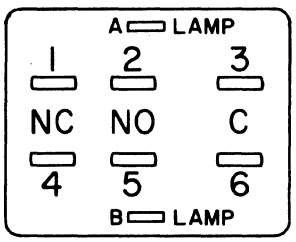
EXAMPLE:

4A	21	B	BA	12
PUSHBUTTON SWITCH	BARRIERS ON SHORT SIDES, MOUNTING CLIPS ON LONG SIDES.	BLACK HOUSING	1-POLE SWITCH WITH 5-AMP SILVER CONTACTS, ALTERNATE-ACTION.	6 VOLT LAMP. ASA #259

	HOUSING STYLE	HOUSING COLOR	SWITCHING ELEMENT Omit Code letters if ordering **4C** indicator	ILLUMINATION include addition to list price, where applicable
4A PUSHBUTTON SWITCH **4C** INDICATOR ONLY	**11** Bezel on all sides, mounting clips on long sides **12** Bezel on all sides, mounting clips on short sides **21** Barriers on short sides. mounting clips on long sides **22** Barriers and mounting clips on short sides **23** Barrier on *one* short side, mounting clips on long sides **24** Barrier on *one* short side, mounting clips on short sides **31** Barriers and mounting clips on long sides **32** Barriers on long sides, mounting clips on short sides **33** Barrier on *one* long side, mounting clips on long sides **34** Barrier on *one* long side, mounting clips on short sides	**B** Black **G** Gray Contact your nearest MICRO SWITCH branch office for availability of other colors	**AA** Momentary / **BA** Alt. Action — 1-Pole (SPDT), 5 a. silver contacts **EA** Momentary / **FA** Alt. Action — 2-Pole (DPDT), 5 a. silver contacts **CA** Momentary / **DA** Alt. Action — 1-Pole (SPDT), gold contacts **GA** Momentary / **HA** Alt. Action — 2-Pole (DPDT)8 gold contacts **JA** Momentary / **KA** Alt. Action — 2-Pole combination gold (SPDT) and 5 a. silver (SPDT) contacts **LA** Momentary / **MA** Alt. Action — 1-Pole (SPDT), 10 a. silver contacts **NA** Momentary / **PA** Alt. Action — 2-Pole (SPDT), 10 a. silver contacts **LIGHTED INDICATOR ONLY** (No switching element)	**11** No lamp, has lamp socket **12** 6 volt lamp. ASA #259 **13** 6 volt lamp. ASA #159 **21** 12 volt lamp. ASA #161 **31** 28 volt lamp. ASA #656 **91** Unlighted, no lamp socket

SERIES 4 lighted pushbutton switches (4A) and indicators (4C)

TERMINAL VIEW



ELECTRICAL RATING:

5-Amp Silver Contacts— 5 a. res., 3 a. ind. 30 vdc. UL Listed: 5 a., 250 vac.

10-Amp Silver Contacts— UL Listed: 10 a., 1/4hp, 125 or 250 vac.

Gold Contacts— 1 a. res., 0.5 a. ind., 30 vdc. UL Listed: 1 a., 125 vac.

B	Y	L	4A21BBA12BYL
PROJECTED COLOR	STD. YELLOW	LEGEND ON BUTTON BUTTON ASSEMBLED	COMPLETE LISTING

BUTTON (Incl. Metal Shell) Include addition to list price, where applicable	**DISPLAY COLOR**	**LEGEND** (Legend Order Sheet must accompany all orders for legended buttons)
A Transmitted color. 5 sides lighted. 1-piece translucent button.	**B** Std. Blue	**U** No legend, button unassembled. (For customer who does his own legending.) Use with any button.
E Transmitted color 5 sides lighted. Transparent colorless button w/translucent color insert.	**G** Std. Green	**N** No legend, button assembled. (For applications not requiring legends.) Use with any button.
F Transmitted color. Only face lighted. Transparent colorless button w/translucent color insert.	**R** Std. Red	**L** Legend on button only, button assembled.(For customer who prefers to have MICRO SWITCH provide legending.) Use with any button.
B Projected color. 5 sides lighted. Translucent white button w/color insert.	**Y** Std. Yellow	**K** Legend on insert only, button assembled.(For C, D, E and F button types.)
C Hidden color/hidden legend. 5 sides lighted. Transparent black button w/translucent color insert.	**W** Std. White	**J** Legends on both *button and insert,* button assembled. Use with C & D button types.
D Hidden color/hidden legend. Only face lighted. Transparent black button w/translucent color insert.		

Mounting clips on the long sides of the housing are specified when individually mounted or when the long sides of strip mounted housings parallel the long sides of the panel cutout slot.

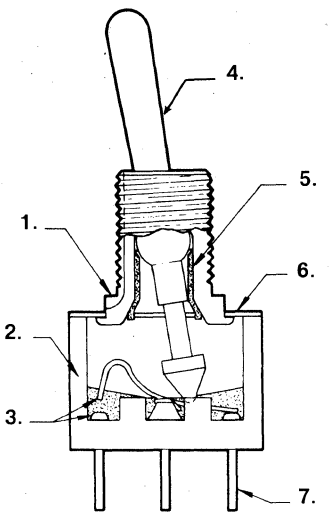
The most secure mounting is achieved when the mounting clips are on the long sides.

Mounting clips on the short sides of the housing are specified when short sides of strip mounted housings parallel the long sides of the panel cutout slot.

MICRO SWITCH SERIES 8 MINIATURE MANUAL SWITCHES

QUALITY CONSTRUCTION

Series 8 offers an outstanding variety of electrical and structural features throughout this line of commercial miniature manual switches.



Features/Benefits

1. HIGH TORQUE BUSHING. Prevents toggle switch bushing from rotating or separating from case during assembly.
2. ARC-RESISTANT CASE. Constructed of high strength plastic and compartmented to assure isolation of circuits in multi-pole devices.
3. CONTACTS. Choice of fine silver, gold/nickel plated brass, or gold/nickel plated fine silver contacts for handling a variety of electrical loads.
4. OPERATORS. Choice of levers, i.e., small, large, flatted, and long levers; and rocker, paddle, and pushbutton operators, to provide maximum flexibility in panel appearance.
5. LEVER STOP. Toggle switch bushings have a built-in lever stop to prevent contact transfer or switch damage should a downward force be applied to the lever.
6. RECESSED COVER ATTACHMENT. All Series 8 switches have the stainless steel cover attached to the case away from close proximity to the switch terminals. This isolation aids in preventing shorting between the terminals and case during assembly or use.
7. TERMINALS. Choice of solder terminals, which will accept two No. 22 AWG wires; quick-connect; printed circuit; or wire wrap type.

The MICRO SWITCH Series 8 line of miniature manual switches is ideally suited for commercial applications which have limited space requirements and demand high quality and performance standards. There is a wide choice of operator options: toggles - with small, large, flatted, long, and pull-to-unlock levers; rockers - in lighted and unlighted versions; paddles; and pushbutton switches - with a choice of two button sizes. Accessories, such as colored plastic lever sleeves for small lever toggle switches and colored bezels for rocker and paddle switches, can be used to enhance panel appearance and to identify control functions.

Switches are normally supplied with fine silver contacts, terminals for solder or quick-connect wiring, and mounting hardware.

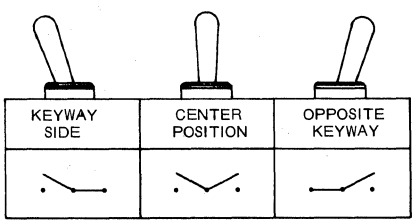
TYPICAL APPLICATIONS

COMMUNICATION EQUIPMENT
COMPUTER AND RELATED PERIPHERALS
ELECTRICAL AND ELECTRONIC TEST AND MEASURING EQUIPMENT
PORTABLE ELECTRICAL DEVICES
BUSINESS MACHINES
PHOTOGRAPHIC AND REPRODUCTION DEVICES
MEDICAL EQUIPMENT

UL LISTED

Series 8 switches with fine silver contacts are listed by Underwriters' Laboratories, Inc., for 6 amps at 125 vac.

LEVER/CIRCUIT RELATIONSHIP



The operating sequence shown above is repeated in multi-pole devices. Each pole has double-throw circuitry and consists of three terminals which exit at the bottom of the switch case.

When the lever is thrown towards the keyway side, the center terminal of each pole is connected to the terminal at the end of the switch opposite the keyway and vice versa.

The keyway is a helpful reference when you are applying a switch with the momentary (ON) circuit at one of the extreme lever positions.

MICRO SWITCH SERIES 8 MINIATURE MANUAL SWITCHES

SPECIFICATIONS

GENERAL

Contacts: Fine silver are standard. See page 1118 (EEM Vol. 2) for optional contact material choices.

Electrical Ratings: Fine silver contacts—6 amps res., 2 amps ind., 125 vac and 28 vdc;
UL listed—6 amps, 125 vac.
Optional gold/nickel plated brass or fine silver contacts—0.5 VA max. at 20 volts max.

Switch Terminals: Silver plated terminals are standard and may be used for manual solder or quick-connect wiring. See page 1118 for optional terminal plating.

Metal Housing: Stainless steel

Case: Epoxy resin

TOGGLE SWITCHES
(8A, 8B, 8C and 8E)

Bushing: Nickel plated brass

Mounting Hardware (Unassembled): Two hexnuts, one locking ring, and one lockwasher

Anti-rotation mount: Keyway slot on bushing prevents rotation of switch in panel

Toggle Lever: Chrome-plated brass except 8C switches have nickel-plated brass lever

Lever Sleeve: Vinyl

PADDLE AND ROCKER SWITCHES
(8H and 8K)

Spring Mounting Clips: Stainless steel

Operators: Polycarbonate

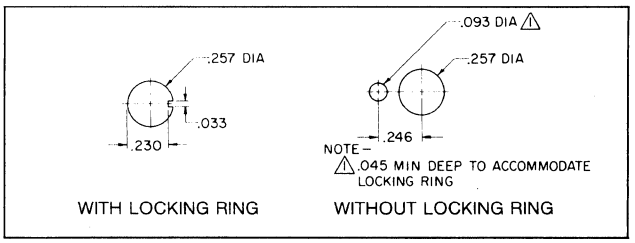
Lamp Terminals: 8K switches have silver plated phosphor bronze terminals which will accept two No. 22 AWG wires

PUSHBUTTON SWITCHES

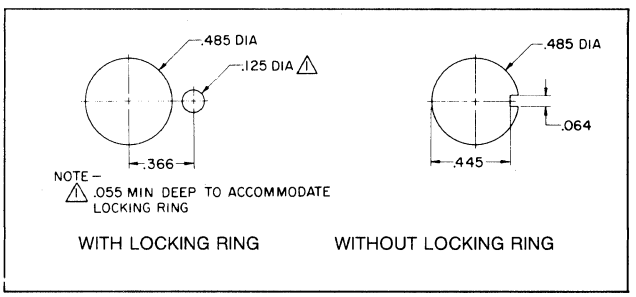
Buttons: Nylon

MOUNTING DETAIL

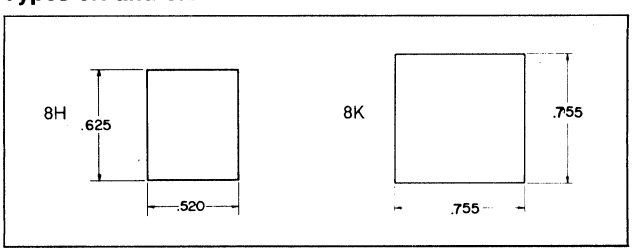
Types 8A, 8C, 8D, 8E and 8N



Type 8B



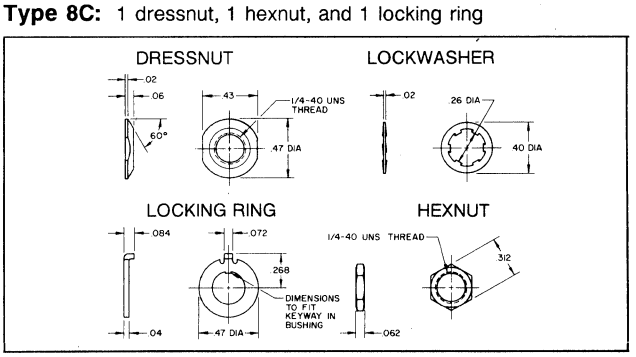
Types 8H and 8K



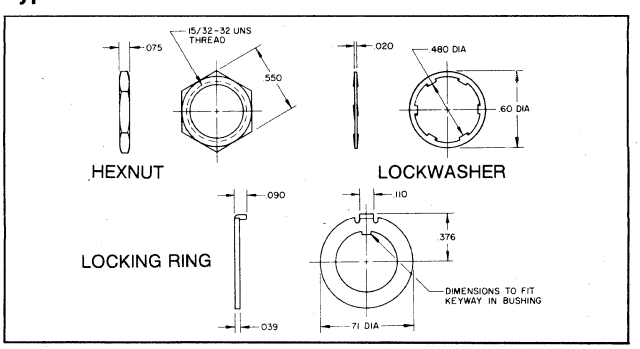
MOUNTING HARDWARE

Types 8A, 8D, 8E and 8N:
2 hexnuts, 1 lockwasher, and 1 locking ring

Type 8C: 1 dressnut, 1 hexnut, and 1 locking ring



Type 8B



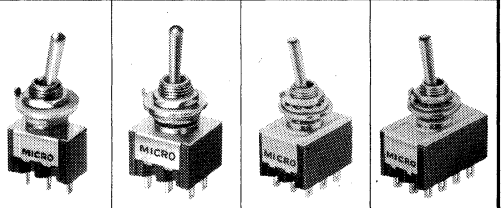
SERIES 8 MINIATURE MANUAL SWITCHES

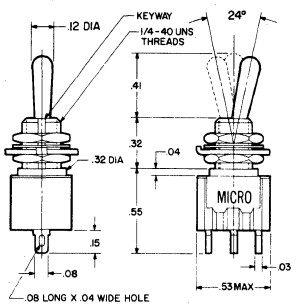
All Series 8A and 8B catalog listings shown are normally stocked. The Series 8C is not carried in stock and requires a minimum order of 1000 switches per listing. All these listings have fine silver contacts and terminals that can be used for manual solder or quick-connect wiring.

8A SMALL LEVER TOGGLE SWITCHES

Series 8A Small Lever Toggle Switches

- Small Lever
- 1/4" Dia. Bushing
- 1 to 4-Pole Double-Throw
- Colored Lever Sleeves





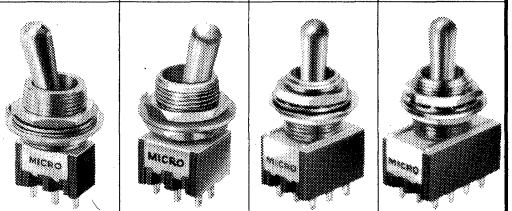
W = .33 1 pole
.55 2 poles
.73 3 poles
.93 4 poles
X = .55 1 + 2 poles
.64 3 + 4 poles

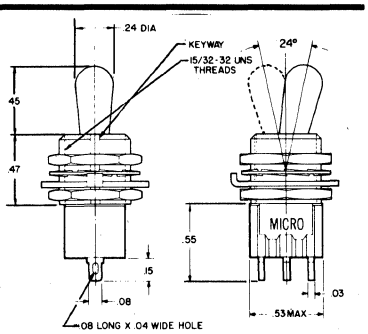
LEVER/CIRCUIT ACTION			1 POLE 8A1 SERIES	2 POLE 8A2 SERIES	3 POLE 8A3 SERIES	4 POLE 8A4 SERIES
OPPOSITE KEYWAY	CENTER	KEYWAY	CATALOG LISTINGS			
ON	NONE	ON	8A1011	8A2011	8A3011	8A4011
ON	OFF	ON	8A1021	8A2021	8A3021	8A4021
(ON)	OFF	(ON)	8A1041	8A2041	8A3041	8A4041
ON	OFF	(ON)	8A1051	8A2051	8A3051	8A4051
ON	NONE	(ON)	8A1061	8A2061	8A3061	8A4061

8B TOGGLE SWITCHES

Series 8B Toggle Switches

- Large Lever
- 15/32" Dia. Bushing
- 1 to 4 Pole Double-Throw





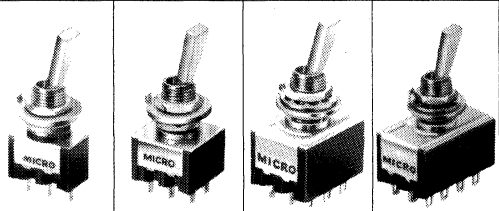
W = .33 1 pole
.53 2 poles
.73 3 poles
.93 4 poles
X = .55 1 + 2 poles
.60 3 + 4 poles

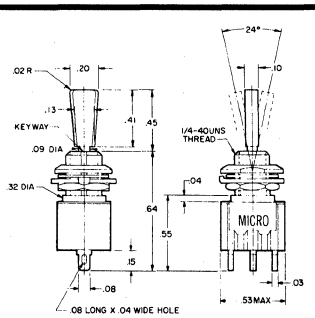
LEVER/CIRCUIT ACTION			1 POLE 8B1 SERIES	2 POLE 8B2 SERIES	3 POLE 8B3 SERIES	4 POLE 8B4 SERIES
OPPOSITE KEYWAY	CENTER	KEYWAY	CATALOG LISTINGS			
ON	NONE	ON	8B1011	8B2011	8B3011	8B4011
ON	OFF	ON	8B1021	8B2021	8B3021	8B4021
(ON)	OFF	(ON)	8B1041	8B2041	8B3041	8B4041
ON	OFF	(ON)	8B1051	8B2051	8B3051	8B4051
ON	NONE	(ON)	8B1061	8B2061	8B3061	8B4061

8C TOGGLE SWITCHES

Series 8C Toggle Switches

- Flatted Lever
- 1/4" Dia. Bushing
- 1 to 4 Pole Double-Throw





W = .33 1 pole
.53 2 poles
.73 3 poles
.93 4 poles
X = .55 1 + 2 poles
.64 3 + 4 poles

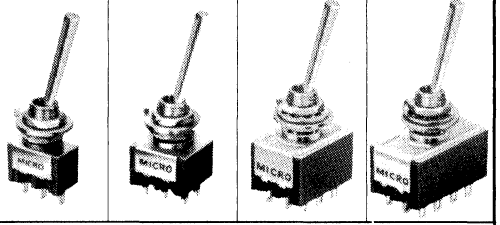
LEVER/CIRCUIT ACTION			1 POLE 8C1 SERIES	2 POLE 8C2 SERIES	3 POLE 8C3 SERIES	4 POLE 8C4 SERIES
OPPOSITE KEYWAY	CENTER	KEYWAY	CATALOG LISTINGS			
ON	NONE	ON	8C1011	8C2011	8C3011	8C4011
ON	OFF	ON	8C1021	8C2021	8C3021	8C4021
(ON)	OFF	(ON)	8C1041	8C2041	8C3041	8C4041
ON	OFF	(ON)	8C1051	8C2051	8C3051	8C4051
ON	NONE	(ON)	8C1061	8C2061	8C3061	8C4061

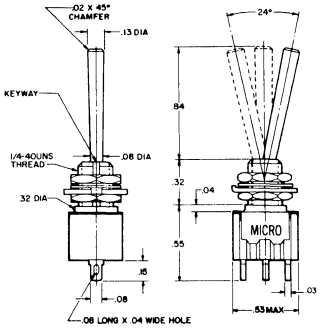
( ) Parenthesis denotes momentary position

MICRO SWITCH SERIES 8 MINIATURE MANUAL SWITCHES

Series 8D catalog listings are not carried in stock and require a minimum order or 1000 switches per listing. The 8E and 8H listings are normally stocked. All these listings have fine silver contacts and terminals that can be used for manual solder or quick-connect wiring.

Series 8D Long Lever Toggle Switches
- Long Lever
- 1/4" Dia. Bushing
- 1 to 4 Pole Double-Throw

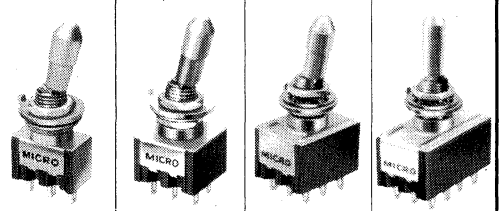


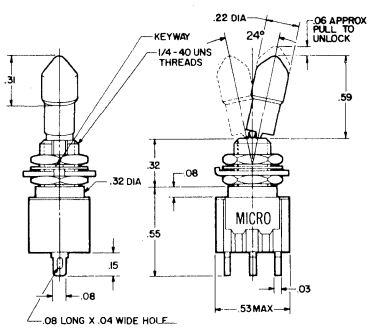


LEVER/CIRCUIT ACTION			1 POLE 8D1 SERIES	2 POLE 8D2 SERIES	3 POLE 8D3 SERIES	4 POLE 8D4 SERIES
OPPOSITE KEYWAY	CENTER	KEYWAY	CATALOG LISTINGS			
ON	NONE	ON	8D1011	8D2011	8D3011	8D4011
ON	OFF	ON	8D1021	8D2021	8D3021	8D4021
(ON)	OFF	(ON)	8D1041	8D2041	8D3041	8D4041
ON	OFF	(ON)	8D1051	8D2051	8D3051	8D4051
ON	NONE	(ON)	8D1061	8D2061	8D3061	8D4061

W = .33 1 pole
.53 2 pole
.73 3 pole
.93 4 pole
X = .55 1 + 2 pole
.64 3 + 4 pole

Series 8E Toggle Switches
- Pull-To-Unlock Levers
- 1/4" Dia. Bushing
- 1 to 4 Pole Double-Throw

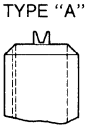




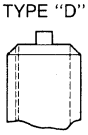
LEVER/CIRCUIT ACTION				1 POLE 8E1 SERIES	2 POLE 8E2 SERIES	3 POLE 8E3 SERIES	4 POLE 8E4 SERIES
OPPOSITE KEYWAY	CENTER	KEYWAY	LOCK LEVER TYPE	CATALOG LISTINGS			
ON	NONE	ON	"D"	8E1011	8E2011	8E3011	8E4011
ON	OFF	ON	"A"	8E1021	8E2021	8E3021	8E4021

Pull-to-Unlock levers are a guard against accidental lever movement. To change lever positions, a spring-loaded locking mechanism must be released by pulling outward on the knob lever.
Two-position switches have a type D locking configuration which locks the lever in either of the two extreme positions. Three-position switches have a type A configuration which locks the lever in any of the three positions.

TYPE "A"

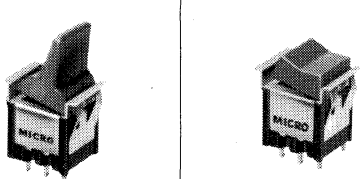


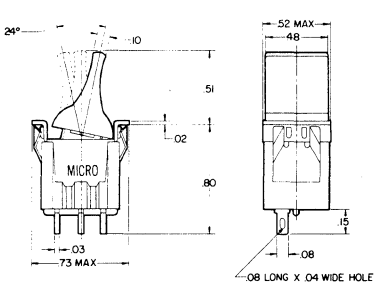
TYPE "D"



W = .33 1 pole
.53 2 pole
.73 3 pole
.93 4 pole
X = .58 1 + 2 pole
.68 3 + 4 pole

Series 8H Paddle and Rocker Operated Switches
- Colored Paddles and Rockers
- Snap-In Mount
- 1 or 2-Pole
- Colored Bezels





LEVER/CIRCUIT ACTION			1 POLE 8A1 SERIES	2 POLE 8A2 SERIES
ONE EXTREME	CENTER	OTHER EXTREME	CATALOG LISTINGS	
ON	NONE	ON	8H1011	8H2011
ON	OFF	ON	8H1021	8H2021
(ON)	OFF	(ON)	8H1041	8H2041
ON	NONE	(ON)	8H1061	8H2061

WITH PADDLE OPERATOR

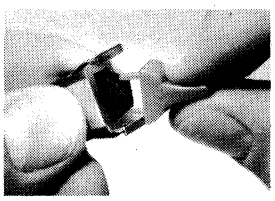
SERIES 8 MINIATURE MANUAL SWITCHES

8H (Cont'd)

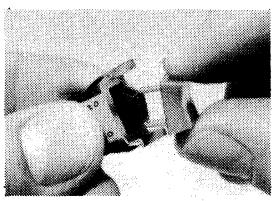
To simplify user parts inventories and provide versatility in operator options, 8H switches, paddles, and rockers are sold separately.

Switches snap into panels, held secure by spring clips on the mounting flanges. They can be mounted individually or in strips. Both 1 and 2-pole versions can be used with either paddle or rocker operators, which are available in eight attractive colors.

The photos below show how paddles and rockers are easily assembled to the switches by simply pressing them into place in the recesses of the switch operator socket. They are not intended to be easily removed.



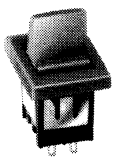
PADDLE BEING ASSEMBLED



ROCKER BEING ASSEMBLED

Bezel Accessory

An optional colored bezel accessory is available for use with individual mount units (see photo) to enhance panel appearance and identify control functions. The bezel is assembled by snapping it into the flanges on two sides of the switch. They can be removed and replaced if color changes are necessary.



WITH BEZEL

COLOR	OPERATOR* PADDLE	OPERATOR* ROCKER	BEZEL (OPTIONAL)
White	8Z0001	8Z0021	8Z0191
Red	8Z0002	8Z0022	8Z0192
Black	8Z0003	8Z0023	8Z0193
Gray	8Z0004	8Z0024	8Z0194
Green	8Z0005	8Z0025	8Z0195
Blue	8Z0006	8Z0026	8Z0196
Amber	8Z0007	8Z0027	8Z0197
Yellow	8Z0008	8Z0028	8Z0198

*Specify 1 and 2-pole 8H switch catalog listings from the ordering charts under the mounting dimension drawings.

LAMP INFORMATION

These are a number of type T-1 3/4 subminiature screw-base lamps which will fit the socket of 8K switches.

Lamps that are rated for 28 volts or less are recommended.

Lamps which are below .8 watt or above 1.5 watts should not be used in these devices. The former will be too dim for adequate illumination of the rockers and the latter will be too warm for the plastic or the finger's touch, especially if used with over-voltage.

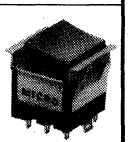
Lamps are not furnished with 8K switches. However, MICRO SWITCH will stock and sell limited quantities of the following types:

CATALOG LISTING	LAMP NO.	RATED VOLTAGE	NOMINAL CURRENT (AMPS)
8Z0101	378	6.3	.20
8Z0103	399	28.0	.040
8Z0102	362	14.0	.08

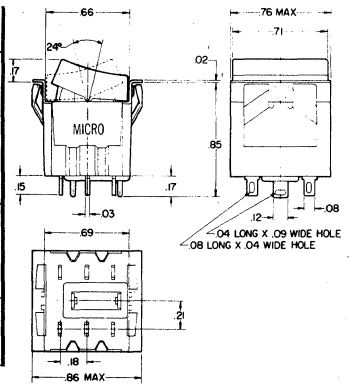
Users having lamp contracts may prefer to purchase large quantities by that means.
Order by catalog listing, rather than lamp number.

WITH ROCKER OPERATOR Series 8K Lighted Rocker Switches

- Colored Rockers
- Snap-In Mount
- 2 pole



2 POLE 8K2 SERIES			
OPERATOR/CIRCUIT ACTION			CATALOG LISTING
ONE EXTREME	CENTER	OTHER EXTREME	
ON	NONE	ON	8K2011
ON	OFF	ON	8K2021
ON	NONE	(ON)	8K2061



8K switches feature one-lamp illumination and relamping from the front of panel. They snap into the panel, held secure by spring clips on the mounting flanges. Switches can be mounted in an individual panel hole or mounted in a strip, in a common panel slot.

Rocker operators, available in eight colors, are ordered separately.

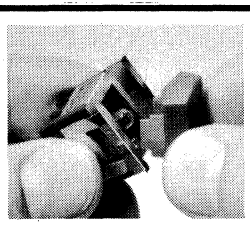
EASY TO RELAMP

Relamping of 8K switches is accomplished by (1) grasping the rocker and removing it with an outward pull and (2) extracting lamp by unscrewing or by pulling it out with a lamp tool. The lamp is installed by inserting it in the lamp socket.

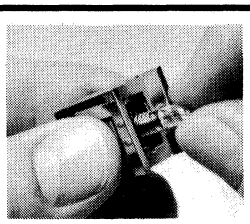
MICRO SWITCH lamp tool, catalog listing 15PA7, or a short length of plastic tubing (.220-inch I.D.) can also be used for lamp removal.

BEZEL ACCESSORY

An optional colored bezel accessory is available for use with individual mount units (see photo). It snaps into flanges on two sides of the switch. The bezel can be removed if color changes or relamping is necessary.



REMOVE ROCKER



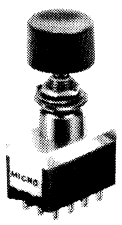
REPLACE LAMP

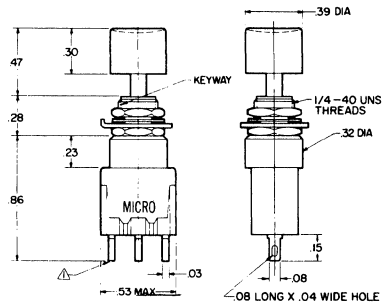
COLOR	ROCKER OPERATOR*
White	8Z0041
Red	8Z0042
Green	8Z0045
Blue	8Z0046
Amber	8Z0047
Yellow	8Z0048

*Specify 2-pole 8H switch catalog listings from the ordering charts under the mounting dimension drawings.

MICRO SWITCH SERIES 8 MINIATURE MANUAL SWITCHES

All 8N catalog listings shown are normally stocked. They have fine silver contacts and terminals that can be used for manual solder or quick-connect wiring.

	1 POLE 8N1 SERIES	2 POLE 8N2 SERIES	3 POLE 8N3 SERIES	4 POLE 8N4 SERIES
Series 8N Pushbutton Switches • Colored Buttons (2 Sizes) • 1/4" Dia. Bushing • 1 to 4 Pole				
ACTION	**CATALOG LISTINGS**			
ALTERNATE	8N1011	8N2011	8N3011	8N4011
MOMENTARY	8N1021	8N2021	8N3021	8N4021



W= .33 1 pole
.53 2 pole
.73 3 pole
.93 4 pole

X = .86 1+2 pole
.95 3+4 pole

8N switches are furnished with momentary (push-on, release-off) or alternate action (push-on, push-off). A double-headed arrow (↕) on the switch case identifies momentary switches, while a single-headed arrow identifies alternate-action types.

Buttons, available in two sizes and eight colors, are ordered separately. They press-fit to the switch plunger after the switch is mounted.

CONTACT ACTION

When the button is depressed, alternate-action 8N devices transfer the circuit between the center (common) terminal(s) and the terminal(s) on one side of the switch. When the button is released, the circuit is maintained. The next operation transfers the circuit to the terminal(s) on the other side of the switch.

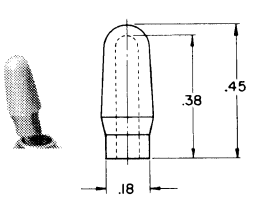
Momentary action switches have the normally closed terminal(s) located on the keyway side of the switch. When the button is depressed, the circuit transfers the circuit to the terminal(s) opposite the keyway Releasing the button transfers the circuit to the terminal(s) on the keyway side.

Order switches from the charts under the mounting dimension drawings and buttons from the chart below. Buttons are interchangeable.

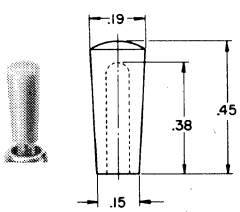
	DIMENSIONS	CATALOG LISTING	COLOR
LARGE BUTTON	.59" DIA. BY .39" HEIGHT	8Z0061	WHITE
		8Z0062	RED
		8Z0063	BLACK
		8Z0064	GRAY
		8Z0065	GREEN
		8Z0066	BLUE
		8Z0067	AMBER
		8Z0068	YELLOW
SMALL BUTTON	.39" DIA. BY.30" HEIGHT	8Z0081	WHITE
		8Z0082	RED
		8Z0083	BLACK
		8Z0084	GRAY
		8Z0085	GREEN
		8Z0086	BLUE
		8Z0087	AMBER
		8Z0088	YELLOW

COLORED LEVER SLEEVE ACCESSORY FOR 8A SMALL LEVER TOGGLE SWITCHES

ROUND TIP



CONE TIP



Plastic sleeves, available in two styles and nine colors can be easily slipped on 8A toggle switch levers and will fit firmly thereafter. They are ordered separately, in packets of 25 of each color and style combination.

These sleeves assist in identifying control functions and will be acceptable to most industrial design needs.

COLOR	CATALOG LISTING ROUND TIP	CONE TIP
White	8Z0111	8Z0151
Red	8Z0112	8Z0152
Black	8Z0113	8Z0153
Gray	8Z0114	8Z0154
Green	8Z0115	8Z0155
Blue	8Z0116	8Z0156
Amber	8Z0117	8Z0157
Yellow	8Z0118	8Z0158
Pink	8Z0119	8Z0159

Sold Only in 25 Piece Multiples

SERIES 8 MINIATURE MANUAL SWITCHES

ORDERING POLICY

Most of the Series 8 switches shown are available from stock.

At the present time, 8C Flatted Lever and 8D Long Lever Toggle Switches, plus the 1B, 1C, 2A, 2B, 2C and 3B terminal/contact variations (shown below), are not available from stock. These items are subject to a minimum ordering and shipping quantity of 1,000 pieces per catalog listing. However, limited quantities may be obtained for evaluation and/or prototype requirements, through your nearest MICRO SWITCH Branch Office.

ORDERING INFORMATION

For further technical data and assistance in specifying and entering your order for Series 8 switches, please contact your nearest MICRO SWITCH Branch Office or Authorized Distributor.

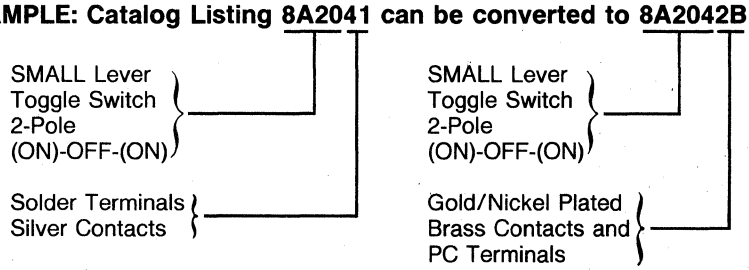
HOW TO ORDER TERMINAL/CONTACT VARIATIONS

CATALOGING SYSTEM

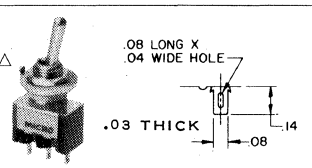
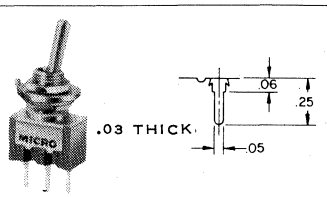
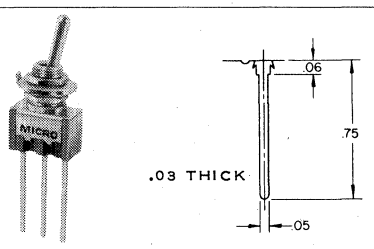
All switches shown have fine silver contacts and solder terminals. This is indicated by a number 1 at the end of the catalog listings, i.e., 8A1011, 8B3021, etc.

The terminal/contact code for other variations consists of **a number and a letter,** i.e., **1B, 2C, 3B,** etc. To specify these variations, substitute the appropriate codes (bold type) from the chart below.

EXAMPLE: Catalog Listing 8A2041 can be converted to 8A2042B



TERMINAL/CONTACT CODE CHART

		Type A Silver Contacts	Type B Gold/Nickel Plated Brass	Type C Gold/Nickel Plated Fine Silver
Type 1 Solder Terminal△		**1** Copper end terminals Brass center terminal. Silver terminal plating.	**1B** Brass contacts and terminals, plated with .0001" min. gold over .0002" min. nickel	**1C** Brass terminals and fine silver contacts, plated with .0001" min. gold over .0002" min. nickel.
Type 2 P.C. Terminals*		**2A** Brass terminals. Silver terminal plating.	**2B** Brass contacts and terminals, plated with .0001" min. gold over .0002" min. nickel	**2C** Brass terminal and fine silver contacts, plated with .0001" min. gold over .0002" min. nickel.
Type 3 Wire Wrap# Terminal			**3B** Brass contacts and terminals plated, with .0001" min. gold over .0002" min. nickel. Has epoxy terminal seals.	

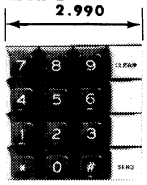
△ May also be used for quick-connect termination.
* May also be used for manual solder, wire wrap, or quick-connect termination.
\# May also be used for printed circuit termination.

PRODUCT MODIFICATION OPTIONS

If your application requires modifications of the Series 8 products shown, contact your nearest MICRO SWITCH Branch Office. Our experienced field engineers will work with you in developing the proper solution to your specific needs.

MICRO SWITCH

KEYBOARDS AND SOLID STATE PUSHBUTTON SWITCHES



NW Numeric Keyboards

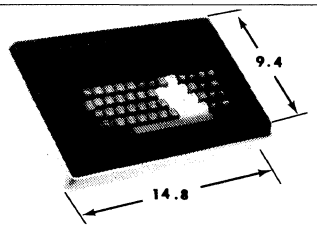
High Reliability And Long Life At Low Cost
Low Profile Design Conserves Space
Off-The-Shelf Availability
With Or Without Solid State Encoding

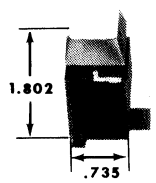
Request Product Brochure NW

SW Solid State Keyboards

MOS Or DTL Encoding
Solid State Keys For High Reliability
USASCII Code Assignment
Two Key Or "n" Key Rollover
Also available; 12 or 16 key numeric keyboards featuring solid state keys.

Request Keyboard Packet





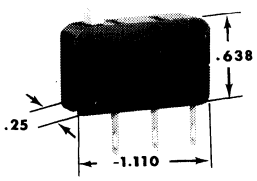
Solid State Pushbutton Switches

Direct Circuit Board Mounting
Lighted Or Unlighted Buttons
Momentary Or Alternate Action Modules
Wide Selection Of Button Colors And Legends

Request Product Brochure SN

TYPE SV LOW ENERGY MINIATURE BASIC SWITCH

Type SV is the first precision snap-action switch designed for low voltage and low power systems. It features a new rolling wave spring with gold contacts and unique multi-point gold stationary contacts for reliable interfacing with DTL, TTL, and MOS logic systems. Type SV enclosures have the same length, height and mounting hole locations as the popular MICRO SWITCH Series V3, but a thinner profile.



END PLUNGER
1SV1

CENTER PLUNGER
11SV1

ROLLER LEVER
301SV2

FEATURES

- **THIN PROFILE— .25" WIDE**
- **LOW OPERATING FORCE**
- **LOW AND STABLE RESISTANCE**
- **HIGH RETURN FORCE**
- **RELIABILITY—MULTI-POINT CONTACTS**
- **INTEGRAL LEVER ACTUATORS**

ELECTRICAL DATA: Contact Arrangement—Single-Pole Double-Throw Form C

ELECTRICAL RATINGS

VDC RATINGS		VAC RATINGS	
15 Watts Max—Resistive only Max Voltage: 250 VDC Max Current: 750 Milliamps		12VA Max—Inrush or Resistive Max Voltage: 250 VAC Max Current: 500 Milliamps	
VDC	Max Current In Milliamps	VAC 60 Hz	Max Current In Milliamps
.5-11	750	.5-11	500
11-30	500	11-30	250
30-125	80	30-125	100
125-250	40	125-250	50

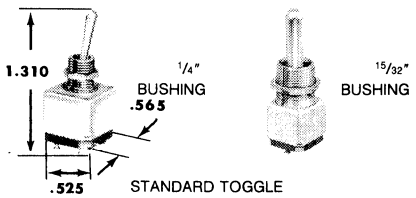
TYPICAL CATALOG LISTINGS

301SV3—Short integral lever
301SV4—Long integral lever
301SV2—Roller lever
301SV5—Long wire lever

Request Product Sheet SV

SERIES TW TOGGLE SWITCHES

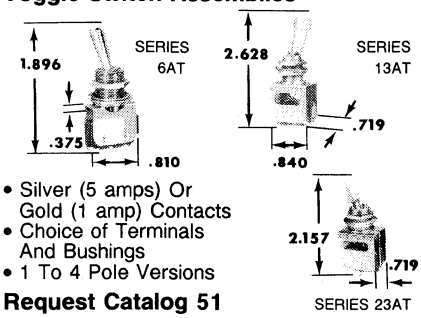
Small 2 & position, light weight toggle switches that meet MIL-S-3950 requirements. Plated, molded-in terminals, choice of SPDT or DPDT circuitry and two bushing sizes. Special "ON-ON-ON" circuitries and pull-to-unlock options available. 5 amps resistive at 115 vac.



TYPICAL CATALOG LISTINGS

1TW1-3—1/4" diameter bushing, 1-pole, ON-ON circuitry
12TW1-1—15/32" diameter bushing, 2-pole, ON-OFF-ON circuitry
12TW1-1A—Same as 12TW1-1, but with lever lock in all three positions.

Other MICRO SWITCH Toggle Switch Assemblies



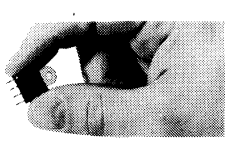
- Silver (5 amps) Or Gold (1 amp) Contacts
- Choice of Terminals And Bushings
- 1 To 4 Pole Versions

Request Catalog 51

SERIES SS MAGNETICALLY OPERATED SOLID STATE SWITCHES

Series SS switches provide a digital output that can be used directly with most electronic circuits: discrete transistor circuits, integrated logic circuits, or SCR's. They have no moving parts and can be operated indefinitely at very high speeds; there is no physical contact between the switch and its operating magnet. The bounce free output signal is 3 volts at 10 milliamps eliminating the need for amplifiers in most applications.

1SS1



TYPICAL CATALOG LISTINGS

1SS1—Solid state switch without magnetic flux concentrator
1SS2, 1SS3 & 1SS4—These listings include magnetic flux concentrators of various sizes

Request Product Sheet SS Packet

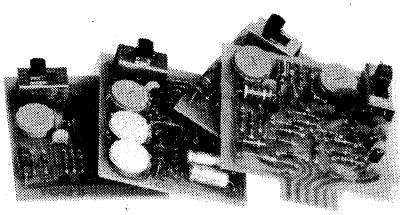
MICRO SWITCH

NO-TOUCH CONTROLS

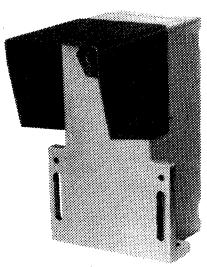
No-touch controls fill an industrial switching need unanswered by electro-mechanical switches. Both photoelectric and proximity no-touch controls do not mar or move objects in their path, are practically wear-proof, there is no operating force to vary, and they are characterized by high speed response.

PHOTOELECTRIC SWITCHES

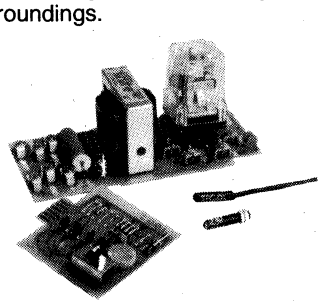
Photoelectric controls generally include a separate light source, photoelectric receiver, amplifier and an output source, yet all these components may also be combined into one compact package. Complete offerings are described in Catalog NTC.



A choice of 21 LOG plug-in cards will perform many functions, including ON/OFF control, electronic latch-in, OFF delay, ON delay, stop-motion control and "one-shot" output.



MLS1 is a retroreflective unit with a light source that produces an invisible infrared modulated light beam which permits use in sunlight and other high ambient surroundings.

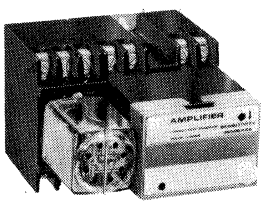


This group includes a control base with an output relay, a plug-in LOG function card, a tubular TLS light source and a TPC photocell receiver (the smallest on-line components available).

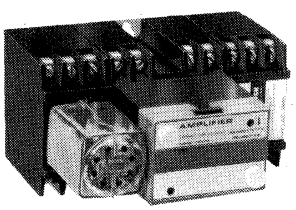
PROXIMITY SWITCHES

Type FM proximity switches offer unusual flexibility and versatility. These units use sealed sensors that detect all metals and/or metal-clad sealed sensors that detect only ferromagnetic materials. The modular construction with interchangeable components is offered as a complete factory assembled switching system or as a group of components from which the user may build his own system.

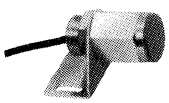
Features include: separate, changeable, plug-in circuit cards for amplifier, power supply and function circuits. The circuit cards fit securely into firm grip connection sockets and slide in and out quickly for testing or exchange. The wide selection of function circuit cards include logic cards, time delay cards, and counting functions. Request Catalog 50.



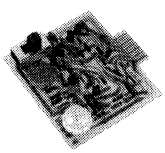
housing with relay module attachment



housing with relay and counter drive attachments



sensor



amplifier circuit card

typical listings:

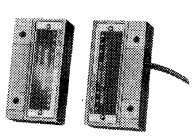
FMA11101-AV: General purpose all metals, 105-130 vac input, 50/60 Hz, relay output, response (operate-20 ms, release-15 ms), use with one sealed sensor.

FMA112T704-VA: All-metals On & Off delay, 105-130 vac, 50/60 Hz relay output, response (.06 to 0.7 sec.), use with one sensor.

FMF111L550-VA: Ferromagnetic "AND" logic, 105-130 vac, 50/60 Hz, relay output, response (operate-20 ms, release-15 ms), use with two sensors.

FMF112K105-VC: Ferromagnetic can counter, 105-130 vac, 50/60 Hz, pulse output, response (operate-3 ms, release-1 ms), use with one sensor.

type FR



External magnetic actuated switches have a basic internal reed switch. These units can be used in many demanding environments. The identical size magnet and reed switch packages offer long life and operating flexibility. Request Catalog 50.

typical listings:

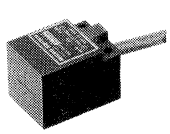
20FR1-6B: Switch with 6 foot wire leads for light loads—milliampere range.

20FR3-25B: Switch with 25 foot wire leads for heavy loads—ampere range.

20FR4-50B: Switch with 50 foot heavy duty cable for heavy duty loads—ampere range.

21FR1-B: Magnet for use with the above reed switches.

type 10FL



The low cost 10FL series self-contained proximity switches are compact, have solid state circuitry, are completely epoxy sealed, and are all-metals sensitive. Speed of operation is to 2,000 cycles per second. Listings 10FL5004 (12 VDC and 10FL5005 (24 VDC) have three color-coded leadwires in a vinyl jacket. Request Catalog 50.

MICRO SWITCH

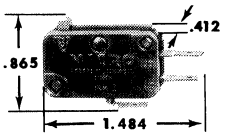
TYPE V3 SMALL BASIC SWITCHES

V3 switches have the same length, height, and mounting hole dimensions as the SV low energy basic switch. Their size and shape meet design requirements for all types of applications. They feature high electrical capacity and long life. Auxiliary and integral actuators are available. Terminals styles include screw, solder, and quick connect.

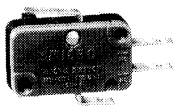
FEATURES

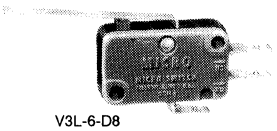
- POWER LOAD SWITCHING CAPABILITY UP TO 15 AMPERES
- GOLD ALLOY CONTACTS FOR SPECIAL APPLICATIONS
- LONG MECHANICAL LIFE OF 10,000,000 CYCLES
- HIGH TEMPERATURE CONSTRUCTION FOR USE UP TO +600°F

Request Catalog 50



V3-101-D8
STANDARD
PLUNGER


V3L-101-D8
SHORT INTEGRAL LEVER


V3L-6-D8
LONG STRAIGHT
INTEGRAL LEVER

V3L-139-D8
SHORT INTEGRAL
ROLLER LEVER

V3L-111-D8
LONG INTEGRAL
ROLLER LEVER

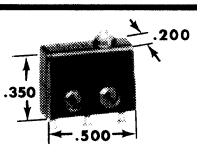
SUBMINIATURE BASIC SWITCHES

FEATURES

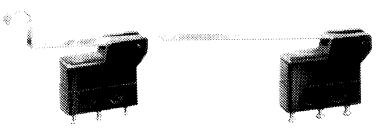
- LOW OPERATING FORCE
- LONG MECHANICAL LIFE OF 10,000,000 CYCLES
- VARIETY OF INTEGRAL AND AUXILIARY ACTUATORS
- BIFURCATED GOLD CONTACTS FOR BEST RELIABILITY
- SENSITIVE DIFFERENTIAL TRAVEL OF .001" MAXIMUM
- TEMPERATURE TOLERANCE UP TO 180°F
- CHOICE OF SEVERAL TERMINAL STYLES
- UL AND CSA LISTED

TYPE 1SX

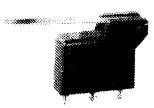
The 1SX series of basic switches is ideal where savings in space and weight are most important. These tiny devices have up to 7 amps capacity.

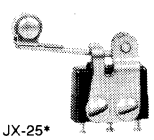


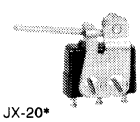
11SX21-T
STANDARD PLUNGER


311SX5-T
INTEGRAL SIMULATED
ROLLER LEVER

311SX3-T
INTEGRAL LONG
STRAIGHT LEVER


311SX2-T
INTEGRAL STRAIGHT
LEVER


JX-25*
AUXILIARY
ROLLER LEVER


JX-20*
AUXILIARY
STRAIGHT LEVER

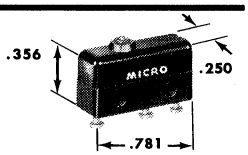
JX-40*
AUXILIARY
STRAIGHT LEAF

* Switch ordered as separate item.

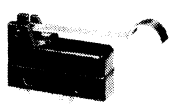
Request Catalog 50

TYPE SM

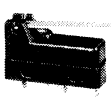
Slightly larger than the type 1SX switches, SM switches combine small size and light weight with ample 10 amp electrical capacity, precision operation and long life.



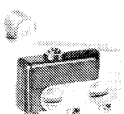
11SM1-T
STANDARD PLUNGER


311SM5-T
.535" LONG SIMULATED
ROLLER LEVER

111SM2-T
FLEXIBLE LEAF
WITH ROLLER


311SM3-T
1.765" LONG STRAIGHT
LEVER, LOWER FORCE

JS-33*
TANDEM
LEAF


JS-5*
ROLLER LEAF
(BRONZE ROLLER)

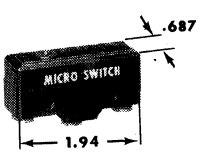
JS-31*
TANDEM ROLLER LEAF
(BRONZE ROLLER)

* Switch ordered as separate item.

Request Catalog 50

STANDARD BASIC SWITCHES

Standard basic switches come in a wide variety of electrical capacities, terminations, actuators, and SPDT or DPDT. Changes in materials and switch design provide operating characteristics, temperature tolerances, and sealing to cover many requirements. Typical listings shown are the Z type which meet most application needs.



PIN PLUNGER
BZ-2R-A2

ROLLER LEVER
BZ-2RW82-A2

STRAIGHT LEVER
BZ-2RW80-A2

FORMED LEVER
BZ-2RW80196-A2

PANEL MOUNT
ROLLER PLUNGER
BZ-2RO181-A2

MICRO SWITCH products are available off-the-shelf at our Authorized Distributors coast to coast. For pricing and discount information or helpful assistance check with our nearest Distributor or Branch Office. Both are listed in the Yellow Pages, under "Switches, Electric."

MICRO SWITCH

FREEPORT, ILLINOIS 61032

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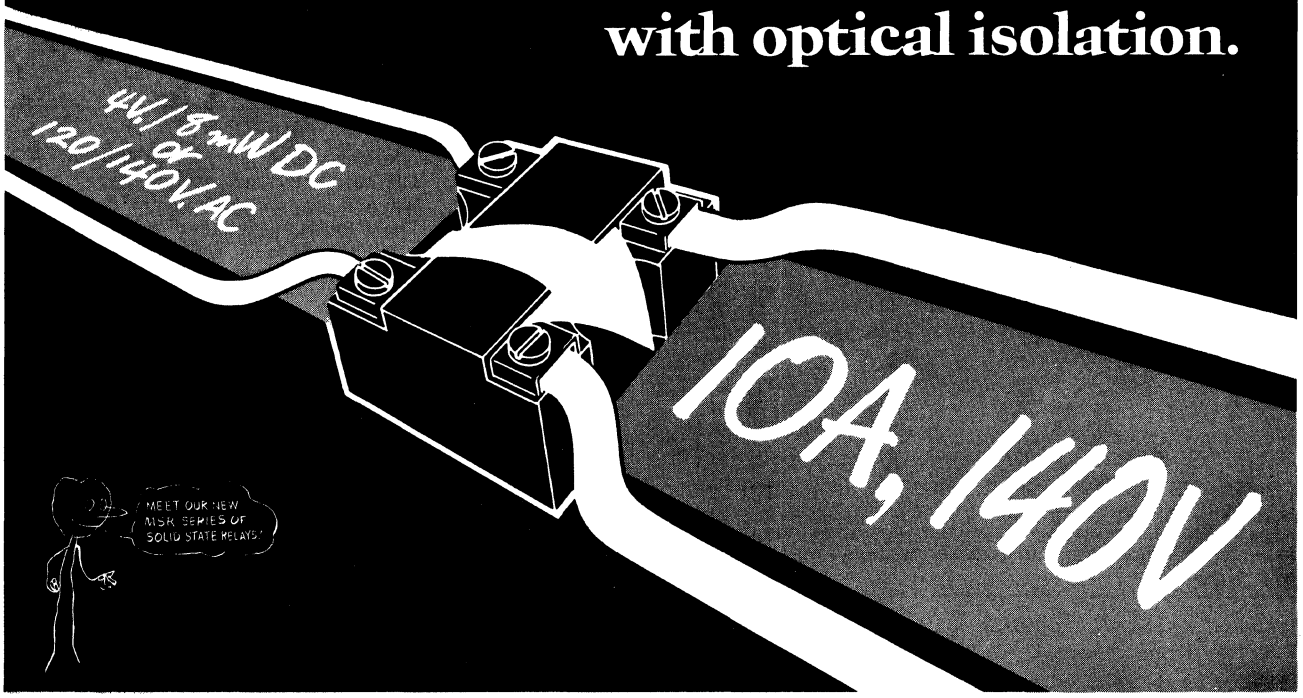
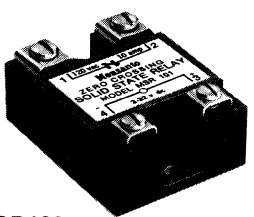
Switch 1400 watts with optical isolation.



These solid state switches offer normally-open or normally-closed contacts that are compatible with TTL, DTL, or MOS inputs (8mW at 4 volts). That's for DC. For AC applications, they'll handle 120 or 240 VAC input. The output of either variety switches 140 volts AC at 10 amps.

There are many more features: **zero voltage turn-on; zero current turn-off;** they eliminate electrical noise from arcing contacts, transients from contact bounce, high voltage transients with inductive loads, and derating because of inductive or lamp loads.



MSR100
DC input, N.O. contacts

MSR101
DC input, N.C. contacts

MSR102
AC input, N.O. contacts

MSR103
AC input, N.C. contacts

They also have high noise immunity; they're protected from false actuation; they don't need electromagnetic shielding, coil-suppression diodes, transistor buffers or magnets.

And they're small (2¼″ x 1¾″ x 1⅞″), 4 ounces, with rugged screw terminals and a wide operating range. Ask for our new data sheet on the MSR Series of solid state relays from **Monsanto Commercial Products Co.,** Electronic Special Products, 10131 Bubb Road, Cupertino, California 95014. Phone (408) 257-2140.

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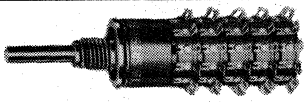
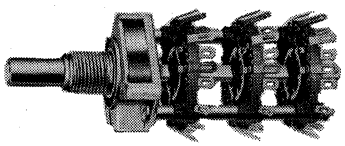
Monsanto



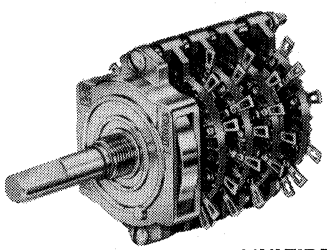
SUBMINIATURE ½" SWITCH

...also provides superior insulation and dimensional stability—even under severe environments, where small size is essential.



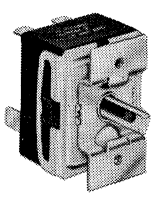
AND THE 1" ACORN SWITCH

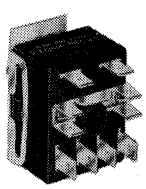
...an engineered combination of molded diallyl phthalate stators and Oak's exclusive Unidex™ indexing.



MULTIDEX® ROTARIES

... these universal rotary switches will put a lot of the older and bigger ones out of business. They're smaller, more economical and still offer all of the features and options of expensive custom-made OEM switches. What's more, they cut engineering design expenses.



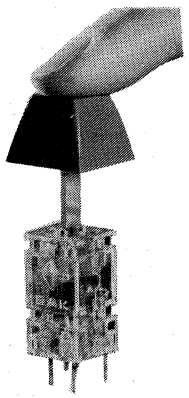


HEAVY-DUTY SWITCHES

...U.L. approved. For appliances, air conditioners, ranges, medical and lab equipment, ovens, etc. Three-wire or two, up to 38 amps., 240 volts and 250°F. Many positions, SP or DP.

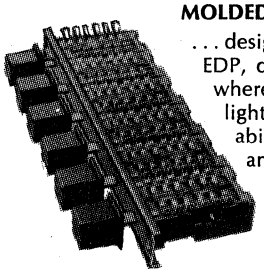
KEYBOARD SWITCHES FOR PRINTED-CIRCUIT BOARDS

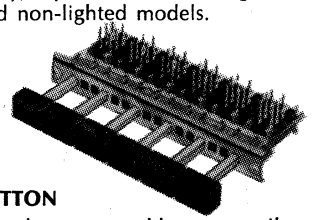
Enjoy the inherent reliability of Oak electro-mechanical operation plus the cost-savings of a switch that sells for less than 30¢ each in quantity. CHOOSE: **SPST—N.O. • SPST—N.O. + Dummy • SPST—N.C. • SPST—N.C. + Dummy • SPST—N.O. + SPST—N.C. • DPST—N.O. • DPST—N.C.** (Equivalent to SPDT)



MOLDED PUSHBUTTONS

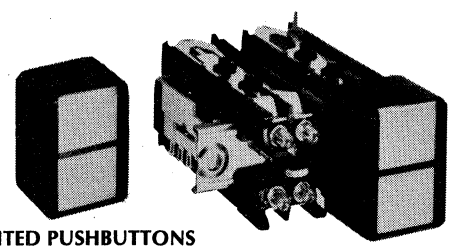
...designed especially for peripheral EDP, data entry and instrumentation, where fast response, short stroke and light touch are required. High reliability, optional actions. Lighted and non-lighted models.





ECONO-LINE™ PUSHBUTTON

One of the most versatile, low-cost pushbuttons available anywhere. More switching and more contacts in less space... direct panel mounting... rugged "U" shaped frame provides extra switching capability.



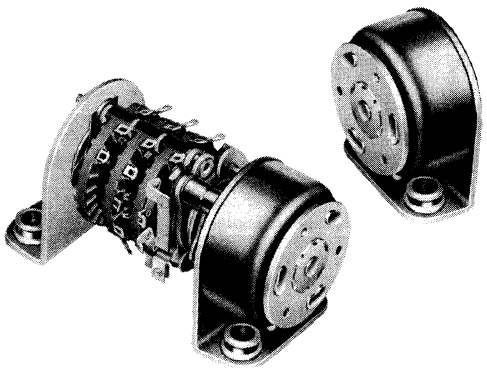
LIGHTED PUSHBUTTONS

Save 75¢ to $3.75 per button with Oak Series 300 switches. Features include front re-lamping, snap-on lamp circuiting. Up to 12 units per module. Choice of seven lens colors, split legends, lamping (including redundant types). Switch actions to order.

Oak Engineered Custom OEM Switches

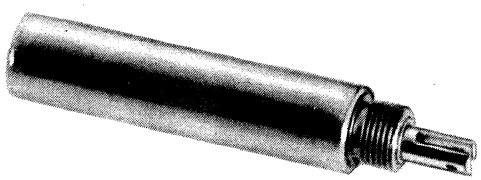
Oak offers you the broadest line of custom OEM switches available . . . engineered to give you the best switch that can be assembled to meet your design problems. Here are the customized variables—tailored to your needs: Insulations include phenolic, silicone-glass, ceramic, Mycalex, Kel-F and diallyl phthalate. Temperature ranges from Standard Commercial (−25° to +85°C.) to Military (−65° to +85°C.) Contacts are Oak-pioneered double-wiping to provide self-cleaning, long life. Five choices fit each application best, shorting and non-shorting, rated from 10,000 to 200,000 cycles. Finishes are Standard Commercial, 50- or 200-hour salt spray. Electrically, these switches break 1 amp. @ 28 vdc or 0.5 amp. @ 110 vac.

OAK HAS MORE SWITCHES THAT MEET MIL-S-3786 (latest issue)



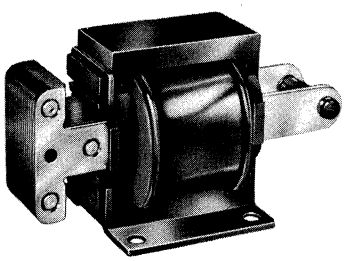
ROTARY SOLENOIDS & STEPPING SWITCHES

Four basic sizes from 1.125 to 2.250 inches diameter. Wide choice of stroke angles. Torque from 0.1 to 31 pound inches. Rotary solenoids available for 50,000,000 operations. Stepping switches offer choice of ganged sections, switching positions, contact materials. Designed for commercial, industrial and military.



TUBULAR SOLENOIDS

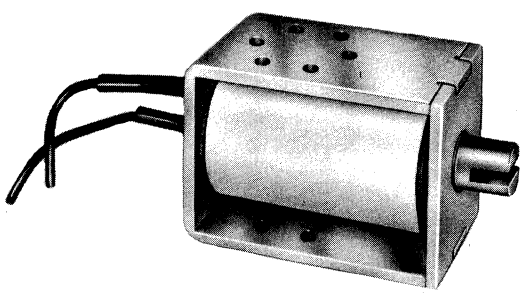
Powerful linear motion in the smallest possible package. Nine basic sizes offer thrust strengths ranging from ⅜ oz. to 12 lbs. with strokes up to 1½ inches. Smallest unit is only 7/16" x 1⅛" long. All Oak tubular solenoids have a life expectancy of 10 million cycles at rated load. Stocked in 6, 12, 24 or 110 VDC.



LAMINATED FRAME SOLENOIDS

Two basic sizes: 2 1/16" x 1 15/16" x 3½" and 2⅜" x 1 15/16" x 3½". Stocked in six AC voltage ratings.

Forces to 20 lbs. Stroke lengths to 1 inch.



SOLID FRAME SOLENOIDS

Five sizes from 1 x 7/32" x 1¼" to 1 9/16" x 1 27/32" x 2⅝". Forces to 300 oz. Stocked in five DC voltage ratings, six AC voltage ratings. Stroke lengths to ⅞".

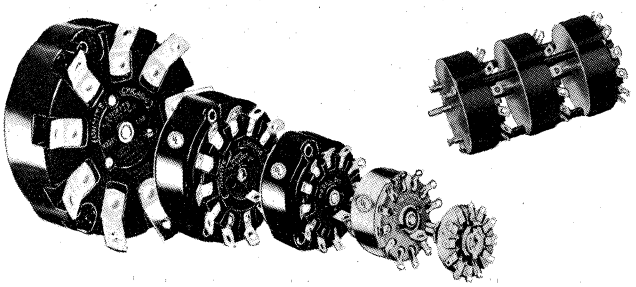
Oak-Designed Solenoids and Stepping Switches

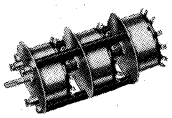
Take your pick from this broad-ranging selection of compact, fast response solenoids. Each type—rotary, tubular, and solid-frame—is backed by Oak's extensive solenoid manufacturing experience. Oak solenoids are ideal for rugged, reliable remote control of a wide variety of product applications.

Remember, Oak distributors stock the broadest available line of solenoids, pushbutton, keyboard and slide switches. Prompt delivery assured. Write for a complete catalog on the switch of your choice. Then get what you want in a hurry from your Oak distributor.

OAK Industries Inc.
SWITCH DIVISION/CRYSTAL LAKE, ILLINOIS 60014
TELEPHONE: 815 • 459 • 5000 ■ TWX: 910 • 634 • 3353 ■ TELEX: 72 • 2447

OHMITE® power tap switches, high current, non-shorting type

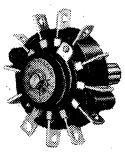




INTRODUCING

MODEL 711

Smallest Switch for Its Rating
7 Amps, 125 Volts



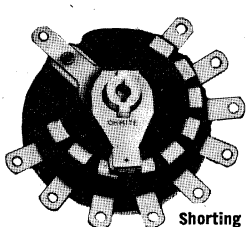
All Ohmite switches feature the slow-break, quick-make action deemed so desirable for switching of AC current.

All models except 711 feature all ceramic, arc-proof bodies and solid silver alloy, fixed and movable contacts. The large, thick, silver-alloy fixed contact disks are permanently welded to copper studs. These, in turn, are riveted and soldered to sturdy terminal lugs, assuring a permanent mechanical and electrical joint. The rotor (moving) contact, also of solid silver-alloy, is riveted and soldered to the contact arm. Face of the rotor contact is slightly rounded assuring a perfect seating of the contacts with a slight rubbing, self-cleaning motion on every operation. Models 111, 212, 312 and 412 are UL listed.

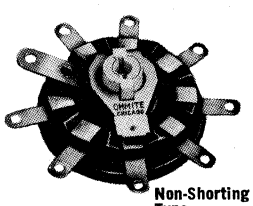
The new Model 711 tap switch was designed to achieve high current capability with small size. It is actually smaller than many low current instrument switches. It interrupts 7 amperes at 125 VAC and can carry 15 amperes AC or DC. The Model 711 features a melamine phenolic body with solid silver-alloy fixed and movable contacts.

Model	Alternate Current Rating		Diameter	Shaft Diameter	Max. Panel Thickness	Weight	No. of Taps
	Amps.	Volts					
711	7	125	1⅛″	¼″	⅛″	.047 lb.	3-11
111	15	125	1¾″	¼″	¼″	.16 lb.	3-11
212	20	150	2¼″	¼″	¼″	.4 lb.	3-12
312	30	300	3 5/16″	¼″	¼″	.75 lb.	3-12
412	50	300	4 3/16″	¼″	¼″	1.4 lb.	3-12
608	100	300	6″	⅜″	1″	5 lb.	3-8

ALL CERAMIC OPEN TYPE TAP SWITCHES



Shorting Type



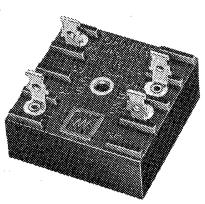
Non-Shorting Type

Designed to transfer currents of several amperes in circuits requiring high voltage insulation. Ceramic body construction. Monel metal taps; silver-graphite brush.

Switches up to 8 taps are approximately 3¼″ diameter including lugs; 9 to 12 tap switches are approximately 4¼″ diameter. Switches can be ordered assembled 2 to 3 in tandem. Single hole mounting by means of ⅜″ diameter bushing and hexagon nut accommodates panels up to ¼″ thick (maximum).

Maximum current capacity is 7 amperes but only 3 amperes at 120 V.A.C. should be interrupted. Current ratings are less for all direct current circuits above 20 volts, for inductive circuits and high voltages.

OHMITE® solid state switches



MODEL SSS

Load Volts	Maximum Load Current		Minimum Load Ratings	Terminal Style	Switching
	Mounted	Free Air			
120 VAC or 240 VAC	2 A. 5 A. 10 A. 15 A. 25 A. 40 A.	2 A. 3.5 A. 4.5 A. 5 A. 8 A. 12 A.	40 mA.	Solder/Faston, P.C. Pins, Octal Socket. Octal Socket w/Heat Sink, or High Current	Any external contact closure capable of carrying 50 mA. current and insulated to withstand the line voltage being used.

NO MOVING PARTS MEAN:

- **EXTREMELY LONG LIFE**
- **HIGH RELIABILITY**
- **NO ARCING**
- **NO NOISE**

PLUS HIGH CURRENT CAPABILITY IN A SMALL PACKAGE

FOR STOCK ITEMS, CALL LOCAL REPRESENTATIVE LISTED IN INDEX

OTTO CONTROLS

OTTO CONTROLS

OTTO snap-action switches MAKE & BREAK everytime

because the OTTO design features inherent rocking-action that breaks welds and wipes contacts clean.

PUSHBUTTONS* miniature & moistureproof

TYPE P1 (MIL-S-8805/3)

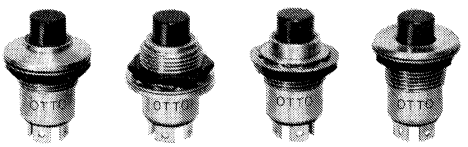
P1-1 P1-2 P1-3 P1-5 P1-6 P1-7 P1-8

FEATURES

- 250,000 mech. cycles.
- High contact pressure: 120 gr.
- Low contact resist: <10 milliohms.
- Repeatable trip point within .001".
- Rolling sleeve principle seals button.
- Sealed case and terminals.

Pushbutton is sealed by silicone rubber boot operating on a "rolling sleeve" principle to give long life and smooth operation. Case & terminals sealed against environment and solder flux. Load ratings: 10 A. res., 5 A. ind., 3A. lamp. Contact forms: N.O., N.C., 2-circuit. Red or black button.

TYPE P3 Commercial Grade



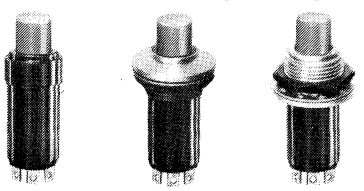
P3-3 P3-6 P3-7 P3-8

Momentary or push-pull double-break action. Same specs as P1 military series. Choice of solder or screw terminals. Designed for use in panel boards, computers, business machines, instruments. Can be used as limit switch.

twostep™ for applications requiring 3 modes of operation

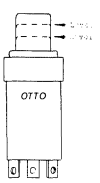
FEATURES

- Unique 2-position design.
- Sequential contact action.
- 12 contact arrangements.
- Make- before-break contact option.
- Moistureproof construction.
- 100,000 mechanical cycles.



P2-1 P2-3 P2-6

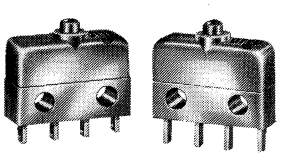
Ideal for "off-high-low", "off-slow-fast", "Stop-fine-course" applications. Each level operates an independent set of SPDT circuits rated to 5 A. Twelve contact arrangements are offered to satisfy just about any circuit requirement. Also available as DPDT single detent.



BASICS* unique patented design assures extraordinary long life less than 10 milliohms contact resistance

SUB-SUBMINIATURE

TYPE B3 for low level circuits



MIL-S-8805/76 MIL-S-8805/101

CHARACTERISTICS

- Contact Resistance: .010Ω max.
- 10 million mech. cycles.
- 100,000 cycles at full load.
- Operating Force: 5^{+3}_{-2} oz.
- Release Force: 1.5 oz. min.
- Pretravel: .035" max.
- Overtravel: .006" min.
- Move. Diff.: .015 ±.005 in.
- Temp. Range: −65° to +125°C.
- Size: .200" or .156" wide x .350" h. x .510" lg.

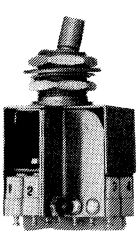
MIL-S-8805/76 THIN B3-4140

For your run-of-the- "MIL" projects, OTTO's B3-4140 series is only .200" thick. Contact resistance less than 10 milliohms, contact pressure higher than normal, minimal contact bounce. Gold flashed contacts, solder terminals in diallyl case. Rated 4A Res. SPDT; 8A. Res., SPDT-DB.

MIL-S-8805/101 THINNER B3-1140

Brand new, OTTO inspired military spec. Only .156" thin, yet all the rating, life, and reliability of the /76 version. You can get five B3-1140 series in the space of four B3-4140 with room to spare. Your choice of double-break form X, Y, Z and single break form C. B3-1140 turret terminals, B3-2140 solder terminals. Also commercial versions.

TOGGLE/PUSHBUTTON ACTUATORS



T1-0001. Four position, 6-pole toggle featuring MIL-S-8805/4 basic switches. Positions #1 & #3 are 2PDT maintained action each, position #4 is 2PDT momentary, position #2 is center "off". Rated 7A. res. each pole. **T1-0004.** Same except 3-position, 4-pole toggle. Position #1 is 2PDT momentary, position #2 is center "off", position #3 is 2PDT maintained action. **T1-0005.** Same as T1-0001 except all four positions are maintained action.

T2-0001. Combo toggle & pushbutton. It's a 2-position toggle and a pushbutton switch all in one. 30° toggle throw, .135" total pushbutton travel with 4.5 lbs. operating force. Rated 10A res. & ind.

T4-0001. Four-way toggle with 4-pole N.O. double-break momentary action. Rated 5A. res. Dims.: 1.156 dia. X 1.160 behind panel.

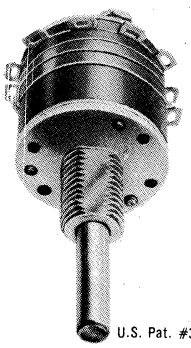
*U.S. Pat. No. 3,612,793.

OTTO CONTROLS Division, OTTO engineering, Inc.
36 Main St., Carpentersville, Illinois 60110 Phone: 312/428-7171

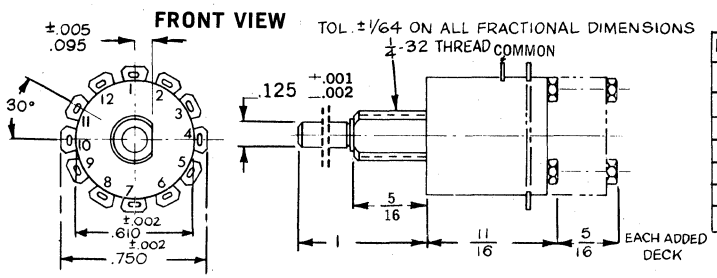
RCL **ELECTRONICS, INC.**
General Sales Office:
700 South 21st Street, Irvington, N. J. 07111 (Area Code 201) 374-3311 • TWX 710-999-5511

series "c" miniature rotary switches

- Up to 12 active positions per deck shorting **or** non-shorting, with 30° spacing.
- Shorting **AND** non-shorting poles may be grouped on one deck in any combination.
- As many as 6 poles per deck.
- All individual deck parts are self-contained, and are permanently molded into place.
- Available with adjustable stops.



U.S. Pat. #3352979



POLE (Common) LOCATION	
POLES	AT TERM. #
1	1
2	1, 7
3	1, 5, 9
4	1, 4, 7, 10
5	1, 3, 5, 7, 9
6	1, 3, 5, 7, 9, 11

"OFF-THE-SHELF DELIVERY"

SERIES "CC" (LOW COST COMMERCIAL VERSION OF SERIES "C")

All specifications and features remain essentially the same as in the Series "C" switch. Electrical specifications are derated by approximately 40%.

Materials and tooling are modified to reduce cost.

Priced at $1.96 each in quantities of 1,000.

Priced at the same level as open frame or wafer switches. Off-the-shelf delivery.

For ordering information see below, but indicate CC. (For example: 11-CCM-2).

ELECTRICAL FEATURES

1. Initial contact resistance — .010Ω max.
2. Current carrying capacity — 5.5 amps.
3. Current breaking capacities
   ¼ amp — 115 V.A.C. resistive
   ¼ amp — 28 V.D.C. resistive
   ⅛ amp — 28 V.D.C. inductive.
4. Dielectric strength (voltage breakdown) —
   a. between any two adjacent positions — 800 v RMs (60 cycles).
   b. between any active position to ground 1500 V (60 cycles).
5. Insulation resistance (measured at 25°C, 50% RH at sea level) — 10^5 megohms.
6. Thermal EMF — 1 microvolt/°C maximum.
7. Capacitance — between adjacent active contacts .5 PFD Max.
8. Capacitance — between contact and common terminal .9 PFD Max.

MECHANICAL FEATURES

1. Life expectancy — in excess of 50,000 mechanical operations.
2. Detent — stainless steel roller-type detent snaps from position to position. Detent housing made of special high-strength plastic, providing positive action and minimal wear.
3. Stop strength — Designed to withstand 10 pounds-inches of torque.
4. "Molded in" terminals give exceptional terminal strength, completely eliminating movement.
5. Terminal locations clearly marked on rear cover plate.
6. On any one deck of a multi-pole switch, a variety of combinations of shorting (MBB) and non-shorting (BBM) actions may be obtained.
7. Materials and finishes:
   Rotor — Lexan
   Rotor blade — Beryllium copper (silver plated)
   Contacts & solder terminals — solid silver alloy
   Housing — Diallyl Phthalate
   Stator — Diallyl Phthalate
   Shaft — stainless steel
   All brass parts nickel plated
8. One piece contact terminal construction has holes large enough to accept two #22 AWG wires.
9. Shaft and panel seal at additional cost may be specified by using prefix "S" before switch type numbers. Bushing and shaft stick-out from mounting surface is reduced by 1/16". Overall length of switch from mounting surface is increased by 1/16".
10. Explosion proof per paragraph 4, p. 12 of MIL-S-3786.

ENGINEERING NOTE
Series "A" available with above specifications but with "wrap-around" turret-type solder lugs. "Across-terminal" dimension is .820 (±.002).

SINGLE DECK

Spacing: 30° between positions

SHORTING

SINGLE POLE

Positions	Type
2	11-CM-2
3	11-CM-3
4	11-CM-4
5	11-CM-5
6	11-CM-6
7	11-CM-7
8	11-CM-8
9	11-CM-9
10	11-CM-10
11	11-CM-11
12	11-CM-12 (with stops)
12	11-CM-12-CR (continuous rotation)

2 POLES PER DECK

Positions	Type
2	12-CM-2
3	12-CM-3
4	12-CM-4
5	12-CM-5
6	12-CM-6

3 POLES

Positions	Type
2	13-CM-2
3	13-CM-3
4	13-CM-4

4 POLES

Positions	Type
2	14-CM-2
3	14-CM-3

5 POLES

Positions	Type
2	15-CM-2

6 POLES

Positions	Type
2	16-CM-2

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-CB-2
3	11-CB-3
4	11-CB-4
5	11-CB-5
6	11-CB-6
7	11-CB-7
8	11-CB-8
9	11-CB-9
10	11-CB-10
11	11-CB-11
12	11-CB-12 (with stops)
12	11-CB-12-CR (continuous rotation)

2 POLES PER DECK

Positions	Type
2	12-CB-2
3	12-CB-3
4	12-CB-4
5	12-CB-5
6	12-CB-6

3 POLES PER DECK

Positions	Type
2	13-CB-2
3	13-CB-3
4	13-CB-4

4 POLES PER DECK

Positions	Type
2	14-CB-2
3	14-CB-3

5 POLES PER DECK

Positions	Type
2	15-CB-2

6 POLES PER DECK

Positions	Type
2	16-CB-2

MULTI-DECK SWITCHES UP TO 12 DECKS AVAILABLE

For multi-deck version of these switches, indicate number of decks as follows. Merely change first number of coding as shown:

Number of decks	
One deck	1 1-CB-4
Two decks	2 1-CB-4
Three decks	3 1-CB-4

"M" = Shorting action (MBB)
"B" = Non-shorting action (BBM)
Supplied unless otherwise specified.

Code: 2 6—CM—2

- 2 — number of decks
- 6 — poles per deck
- CM — Series
- — shorting
- 2 — Positions per pole

e.g. this is 2 decks, 6 poles per deck, Series "C" shorting action, 2 positions per pole.

RCL ELECTRONICS, INC.
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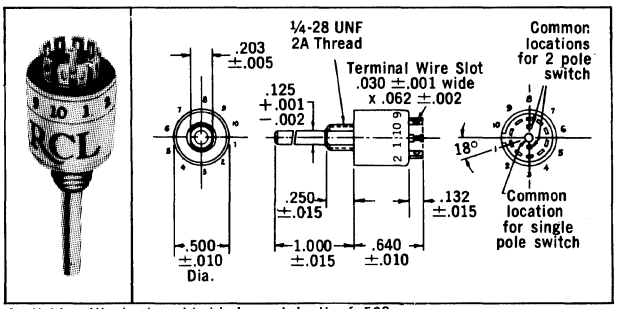
700 South 21st Street, Irvington, N. J. 07111 (Area Code 201) 374-3311 • TWX 710-999-5511

miniature rotary switches

RCL SERIES "F" 10-POSITION SWITCHES

OFF-THE-SHELF DELIVERY



Available with shortened behind panel depth of .563 max.
(Instead of .640 ± .010, specify Series "FF".)

NEW PRODUCT NOTE

NOW AVAILABLE

SERIES "G" 6-POSITION SWITCHES

Specifications are the same as RCL's "F" series, but with 60° throw and non-shorting only. Up to 1 pole-6 position, or 2 pole-3 position.

Available with standard solder lugs or printed circuit terminals.

MILITARY QUALIFIED TO MIL-S-3786/20 AND LISTED ON QPL

½" DIAMETER

This new subminiature rotary switch has been designed to offer the features of larger switches in a fraction of the space formerly required.

SPECIFICATIONS FOR BOTH "F" AND "R" SERIES

Contact Resistance: 10 milliohms maximum initial.

Insulation Resistance: 50,000 megohms initial; 10,000 megohms min. between mutually insulated parts.

Voltage Breakdown: 600 VAC min. between mutually insulated parts.

Electrical Rating: Will make and break 50 milliamperes: 115 VAC for 25,000 cycles or 200 milliamperes 115 VAC for 10,000 cycles.

Contacts: Shorting or non-shorting contacts.

Deck and Terminal Arrangement: Available only in one deck with terminals projecting from rear of switch.

Shaft Length, Flat and Orientation: Available in accordance with individual requirements.

Materials and Finishes: In accordance with applicable MIL specs.

Contact Terminals: Solid silver alloy gold plated. Will accept Two #22 AWG wires.

Common: Terminal brass gold plated.

Wipers: Solid silver alloy.

Environmental requirements: Meets or exceeds MIL-S-3786. Explosion proof per paragraph 4.8.12 of MIL-S-3786.

SERIES "F" SINGLE DECK — 36° BETWEEN POSITIONS

SHORTING

SINGLE POLE

Positions	Type
2	11-FM-2
3	11-FM-3
4	11-FM-4
5	11-FM-5
6	11-FM-6
7	11-FM-7
8	11-FM-8
9	11-FM-9
10	11-FM-10
*10	11-FM-10-CR

2 POLES

Positions	Type
2	12-FM-2
3	12-FM-3
4	12-FM-4
5	12-FM-5

3 POLES

Positions	Type
2	13-FM-2
3	13-FM-3

(*continuous rotation)

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-FB-2
3	11-FB-3
4	11-FB-4
5	11-FB-5
6	11-FB-6
7	11-FB-7
8	11-FB-8
9	11-FB-9
10	11-FB-10
*10	11-FB-10-CR

2 POLES

Positions	Type
2	12-FB-2
3	12-FB-3
4	12-FB-4
5	12-FB-5

3 POLES

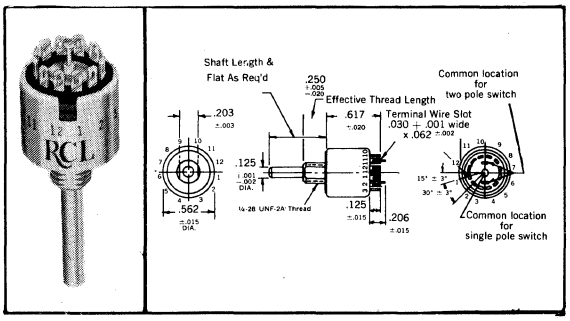
Positions	Type
2	13-FB-2
3	13-FB-3

(*continuous rotation)

ORDERING INFORMATION:
△ Shortened bushing and shaft stick-out available with screwdriver slot for P.C. applications. Specify PCA
△ Shaft and panel seals may be specified by using Prefix "S".
△ Standard terminal with shortened bushing and shaft stick-out available. Contact factory.

SERIES "R" 12-POSITION SWITCHES

MILITARY QUALIFIED TO MIL-S-3786/35 AND LISTED ON QPL



SPECIAL ENGINEERING NOTE
BOTH SERIES ("F" and "R") AVAILABLE WITH PRINTED CIRCUIT TERMINALS! (To order specify prefix "PC")

5/16" DIAMETER

SHORTING

SINGLE POLE

Positions	Type
2	11-RM-2
3	11-RM-3
4	11-RM-4
5	11-RM-5
6	11-RM-6
7	11-RM-7
8	11-RM-8
9	11-RM-9
10	11-RM-10
11	11-RM-11
12	11-RM-12
*12	11-RM-12-CR

(*continuous rotation)

2 POLES

Positions	Type
2	12-RM-2
3	12-RM-3
4	12-RM-4
5	12-RM-5
6	12-RM-6

3 POLES

Positions	Type
2	13-RM-2
3	13-RM-3
4	13-RM-4

4 POLES

Positions	Type
2	14-RM-2
3	14-RM-3

6 POLES

Positions	Type
2	16-RM-2

NON-SHORTING

SINGLE POLE

Positions	Type
2	11-RB-2
3	11-RB-3
4	11-RB-4
5	11-RB-5
6	11-RB-6
7	11-RB-7
8	11-RB-8
9	11-RB-9
10	11-RB-10
11	11-RB-11
12	11-RB-12
*12	11-RB-12-CR

(*continuous rotation)

† 6 POLE SERIES AVAILABLE WITH STANDARD TERMINALS ONLY

2 POLES

Positions	Type
2	12-RB-2
3	12-RB-3
4	12-RB-4
5	12-RB-5
6	12-RB-6

3 POLES

Positions	Type
2	13-RB-2
3	13-RB-3
4	13-RB-4

4 POLES

Positions	Type
2	14-RB-2
3	14-RB-3

6 POLES†

Positions	Type
2	16-RB-2

RCL **ELECTRONICS, INC.**

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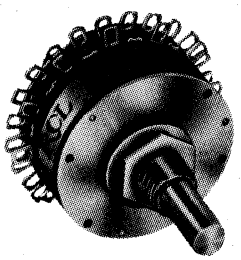
700 South 21st Street, Irvington, N. J. 07111 (Area Code 201) 374-3311 • TWX 710-999-5511

miniature rotary switches

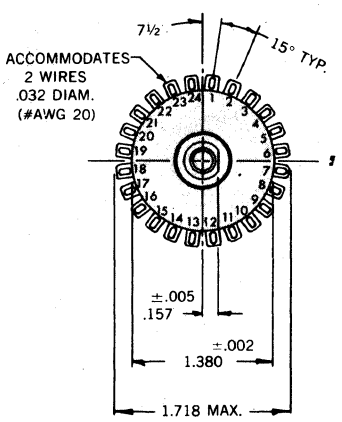
OFF-THE-SHELF DELIVERY

SERIES "E" 1⅜" BODY DIAMETER

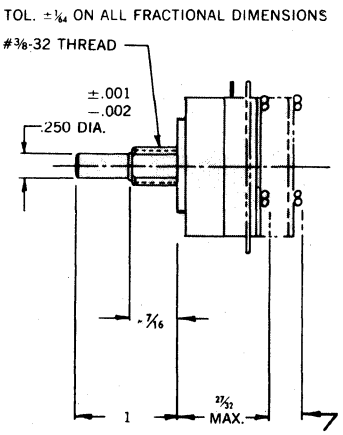
- Up to 24 active positions per deck, **shorting or non-shorting**, and up to 12 poles per deck
- Meets all applicable requirements of Mil S-3786
- Available with concentric shaft
- Available with adjustable stops



Poles	Pole (Common) Location At Term. #
1	1
2	1, 13
3	1, 9, 17
4	1, 7, 13, 19
5	1, 5, 9, 13, 17
6	1, 5, 9, 13, 17, 21
7	1, 3, 5, 7, 9, 11, 13
8	1, 3, 5, 7, 9, 11, 13, 15
9	1, 3, 5, 7, 9, 11, 13, 15, 17
10	1, 3, 5, 7, 9, 11, 13, 15, 17, 19
11	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21
12	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23



FRONT VIEW



3/16 EACH ADDED DECK

SERIES "EC" (LOW COST COMMERCIAL VERSION OF SERIES "E")

OFF-THE-SHELF DELIVERY

All specifications and features remain essentially the same as in the Series "E" switch. Materials and tooling are modified to reduce cost. Electrical specifications are derated by approximately 40%.

Priced at $1.96 each in quantities of 1,000. Priced at the same level as open frame or wafer switches. For ordering information see below but indicate EC. (For example: 11-ECM-2)

ELECTRICAL FEATURES

- Contact resistance: .010 ohms max. initial
- Current carrying capacity: 10 amps
- Current breaking capacity
  2 amps — 115 VAC Resistive
  1 amp — 28 VDC Resistive
  .5 amps — 28 VDC Inductive

MECHANICAL FEATURES

- Life expectancy: in excess of 50,000 mechanical operations.
- Rotational Torque: 20 to 80 ounce-inches depending on number of poles per deck and number of decks.
- Stop Strength: 15 pound-inches.
- Solder terminals will accept two .032 diam. (AWG #20) wires.
- "Molded-in" terminals result in exceptionally high contact stability, completely eliminating movement.
- Shaft and Panel Seals at additional cost may be specified by using Prefix "S" before Switch Type Numbers. This reduces bushing and shaft stick-out from mounting surface by 1/16". Overall lengths of switch from mounting surface is increased by 1/16".
- Explosion Proof per paragraph 4.8.12 of Mil-S-3786.
- Weight: 1 Deck Switch 1.75 oz. For each additional deck add .500 oz.

SINGLE DECK SPACING 15° BETWEEN POSITIONS

SINGLE POLE

Positions	Shorting Type	Non-Shorting Type
2	11-EM-2	11-EB-2
3	11-EM-3	11-EB-3
4	11-EM-4	11-EB-4
5	11-EM-5	11-EB-5
6	11-EM-6	11-EB-6
7	11-EM-7	11-EB-7
8	11-EM-8	11-EB-8
9	11-EM-9	11-EB-9
10	11-EM-10	11-EB-10
11	11-EM-11	11-EB-11
12	11-EM-12	11-EB-12
13	11-EM-13	11-EB-13
14	11-EM-14	11-EB-14
15	11-EM-15	11-EB-15
16	11-EM-16	11-EB-16
17	11-EM-17	11-EB-17
18	11-EM-18	11-EB-18
19	11-EM-19	11-EB-19
20	11-EM-20	11-EB-20
21	11-EM-21	11-EB-21
22	11-EM-22	11-EB-22
23	11-EM-23	11-EB-23
24	11-EM-24	11-EB-24
*24	11-EM-24CR Continuous Rotation	11-EB-24CR Continuous Rotation

2 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	12-EM-2	12-EB-2
3	12-EM-3	12-EB-3
4	12-EM-4	12-EB-4
5	12-EM-5	12-EB-5
6	12-EM-6	12-EB-6
7	12-EM-7	12-EB-7
8	12-EM-8	12-EB-8
9	12-EM-9	12-EB-9
10	12-EM-10	12-EB-10
11	12-EM-11	12-EB-11
12	12-EM-12	12-EB-12

3 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	13-EM-2	13-EB-2
3	13-EM-3	13-EB-3
4	13-EM-4	13-EB-4
5	13-EM-5	13-EB-5
6	13-EM-6	13-EB-6
7	13-EM-7	13-EB-7
8	13-EM-8	13-EB-8

4 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	14-EM-2	14-EB-2
3	14-EM-3	14-EB-3
4	14-EM-4	14-EB-4
5	14-EM-5	14-EB-5
6	14-EM-6	14-EB-6

5 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	15-EM-2	15-EB-2
3	15-EM-3	15-EB-3
4	15-EM-4	15-EB-4

6 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	16-EM-2	16-EB-2
3	16-EM-3	16-EB-3
4	16-EM-4	16-EB-4

7 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	17-EM-2	17-EB-2

8 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	18-EM-2	18-EB-2

9 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	19-EM-2	19-EB-2

10 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-10-EM-2	1-10-EB-2

11 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-11-EM-2	1-11-EB-2

12 POLES PER DECK

Positions	Shorting Type	Non-Shorting Type
2	1-12-EM-2	1-12-EB-2

ALSO AVAILABLE IN 12 POSITION VERSION AS SERIES "T"

ALTHOUGH ONLY 1 DECK IS SHOWN FOR ILLUSTRATIVE PURPOSES, UP TO 20 DECKS ARE AVAILABLE.

RCL ELECTRONICS, INC.

miniature rotary switches

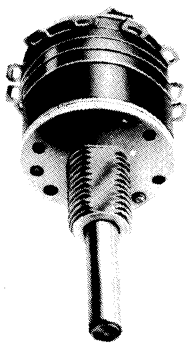
(LOW COST COMMERCIAL VERSIONS)

Completely automated facilities and mass production tooling, now makes RCL highly competitive in commercial applications with "obsolete" wafer-type and open frame switches.

Material and tooling are modified to reduce cost, but comparable performance is maintained with our "standard" series of switches, to correspond with "instrument type" switches.

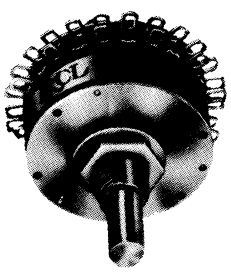
as low as **$1.96 each** in quantities of 1,000

DELIVERY FROM STOCK



SERIES "CC", "DC", "HC" (Typ.)

SERIES "AC", "FC", "GC", "RC" (Typ.)



SERIES "EC", "TC" (Typ.)

RCL STANDARD TYPE	RCL COMMERCIAL TYPE	MAX. POSITIONS PER DECK (Shorting or non-shorting)	MAX. POLES PER DECK	MAX. DECKS AVAIL.
A	AC	12	6	12
C	CC	12	6	12
D	DC	10	2	12
E	EC	24	12	20
F	FC	10	3	1
G	GC	6	2	1
H	HC	6	3	12
R	RC	12	6	1
T	TC	12	6	20

MODIFICATIONS OF ELECTRICAL FEATURES

COMMERCIAL TYPE "CC", "DC", "HC", "AC", "FC", "GC", "RC"

- Initial contact resistance — .015Ω max.
- Current breaking capacities
  - ⅛ amp — 115 V.A.C. resistive
  - ⅛ amp — 28 V.D.C. resistive
  - ⅛ amp — 28 V.D.C. inductive
- Dielectric strength (voltage breakdown) —
  a. between any two adjacent positions — 500V (60 cycles)
  b. between any active position to ground 1000V (60 cycles)

COMMERCIAL TYPES "EC", "TC"

- Current carrying capacity; 6 amps
- Current breaking capacity (Rated Load at 125°C)
  - 1 amp — 115 V.A.C. resistive
  - ¾ amp — 28 V.D.C. resistive
  - ¼ amp — 28 V.D.C. inductive

SPECIAL MODIFICATIONS AVAILABLE:

All commercial version RCL switches are available with the following features at additional cost:

- Spring return feature (Series AC, CC and DC only)
- "Push-to-turn" and "pull-to-turn" spring loaded action where an isolated position is required.
- Shaft and panel seals (specify by using prefix "S" when ordering).
- Non-standard shaft and bushing lengths.
- Specially coded outputs, including decimal to binary for digital applications.
- ¼" diameter shaft and ⅜"-32 threaded bushing (Series CC, DC, HC, AC only)

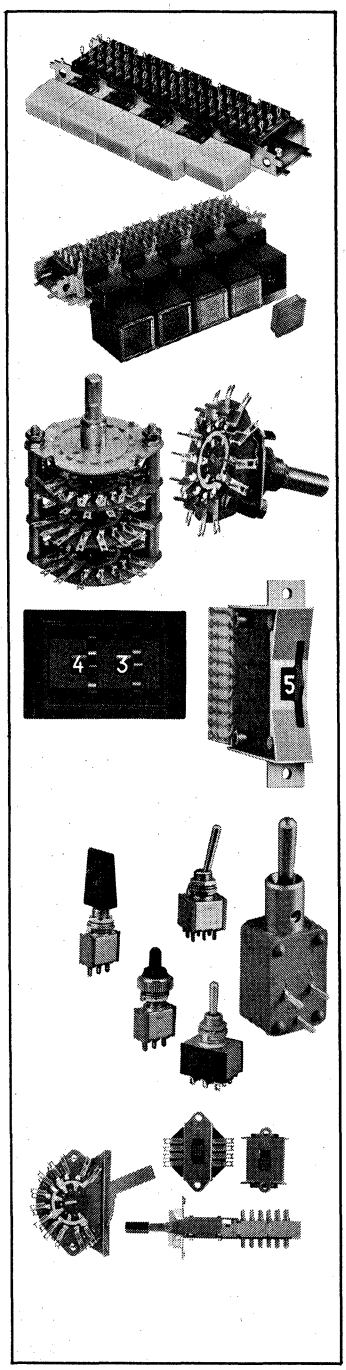
CONTACT FACTORY FOR COMPLETE SPECIFICATIONS

OFF-THE-SHELF DELIVERY

SWITCHES

SWITCHES
SWITCHES

IF IT'S A SWITCH WE ALMOST CERTAINLY HAVE IT.



Seacor offers one of the widest lines of switches available; pushbutton, rotary, thumbwheel, toggle, slide, lever, etc., etc. Whatever your need in a switch, Seacor probably has it. Exactly. Along with top quality, reliability **proven** over the years. Combine this with top-flight consulting engineering when you need it and rock-bottom prices and you have the best single source for any switch requirement. Typical Seacor switches are described. They're a minute fraction of switches available. From Seacor. And Seacor delivers.

PUSHBUTTON SWITCHES

The most flexible high quality pushbutton switch "systems" available. Illuminated or non-illuminated. One to 24 stations in a single frame. Unlimited arrangements result from modular design. Wide selection of button styles with or without legends. Button spacing 10 mm to 20 mm. Up to 8PDT per button. Double wiping contacts can be shorting or non-shorting. UL rated TV-3 power switches or UL rated 6A/125 VAC in same frame. Some types under 10¢ per pole in production quantities. "All Metal" construction. All combinations of latching with/without lockout.

ROTARY SWITCHES

Widest range of types. Detent indexing from 15° to 30°, in double ball or ratchet roller construction. Unique design permits up to 24 contacts per single 12-position wafer. Custom made to your specs—bushing, shaft and wafer spacing. Concentric shaft arrangements available. PC lug parallel to shaft optional. Custom design optimizes every switch, results in best value, maximum utility.

THUMBWHEEL SWITCHES

The thinnest thumbwheel switches in the world! Infinite switching combinations. Conversion of dial settings to coded output. Best price/performance values. Top quality: finest materials; guaranteed for 1,000,000 operations. Outputs on PC board plus pin connectors or hand wired. Space provided for component mounting. Standard positions: 8, 10, 12. Ultraminiature to standard sizes.

TOGGLE SWITCHES

SERIES 5000, SUBMINIATURE SPDT, DPDT, 3PDT. Typical ratings include 5A @ 125 VAC to 8A @ 6 VDC. Hundreds of models in 3 types. All standard functions. Pinned handles; diallylphthalate bodies. Wide range of hardware, accessories, options including handle shapes, sizes, caps. Excellent performance. Superior specs, top quality. Highly competitive prices.

SERIES 21,000 MINIATURE high humidity, high insulation resistance types. SPDT, DPDT. Most standard functions. All models have right-angled PC lugs. Diallylphthalate body, solid silver contacts. Ratings: 2A @ 250V, 4A @ 125V, 4A @ 30V. Wide range of options, accessories, hardware including handle shapes, dimensions, caps.

OTHER SWITCHES

Wide range of slide switch types up to 8PDT, double wiping, shorting or non-shorting. Virtually any lever type from low cost 2-position to 4P, 6-position switches. Guaranteed for 1,000,000 operations. Wide range of ratings, sizes, materials.

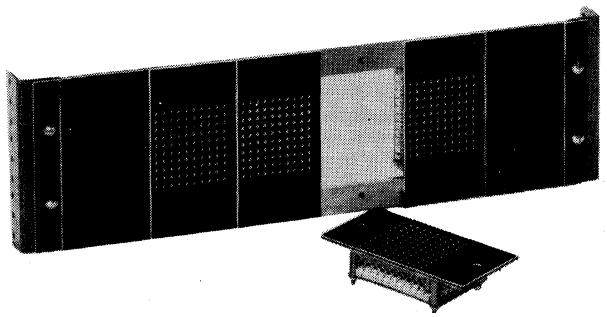
SEACOR, INC.
598 Broadway ■ Norwood, New Jersey 07648 ■ (201) 768-6070 ■ TELEX 135354

SEACOR DELIVERS

SEALECTRO

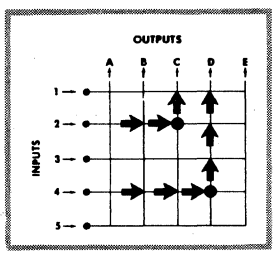
SEALECTROBOARD®

CORDLESS PROGRAMMING BOARDS



"Sealectroboard" programming and switching provides complete ease and simplicity of operation with drastic reductions in hardware and space. A single pin is used to complete the program circuit or insertion of a component . . . move the pin to a new location and you have a new program function. "Sealectroboards" are made in 2 to 5 deck versions and with a variety of pin styles such as shorting pins, diode holders and skip pins as well as with engraved or silk-screened panel marking and color coded program areas.

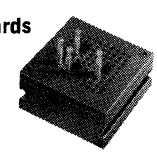
Modular "Sealectroboard" are designed to facilitate program board expansion in prototype and design applications and are offered off-the-shelf from Sealectro Distributors. Each modular board is a 10 x 10 matrix with two contact decks in bussed upper and lower or bussed upper, individual lower contact configurations. Companion mounting and panel pieces are designed for 19" relay rack mounting and allow expansion from a single board up to 6 boards in just 5½" of rack space. Write for our complete catalog and technical specifications. . . .



Bussed Upper and Lower Contacts

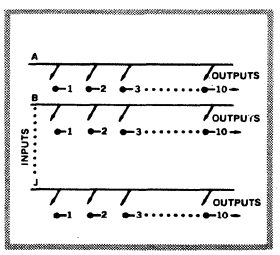
The Modular Sealectroboard is available with bussed upper and lower contacts and provides an ideal means for input / output switching. The standard 10 x 10 hole Modular Sealectroboard may be considered 10 Single Pole, Single Throw, Normally Open switches with 10 inputs each.

New Miniboards



Pack a 10 x 10 hole format (100 crosspoints) into a 1 inch square. These new microminiature boards have all of the standard features of the larger size Sealectroboard, including modular, expandable construction, shorting and diode pins, and Sealectro's built-in reliability.

U.S. Pat. No. 3,027,534



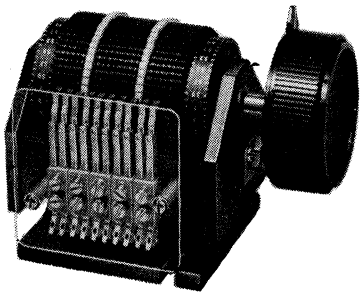
Bussed Upper and Individual Lower Contacts

The Modular Sealectroboard is also available with bussed upper and individual lower contacts which provide individual electrical access to each program hole and a path between many terminals and a lesser number of bussed terminals. The standard 10 x 10 hole Modular Sealectroboard with this contact configuration may be considered a 10 Pole, Single Throw, Normally Open switch with 10 positions per pole.

PROGRAM SWITCHING

SEALECTROSWITCH®

PROGRAMMING SWITCHES



Programs may be changed in seconds without special tools and with 100% reproducibility. The Sealectroswitch programming switch provides a degree of versatility that can't be met by comparable devices . . . and in half the space and half the cost. Extremely high "built-in accuracies" are provided through precision machined drums while flexibility is obtained through unique, field-adjustable, sliding contact actuators. Check these features • Field Adjustable Cams with Multiple ON/OFF Functions or Point-to-Point Switches • Manual or Remote Operation with Timing Motor or Solenoid Drive • Transfer Speeds to 50 Milliseconds without Appreciable Contact Bounce • Removable Drums • Form A, B, and C Contacts in a Single Unit • Up to 57 Circuit Controls in a Single Unit • Contacts Rated for Dry Circuit to 2 Amps, 24 VDC or 115 VAC • Optional 10 Amp or 20 Amp, 115 VAC U.L. Approved Contacts.

Enclosed, snap-action contacts and timing motor drive.

60 program positions, 60 contacts and stepping motor drive.

U.S. Pat. No. 3,330,917 Also protected by foreign patents

LCT SEALECTRO TIMER

- Field adjustable
- Multiple function
- Economical, precise programming
- Sets up in seconds with 100% repeatability
- Up to 60 On/Off functions per revolution
- 15 Amp contact rating
- U.L. approved

60 drum positions, precisely fabricated at factory, permit up to 60 On/Off functions in a single 360° operation on a single contact. The drum is indexed, eliminating guesswork in set-ups, and also guaranteeing 100% repeatability when re-setting to a former program.

Actuators are merely slid by hand, to or out of operational position. In seconds, set up a complex timing program with varying time dwells for On/Off functions. In seconds, set up a pulse generator capable for supplying precisely timed pulses in various groups.

SEALECTRO SLIDE-N-SWITCH™

- Exclusive random access to any circuit from any circuit.
- Up to 10 times as fast as thumbwheel switches.
- Modular expandable design.
- Compact, 2⅝" high. Each switch module 1/32" wide.
- Reduced contact wear.
- Economical, costs far less than average thumbwheel switch.
- Guaranteed for 250,000 operations per contact minimum.
- Terminates in standard PC card connector, or hard wire.

Write today for our complete catalog . . .

®

PROGRAMMING DEVICES DIVISION

SEALECTRO CORPORATION

MAMARONECK, N. Y. 10543

PHONE: (914) 698-5600 TWX: 710-566-1110

Sealectro Ltd., Portsmouth, Hants, England
Sealectro S.A., P.O. Box 24,
Zone Industrielle de la Garde, la Garde 83, France

Signalite your single source for Transient Protectors

ADVANTAGES

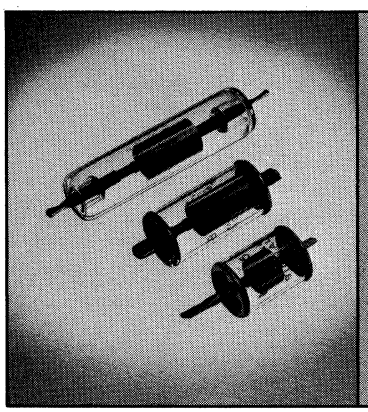
Signalite's five specialized lines of protectors against spurious voltage and current transients offer a full range of advantages to the circuit designer including reliability, high speed, low cost, small size, long life and wide operating voltage range. Whether unwanted surges are generated by short circuits, switching of inductive components, motor starting, contactor arcing, lightning effects or EMP, a Signalite transient protector can be selected to solve the problem.

APPLICATIONS

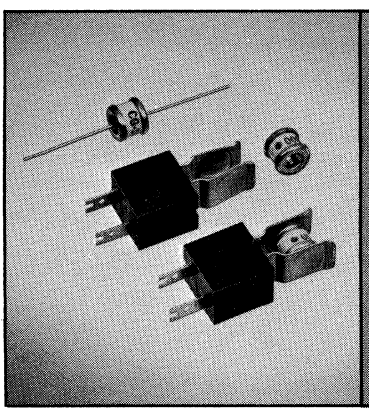
Typical applications of Signalite transient protectors are found in a number of industries including telephone, entertainment, security, aircraft, aerospace, CATV, general manufacturing, and in the military sector. Reliable protection against surge transients is provided for solid-state circuitry, telephone and CATV circuits, microwave and radio equipment, intrusion detection and other alarm systems, traffic controllers, and a wide variety of electrical/electronic equipment. They are also used as active switches, starters, timers and pulse generators.

SERVICE

Whether you anticipate a transient surge problem or require fast help with an existing condition, make use of the comprehensive Signalite sales and technical service organization. Field sales representatives are located in every geographical area. Our factory engineering staff will assist you with circuit analyses, protector selection, testing under your specific conditions, development of special purpose devices, and special packaging. Price and delivery information, samples, and literature are available on request.

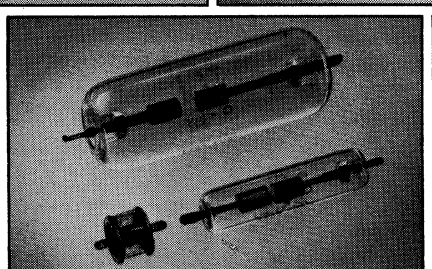


UNI-IMP® Transient Protectors provide ultra-fast protection (zero reaction time), constant trip voltage from DC to 200 kV/μs, trip voltage range from 550 V to 20 kV, and life in thousands of operations.

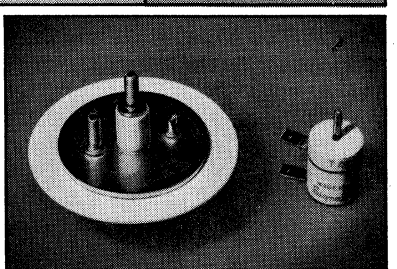


COMM GAP (CG Series) subminiature protectors feature fast protection at low cost, trip voltage range from 75 V to 1000 VDC, extremely low capacitance, high peak current capability and rugged ceramic construction.

LINE PROTECTORS (LP Series) solve the follow-on current problem by self-restoring in approximately 8 milliseconds. Features include speed, high current handling ability, wide operating temperature range, rugged construction and long life.



TWO ELECTRODE SPARK GAPS (SB, SG Series) excel as DC overvoltage protectors and for the efficient transfer of high-voltage, high energy pulses. Voltage range available from 400 V to 45 kV. Tungsten electrodes and rugged glass to metal seals provide long life.



TRIGGERED SPARK GAPS (TA, TB Series) provide low-loss switching of high levels of stored energy with very short delay times. Submicrosecond response time in voltage range from 1 kV to 25 kV and rugged ceramic/metal construction.

Signalite
DIVISION OF GENERAL INSTRUMENT CORPORATION
1933 Heck Ave., Neptune, N. J. 07753 ■ Area Code 201 - 775-2490 ■ TWX 201 - 775-2255

UNI-IMP® TRANSIENT SURGE PROTECTORS

■ Ultra-Fast Protection ■ Trip Voltage Constant From DC To 200 kV/μsec. ■ No Overshoot ■ Trip Voltages Available From 500 V to 20 kV ■ Life Thousands Of Operations

Uni-Imp, the fastest transient protector in existence, protects sensitive components against overvoltages without regard to rate of voltage rise. The voltage at which the Uni-Imp trips does not vary by more than ±10 percent from slow DC overvoltages to 200 kV/μsec transients over the lifetime of the device. Any trip voltage is available from 550 Volt to 20 kV.

Uni-Imp has energy, peak current and di/dt capabilities far exceeding those of solid state protectors. They pass peak-current pulses of thousands of amps at 100 joule energy and di/dt 500 amp/μsec. Infinite resistance is preserved up to the trip voltage, and capacitance is in the picofarad range.

"ZERO" REACTION TIME . . . IDEAL FOR EMP PROTECTION

Tests were made at two independent laboratories with sub-nanosecond rise-time pulse generators at 4000 and 5600 kV/μsec. The documented results show the limiting transition time to be two nanoseconds **from the time the pulse is applied,** regardless of the particular trip voltage of the Uni-Imp tested (0.55, 2.0, 4.0, 6.0 and 8.0 kV).

Thus, if the transient is sufficiently fast that the trip voltage is reached in less than 2 nsec, the Uni-Imp will allow the voltage to overshoot. The limiting ramp speed for zero overshoot as a function of the trip voltage is given by:

$$S_L = \frac{V_T}{2.0} 10^3 \text{ kV/}\mu\text{sec.}$$

where V_T is the trip voltage, in kV. For transients faster than this, the voltage overshoot is given by:

$$\Delta V = 2.0 \times 10^{-3} S - V_T$$

where S is the pulse rise-time in kV/μsec.

RATINGS AND CHARACTERISTICS

Series	Trip Voltage (kv) (See Notes)	Capacitance (pf)	Series	Trip Voltage (kv) (See Notes)	Capacitance (pf)
UBD	.55	< 20	UGT & UBT	4.00	< 1.0
	.60	< 20		5.00	< 1.0
	.65	< 10		6.00	< 1.0
	.75	< 10		7.50	< 1.0
	.85	< 10		10.00	< 1.0
	1.00	< 5		12.00	< 0.5
	1.20	< 5		15.00	< 0.5
	1.50	< 5		20.00	< 0.5
	2.00	< 5			
	2.50	< 5			
	3.00	< 5			
	4.00	< 5			

Operating temperature range —80°C to +85°C.

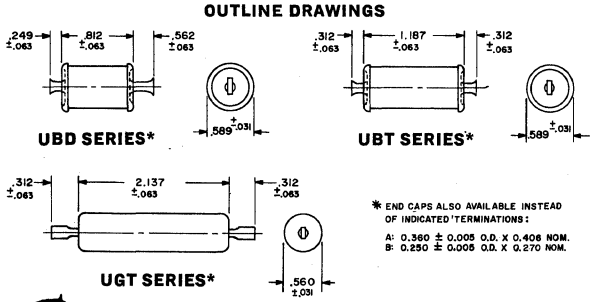
Insulation Resistance: 10,000 MΩ for UBD, UGT and UBT Series. Resistance measurement at 100 VDC.

NOTES:

1. Any trip voltage within the indicated range may be selected. The part number is obtained by adding the trip voltage to the series type (e.g., UBD-1.5 is UBD Series with trip voltage of 1.5 kV).
2. The maximum pulse breakdown and the minimum DC holdoff over the lifetime of the protector are defined in terms of the trip voltage, V_T:

   Max. Pulse Breakdown = V_T + 10 percent
   Min. DC Holdoff = V_T — 10 percent

OUTLINE DRAWINGS



Signalite
DIVISION OF GENERAL INSTRUMENT CORPORATION
1933 Heck Ave., Neptune, N.J. 07753
Area Code 201-775-2490 ■ TWX 201-775-2255

334

COMM GAP SUBMINIATURE LOW VOLTAGE SURGE PROTECTORS — CG SERIES

■ Low Voltages (75-1000 VDC) ■ Subminiature Size ■ Low Cost ■ Fast Protection ■ Low Capacitance (< 1.5 pf) ■ High Peak Current Capability (>10 ka) ■ Rugged Ceramic Construction

The CG-Series, "Comm Gap," protectors find their principal application in the telecommunications industry as high quality, reliable transient protectors. They provide transient protection at minimum cost and size in other applications as well, such as industrial instrumentation and control systems, radio equipment intrusion detection and other alarm systems, traffic controls, and flash tube triggers. Protection is provided wherever unwanted voltage transients occur.

They are available as Type CGL with welded leads. Both series feature rugged miniaturized ceramic construction, picofarad capacitance and high peak current and energy capability. Comm Gap Mounting Clips (CGH-1) are available.

COMM GAP LIFE

The Comm Gap life specifications, below, indicate the typical number of times that the gap can be subjected to a 1000 ampere 10/250 microsecond wavefront at 30 second intervals without causing the DC breakdown to vary:

A. Beyond 18 percent of nominal value for 15 percent tolerance units.
B. Beyond 25 percent of nominal value for 20 percent tolerance units.

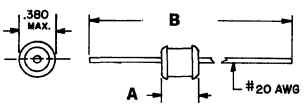
The CG-350 and CG-350L devices typically will withstand 750 surges of a 500 ampere 10/1000 microsecond wavefront at 30 second intervals.

The life of the CG Series of transient voltage protectors, in number of operations, is a function of the anticipated transient pulse, e.g. peak current and pulse duration. The very nature of transients, however, is the unpredictable aspect of their magnitude and energy content. Accumulation of test data at Signalite is a constant effort undertaken to provide the most up-to-date performance characteristics of our products, For CG Series life data at levels other than those specified, please contact our factory for assistance.

ENVIRONMENTAL TESTING

All units meet the requirements of MIL-STD 202 as outlined below.

TEST	METHOD	CONDITION
Vibration	204	C
Shock	213A 213A 213A	A except 100 G's C C except 1 ms.
Humidity	103	B
Temperature Cycling	102A	C
Barometric Pressure	105C	B
Thermal Shock	107	B



SERIES	SIZE A	SIZE B
CG 75 thru 470	.265 ±.012	2.05 Nom.
CG 800 thru 1000	.295 ±.012	2.08 Nom.

RATINGS AND CHARACTERISTICS

Type CG Without Leads*	Breakdown Voltage D.C. (VDC) @ dv/dt < 100 V/sec.		Breakdown Voltage Pulse (kV) @ 5 kV/μsec.	Typical Capacitance (pf)	Typ. Life Operations
CG-75	75	±20%	1.0 Max.	1.4	75
CG-90	90	±20%	1.0 Max.	1.3	200
CG-110	110	±20%	1.0 Max.	1.3	30
CG-145	145	±20%	1.0 Max.	1.1	100
CG-230	230	±15%	1.5 Max.	1.1	100
CG-350	350	±15%	2.0 Max.	0.8	250
CG-470	470	±15%	2.5 Max.	0.8	30
CG-800	800	±15%	4.0 Max.	0.7	20
CG-1000	1000	±15%	4.0 Max.	0.7	20

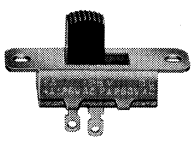
Operating temperature range —55° to +125°C
Insulation Resistance: 10,000 MΩ. The resistance of the protector @ 100 VDC (except @ 50 V for units rated 90 V and below).
*To specify Leads, add suffix "L".

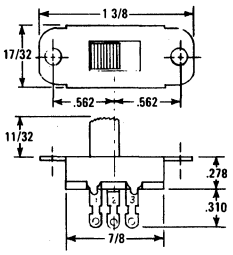
STACKPOLE®

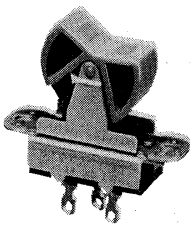
SLIDE AND ROCKER SWITCHES

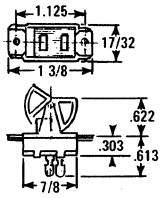
Stackpole is the world's largest producer of slide and rocker switches for the appliance, power tool and electronic industries. For a complete specification guide to all types of Stackpole slide and rocker switches, request Bulletin 78/79-102.

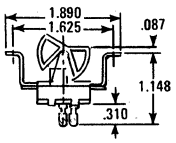
SINGLE POLE – SINGLE THROW, DOUBLE THROW & THREE POSITION





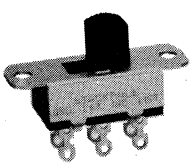


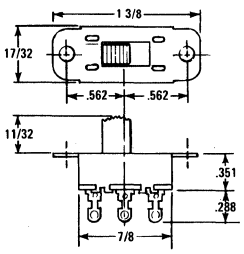


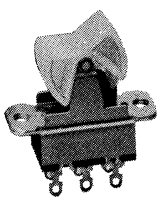


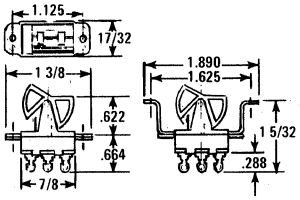
Ratings from 4 amp 125 VAC to 10 amp 125 VAC. Variable knob styles in a wide spectrum of colors. Detent, smooth, and momentary actions. Types available with fire resistant material and TV ratings. Rocker switches available with flat or offset brackets.

DOUBLE POLE – DOUBLE THROW



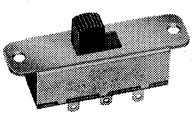


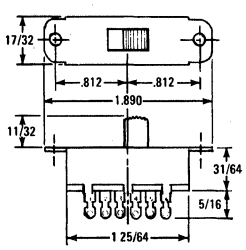


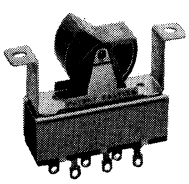


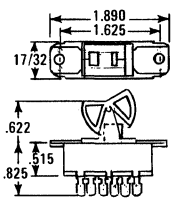
Ratings from 1 amp 125 VAC to 4 amp 125 VAC. Double wipe contacts and gold plating available on request for low current applications. Detent and smooth action. Rocker switches come with flat or offset brackets.

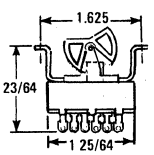
DOUBLE POLE – DOUBLE THROW, THREE POSITION, FOUR POSITION





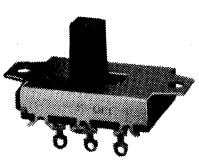


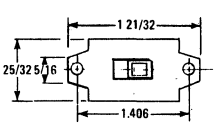


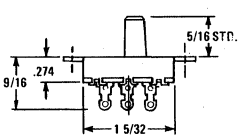


Ratings at 6 amp 125 VAC, 3 amp 250 VAC. Variable knob heights and colors. Solder lug and PC terminals. Rugged performance and long life. Detent, smooth, and momentary actions. Rocker knob lettering available on request. Flat or offset rocker brackets.

TRIPLE POLE – TWO POSITION, THREE POSITION

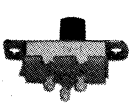






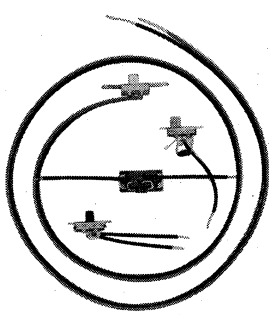
Double wipe contact series. Ideal for low current applications.

TV RATED SWITCHES



For TV Rated Switch requirements, Stackpole is the sole producer of both slide and rocker switches and snap-over-center rotary action switches. The basic slide switch with TV-1 Rating in SP-ST or SP-DT can be modified with glamour caps, toggles and mounting brackets. The basic TV-3 Rated, snap-over-center rotary action switch is SP-ST or SP-DT.

WIRE LEADS AND OTHER FEATURES



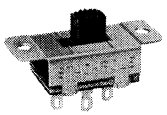
Standard Stackpole slide and rocker switches can be provided with additional features which lower assembly cost and tailor units for specific applications. Switches are available with wire leads, diodes and rectifiers preassembled at the factory. The diode switch becomes a multiple speed control or rating device, eliminating multiple tap windings and complex circuitry.

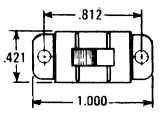
STACKPOLE COMPONENTS CO. / P. O. BOX 14466 / RALEIGH, N. C. 27610 / PHONE: 919-828-6201

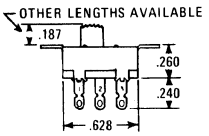
STACKPOLE®
MINIATURE SLIDE SWITCHES

Stackpole miniature switches carry the same reliability as the regular line and provide an efficient answer where space is at a premium. For specifications by type number, request Bulletin 78-902.

SINGLE POLE – SINGLE THROW, DOUBLE THROW
DOUBLE POLE – DOUBLE THROW

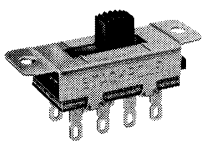


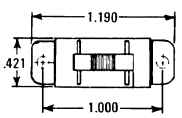


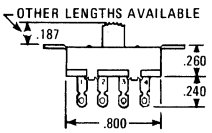


Ratings from 1 amp 125 VAC to 3 amp 125 VAC. Push-button, momentary contact, normally open is available in SP-ST. Spring return from each end available as SP-3 Pos. Triggers are available in variable heights and a spectrum of colors. 3/16" long is standard and material is nylon. Solder guards are available assembled or unassembled to switch. C.S.A. listing is available only when solder guard is used. Contact arrangement is break before make (non-shorting). Standard terminals are solder lug; printed circuit terminals and space-saver terminals are available.

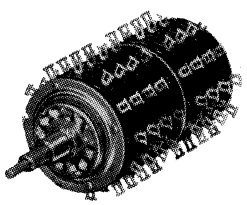
SINGLE POLE – THREE POSITION
DOUBLE POLE – THREE POSITION



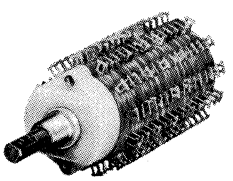




STACKPOLE®
ROTARY SWITCHES



Series 600 1-5/8" dia. Environment Proof Rotary Switch.



Series 100 1-1/8" dia. Environment Proof Rotary Switch.

VERSATILITY

Modular design in both diameters, coupled with external devices, provides incomparable switching variations.

- internal and external interconnections reduce costly hand wiring.
- contact materials of silver plated brass, silver alloy and gold.
- terminations can be solder lugs, quick connect, vertical PC board, front and rear PC pins.
- special configurations include line switches and potentiometers in dual and tri-concentric rotaries, added key-locks, electrostatic shields, spacers and coded outputs.

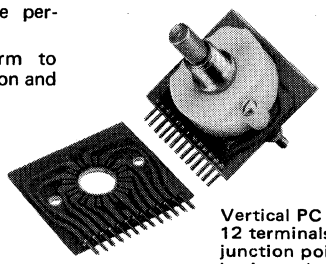
RELIABILITY

Completely enclosed design provides an environment proof assembly.

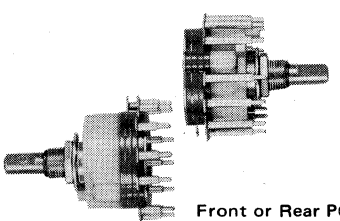
- dust, dirt, moisture, and corrosive atmospheres are sealed out while lubricants are sealed in. "O" ring seals are available.
- production damage is virtually eliminated . . . the switch is solder and flux-proof . . . terminals are permanently locked in position.
- Stackpole rotaries conform to MIL-S-3786B for shock, vibration and explosion proofing.

DELIVERY

Stackpole rotary switch delivery is the best in the industry . . . within one week on standard configurations, within two weeks on special configurations, two to three days on no-charge samples. Get all the specifications. Write for Bulletin 73-103 for standard configurations, Bulletin 73-102 for special configurations.



Vertical PC Board Switch has 12 terminals ending at a common junction point for vertical or horizontal mounting.



Front or Rear PC Pins Switch plugs in instantly to your PC Board, is available with binary codes and special switching sequences.

STACKPOLE COMPONENTS CO. / P. O. BOX 14466 / RALEIGH, N. C. 27610 / PHONE: 919-828-6201

TAPESWITCH®

OPERATED BY

PRESS-AT-ANY-POINT RIBBON type & MAT type SENSING SWITCHES

BUY THE RIBBON SWITCH IN THE SIZE YOU NEED!

SUCCESSFULLY PROVEN IN ALL INDUSTRIES. PATENTED CONSTRUCTION WITHSTANDS MANY TONS OF FORCE YET CLOSES ON LIGHT FINGER PRESSURE. TAPESWITCHES ARE UNEXCELLED FOR—SAFETY . . . AUTOMATION . . . ANTIBURGLAR SYSTEMS . . . COUNTING . . . TIMING . . . DOOR CONTROL . . . LIGHT SWITCHING . . . MACHINE CONTROL . . . MATERIAL HANDLING INSTRUMENTATION . . . COMPUTER AND CONSOLE SWITCHING . . . AND MANY OTHER APPLICATIONS.

These versatile sensing switches may be used directly with **electro-mechanical devices** and **solid state devices.**

Pressure at any point from hand, foot, or vehicle will cause contact. These are ideal for instrumentation and control tasks because of their **flat configuration, "Press-at-any-Point" operation,** and **sealed** qualities.

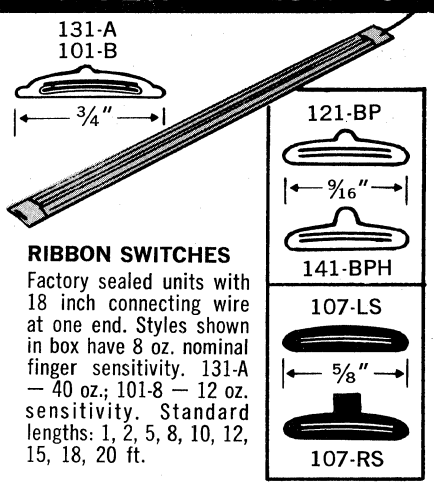
TAPESWITCHES are designed in accordance with the best principles of switch and cable design, with jacketing and insulation meeting the requirements of MIL-C-9154 and MIL-I-631C respectively. Results are exceptional stand-by reliability (required in alarms) as well as excellent contact performance.

Typical life tests with repeated impacts at ONE POINT on a Tapeswitch have given over three million operations without failure. (24 Volt AC relay coil 0.3 Amperes)

RATINGS: All Tapeswitch products are rated 117 VAC, at 1 Ampere. However for floor switching, 30 VAC or less is recommended.

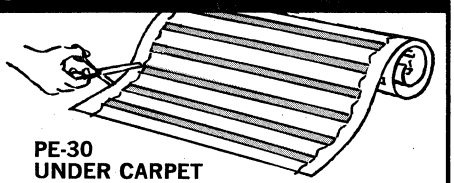
NOTE: U.L. classification for Ribbon Switches does not presently exist.

A FEW TAPESWITCH CONTROL SWITCHES



RIBBON SWITCHES

Factory sealed units with 18 inch connecting wire at one end. Styles shown in box have 8 oz. nominal finger sensitivity. 131-A — 40 oz.; 101-8 — 12 oz. sensitivity. Standard lengths: 1, 2, 5, 8, 10, 12, 15, 18, 20 ft.

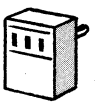


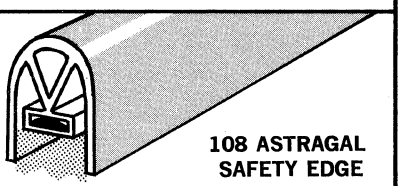
PE-30 UNDER CARPET SWITCHING RUNNER

30 inches wide x 3/32 inches thick and can be cut to any length from 25 ft. or 5 ft. roll. For indoor use under carpeting. Tapeswitches in parallel between Polyethylene sheets. Tinned wires for easy twisting or soldering connections.

TAPESWITCH RELAY R-1

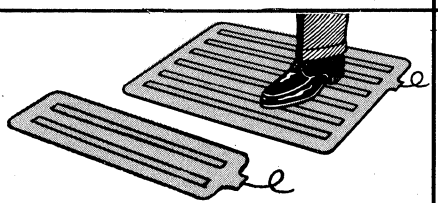
FOR NORMALLY CLOSED OR NORMALLY OPEN OPERATION OF ANY TAPESWITCH. Plug-in unit gives NC or NO control of 117 Volts AC, 5 Amperes. Built-in low voltage transformer.





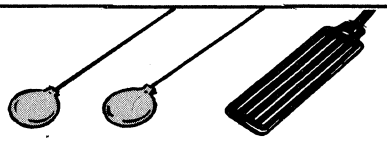
108 ASTRAGAL SAFETY EDGE

Unique patented design universal safety cushion switch for leading edge of doors, machinery, etc. Responds to side thrust and head-on thrust. Std. lengths: 6, 8, 10, 12, 15, 20, 25, 30 ft. OTHER STYLES ALSO AVAILABLE. Mounts on edges 1" to 2½" wide. Cushion depth 1⅞".



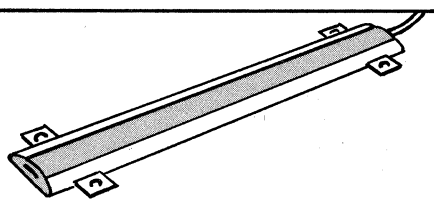
CVP SWITCHING MATS

CVP style mats are durable yet flexible and only ⅛ inch thick (approx.). Available in sizes 23 x 35 inches, 17 x 23 inches and 6 x 23 inches. Very popular items.



NC-3 NO-1 FOOTSWITCH 111

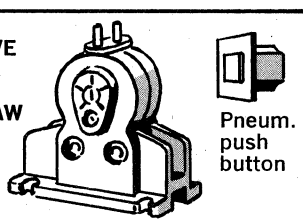
NC-3 is a unique normally closed wafer style switch 1⅛" diameter, by 3/16" thick. Designed to sound alarm when object is lifted off switch. NO-1 similar form but normally open. 20 oz. nominal sensitivity. Footswitch 111 normally open flat rugged, sealed switch, 2" x 5" x ¼" thick.



RBMA ROAD SWITCH

Successful, rugged roadway switch for counting, timing, controlling by vehicles. Replaceable sealed switch element. 2" wide, 7/16" thick. Std. lengths: 2, 3, 5, 8, 10 ft. Cast iron end protectors available.

SENSITIVE AIRWAVE SWITCH MODEL AW

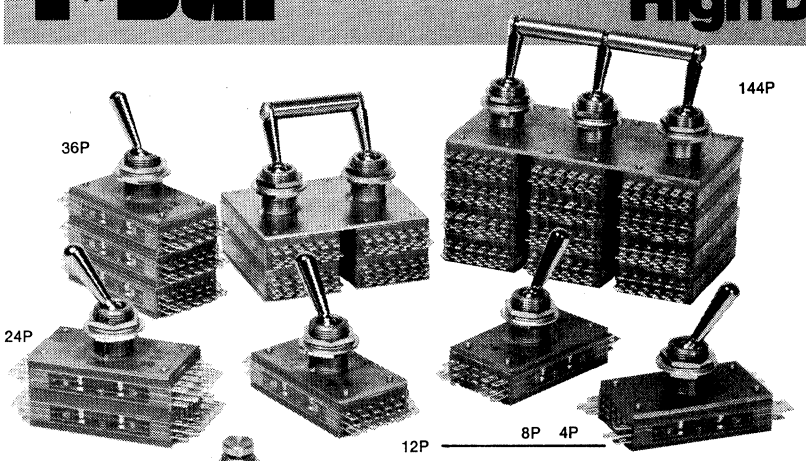


High quality diaphragm switch with adjustable sensitivity. For operation by **tubing squeeze** / impact, air motion, vacuum. Remote push-buttons for explosive environments, etc. Silver contacts operate normally open or normally closed.

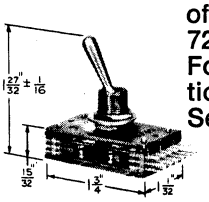
TAPESWITCH CORPORATION OF AMERICA
320 BROAD HOLLOW RD., FARMINGDALE, N.Y. 11735 • (516) 694-6312 — (212) 895-8713

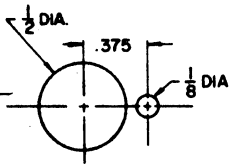
T-bar® SWITCHES for Multipole High Density Switching

T-Bar Toggle Switches



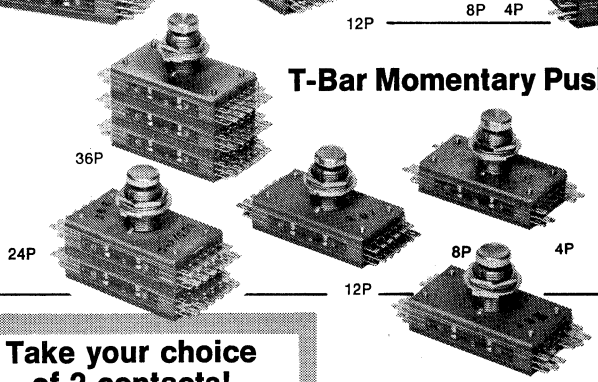
Switch from 4 to 144 circuits with one T-Bar Toggle Switch. Available in configurations of 4, 8, 12, 24, 36, 48, 72, 108 and 144 poles. For low level applications specify the 902 Series.



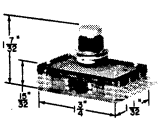


PANEL CUTOUT FOR TOGGLE AND PUSH-BUTTON SWITCHES

T-Bar Momentary Push-Button Switches



Switch from 4 to 36 circuits with one T-Bar Momentary Push-Button Switch. Available in configurations of 4, 8, 12, 24 and 36 poles.

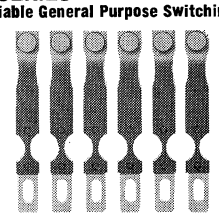


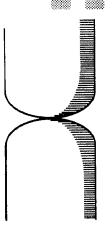
SWITCH SPECIFICATIONS

Contacts:	Series 800—general purpose gold plated Series 900—low-level bifurcated gold plated
Contact Rating:	Series 800—5 amps max. resistive to 150 watts Series 900—1 amp maximum resistive to 50 watts
Life Expectancy: at 20 CPM	Series 800—50,000 cycles Series 900—50,000 cycles
Contact Resistance:	20 milliohms typical
Ambient Temperatures:	—55° to plus 85°C
Terminals:	Mate with T-Bar Connectors
Dielectric Strength:	1000 VRMS @ 60 cycles/sec. (higher available)
Insulation:	5000 megohms min. (higher available)

Take your choice of 2 contacts!

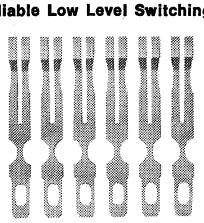
800 SERIES
for reliable General Purpose Switching

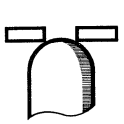




The 800 Series contact is a highly reliable gold-plated button contact. With its high contact pressure and positive wiping action, it is used in control type applications and in general purpose switching, such as relays, valves, lamps, etc. Contact Rating: up to 5 AMPS max.

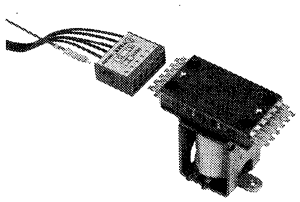
900 SERIES
for reliable Low Level Switching





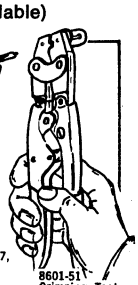
The 900 Series DATA-RITE™ contact has the reliability of a bifurcated contact with the added feature of two degrees of wiping action. The unique EDGE-TO-DOME contact guarantees a clean surface, which is critical for low level signals. The 900 Series is typically used in computer I/O signals; voice and data-grade communications; thermocouple and strain gauge outputs; all low level switching, whenever reliability is a premium, or whenever slight variations in contact resistance cannot be tolerated. Contact Rating: Microvolts up to 1 AMP max.

T-BAR CONNECTORS



The T-Bar Series 88601 Connector has been specifically designed for use with T-Bar switches and relays. The connector contacts are crimp type which are snapped into a plastic insulator block. After installation, connectors are held in place against shock and vibration by use of a retaining clip.

Current Carrying Capacity	5 Amps
Contact Resistance	5 Milliohms Max.
Wire Accommodated	AWG #18 to AWG #26
Dielectric Strength	1000 Volts RMS
Insulation Resistance	100,000 Megohms Min.
Ambient Temperature	—55°C to +85°C
Weight	0.3 Oz.
Recommended Tools	Ratchet Crimping P/N 8601-51 Extraction P/N 8601-61 Connector Tool P/N 8601-71
Use 88601 With	801, 802, 803, 805, 807, 901, 902, 905, 907



HOW TO ORDER

1. Specify Series **2.** Specify Number of Poles and Contact Form

Don't forget to order the mating T-Bar Series 88601 Connector! One for each 6 poles.

902 — **12 C**

SERIES	Application	No. of Poles	Contact Forms*
T-Bar® TOGGLE SWITCHES			
802	Gen. Purpose	4 to 144	"A" or "C"
902	Low Level		
T-Bar® PUSHBUTTON SWITCHES			
803	Gen. Purpose	4 to 36	"A" or "C"

*Form "A" — normally open contacts. Form "C" — double throw, break-before-make.

T-Bar
INCORPORATED
SWITCHING TECHNOLOGY

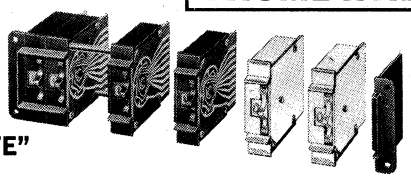
Manufactured under 1 or more of the following patents: 3206990, 3226508, 3689856.
®"T-Bar"—Reg. T.M.

141 Danbury Road, Wilton, Conn. 06897 • (203) 762-8351

Switch to TECH LABS INC.

for the most versatile line of precision switches & attenuators

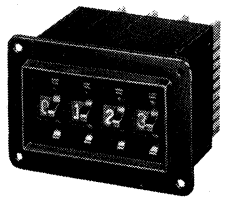
THUMBWHEEL SWITCHES



"THUMB-MITE"

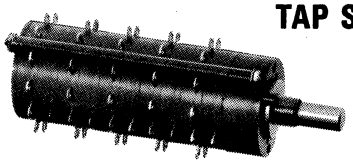
Miniature, precision thumbwheel switch, requiring a panel cutout of 0.980" in height, highly legible readout, excellent switching characteristics, and absolutely positive detent. P/C boards are glass laminate with precious metal contacts and plating. Available in lighted modules and completely sealed against hostile environments. Various logic codes and component mounting boards, which can contain complete circuit modules and logic elements, are available. Rated operating life in excess of 1,000,000 detent operations.

"PANEL-MITE"



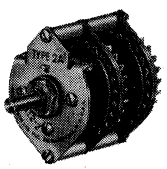
This versatile, finger-actuated thumbwheel switch is available in either front or back panel mounting configurations. Compact printed circuit logic design permits easy installation in limited space. Modular construction permits ganging of modules into unitized assemblies. Also available is a larger, high current carrying version designed to meet special industrial applications. Panel cutout 1.375" in height.

TAP SWITCHES



TYPE 3A MINIATURE, ENCLOSED TAP SWITCH

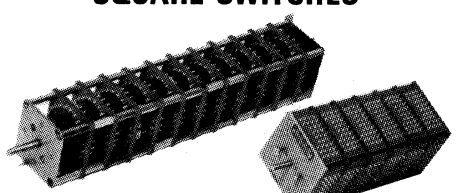
Totally enclosed with molded-in terminals utilizing Diallyl Phthalate. 1¼" O.D., up to 12 positions, up to 6 poles per deck, with multi-decks available. Low contact resistance. Long life — up to 300,000 mechanical operations. Intermix of shorting and non-shorting action available on the same deck. Rating: 1200 Volts RMS, 5 Amp., 115 Volts.



TYPE 2A & 2C TAP SWITCHES

The 2A is a standard control switch for precision instruments and equipment. Up to 24 positions, 1-4 poles per deck, with multi-decks available. Precious metal contacts for low resistance. The 2C has ceramic insulation. Both types have positive "stall-free" detents and adjustable stops.

SQUARE SWITCHES

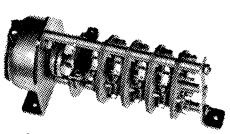


STANDARD

PREWIRED TO TERMINAL BOARDS

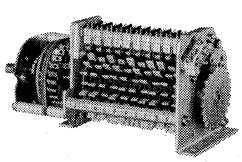
Square switches available from stock parts, as standards or assembled to specifications. Top quality features include glass laminate contact panels with precious metal contacts. Various standard sizes include up to 120 positions, up to 12 poles — 10 positions per deck — with multi-decks available.

STEPPING SWITCHES



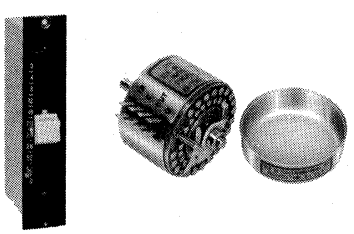
Versatile Tech Labs. motor and solenoid driven stepping switches permit multiple switching functions with a single component. All Tech Labs. switches can be adapted as stepping switches and can be used for transfer switching, sequencing of complex switching arrangements, and programming of sequential operations. A wide choice of multi-pole designs from 2-120 electrical positions are available.

PROGRAMMING SWITCHES



Adjustable programming switches for sequencing, timing, scanning, multiplexing, general programming, and code generation. Drum actuated series of contacts with 2-24 positions per drum and constructed in 10 drum modules. Contact ratings up to 20 Amps. Versatile design allows manual, motor, or solenoid operation, depending upon application requirements.

ATTENUATORS



A comprehensive group of standard audio, video, and RF variable attenuator types can be furnished for motor, solenoid, or remote operation. Tech Labs. will design special attenuators to meet specific requirements.

SPECIAL DESIGN/PROTOTYPE/MANUFACTURING CAPABILITIES

For special applications, Tech Labs. will design and manufacture prototype, pre-production and production switching systems to customer specifications. Tech will also prepare engineering specifications for switch applications without existing specs. Our design engineers have developed specialty switches for many unique applications, such as high voltage switches (100KV), RF types and specialty instrumentation switches.

Figure 2

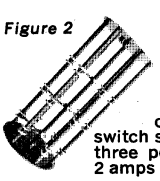
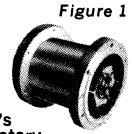


Figure 1



Two switches representative of Tech's capabilities. The remote controlled, solenoid-operated stepping switch shown in Figure 1 has a total of 28 outputs and 168 inputs while rotating at 10,000 RPM in a turbine. This switch's contacts are rated for low level signals. The rotary switch shown in Figure 2 met the requirements for an inexpensive three pole-six position high voltage switch capable of carrying 2 amps at 100,000 volts.

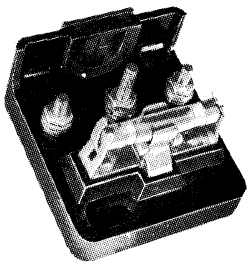
TECH LABORATORIES, INC.

Palisades Park, New Jersey

These switches and attenuators are representative of many types produced by Tech Labs. Wire or teletype for further information.

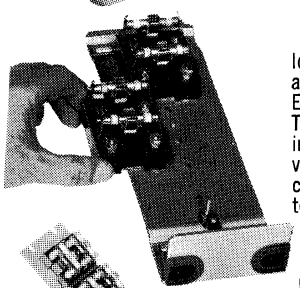
TEL. 201-944-2221 TWX: 201-947-0825

TII® Overvoltage Protection Equipment



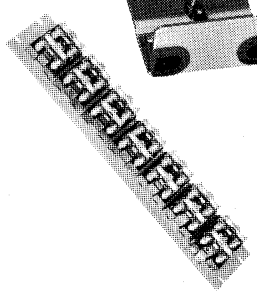
TII-300 SINGLE PAIR

Using a three electrode gas tube arrester, this protector instantaneously and simultaneously grounds both sides of a communication line, then self-restores when the surge is dissipated. Permanent grounding is effected under power cross conditions. Replacement of TII-304-7 FAILSAFE spacer restores protector to service.



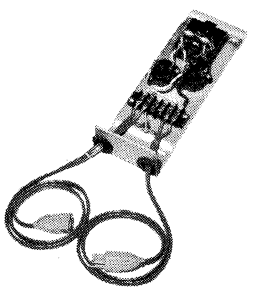
TII-400 MULTIPLE PAIRS

Identical to the TII-300 protector except available in 2, 4, or 6 pair assemblies. Expandable up to six pairs by adding TII-405( )* two pair mounting blocks in field or shop. Used to eliminate overvoltage surge damage to key system line cards, PABX trunk relays, data terminals, tone dials and ringers.



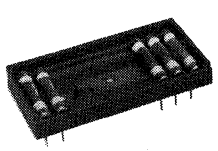
TII-400 SERIES RACK MOUNTED PROTECTORS

Three electrode tube arresters are used on a two pair FAILSAFE mounting block to instantaneously and simultaneously ground both sides of a communication line, then self-restore when the surge is dissipated. Up to 7 two pair blocks can be put on TII-400-14 19″ rack mounting plate (3½″ high) to protect 14 circuit pairs.



POWER LINE PROTECTORS

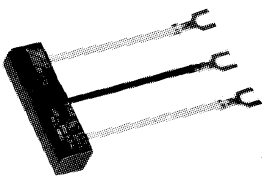
Designed to prevent surges caused by lightning or power fault voltages from damaging equipment connected to the A.C. line by simultaneously grounding both conductors through the TII-16 gas arrester. Surges of longer duration cause two circuit breakers to open the circuit. The arrester and breakers self-restore and return the circuit to normal after surge dissipation.



TII-710 TEN PAIR PACK

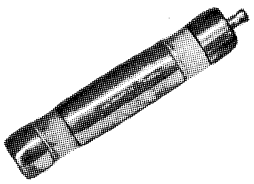
(TII-720 twenty pair pack; TII-730 thirty pair pack).

Compact and simple to incorporate into repeater housings, carrier equipment, signaling, data processing, security equipment, wherever multiple pair protection is needed. Mount 10, 20, 30, or more arresters in a wire-wrap pin lead package and cradle-type board. Dim. 4¾″ long x 2¼″ wide x 1⅜″ thick (including wirewrap pins) for the ten pair TII-710( )* unit: width is proportionately larger for TII-720( )* and TII-730( )* sizes.



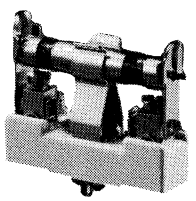
TII-316 PRIMARY ARRESTER

The TII-316( )* arrester has a protective coating and insulated wire leads with spade terminals. Designed to provide self-restoring gas tube protection on existing fuseless and fused type protectors using carbon blocks as the failsafe backup.



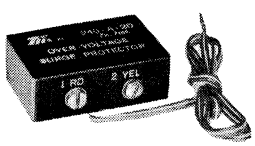
TII-16 ARRESTERS

Three nickel alloy electrodes separated by alumina ceramic are simultaneously fired when excess voltages appear between any two electrodes. Operating delay is less than 1 microsecond when 1500 V.D.C. is applied with a rise time of less than 0.1 microsecond. Will withstand without damage 20 amp A.C. for 1 second repeatedly on any one section, or more than 150mA a.c. for 3 hours. Not affected by light, heat, dust or moisture.



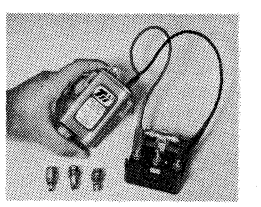
TII-53 MOUNTING

Used to mount one Type 16 Arrester. A parallel air gap set to a nominal spacing of 0.01 inch is provided between each line connection and ground. The base is of glazed ceramic providing high insulation resistance and stability in humid conditions. Can be used on panels up to 0.093 in. 1 15/16″ x 9/16″ x 1 9/32″. Wt. 1¾ oz.



TII-340 LOW VOLTAGE PROTECTOR

Transistorized communications, process control and computer equipment are protected from surge by a new low voltage protector. Maintaining balance between two wires, the protector restricts the voltage difference to a predetermined value and simultaneously prevents either line voltage from exceeding a given line-to-ground specification. Eight standard models have been designed and all units can withstand 20 kilo-amperes surge current as defined by 8/20 waveform.



TII-100 GAS TUBE TESTER

A GO/NO-GO tester used in the field to visually check all gas arresters and carbon blocks to see if they (1) fire at their rated striking voltage, (2) have an open circuit or (3) are shorted. Especially important after power cross conditions. Weather and shock-proof, a single button operates a D.C. voltage generator which pulses 700 peak volts at 500 volts per microsecond wavefront across the arrester simulating a steep wavefront found in lightning strokes. Neon lamp provides immediate indication of condition. Sealed nonrechargeable battery insures 20 hours of continuous operation. Dim. 1 x 2 x 4½. Wt. 7 oz.

TELECOMMUNICATIONS INDUSTRIES, INC.
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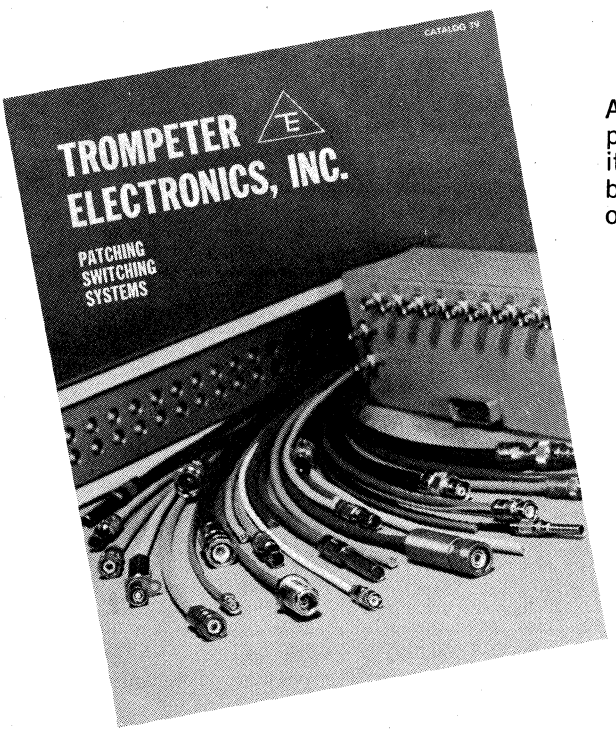
TROMPETER ELECTRONICS

NEW PRODUCT CATALOG SUPPLEMENT

On the following pages are new items and capabilities that have been added to the Trompeter Electronic's line of high quality coax patching, connecting and switching devices. This information supplements the product information to be found in Trompeter Electronic's full-line catalog T-9 or EEM 72/73 Volume 2 pages 2191 to 2204 and Volume 3 pages 3118 to 3157.

These items are designed, like all Trompeter Electronic products, to provide standard system interface patching and switching so that the many end equipments available from other manufacturers can be interconnected with a minimum of additional engineering design. Design consideration was also given to problems of space, cost, reliability and quality.

TECHNICAL PAPER ON NOISE IN ELECTRONIC SYSTEM WIRING AND CABLING



A complete paper on this subject covering the problems of noise in interconnect systems and its affect on overall system performance can be found on pages 1 - 8 of full-line catalog T-9 or in EEM 72/73 Volume 3 pages 3118 to 3125.

APPLICATIONS

Computers • TV Broadcast • CATV • CCTV • ETV • Communications • Telephone • Missile and Space Telemetry • Aircraft • Nuclear and Industrial Instrumentation • Process Controls • Security Equipment • Automatic Testing • Information Retrieval • Microwave Data Transmission.

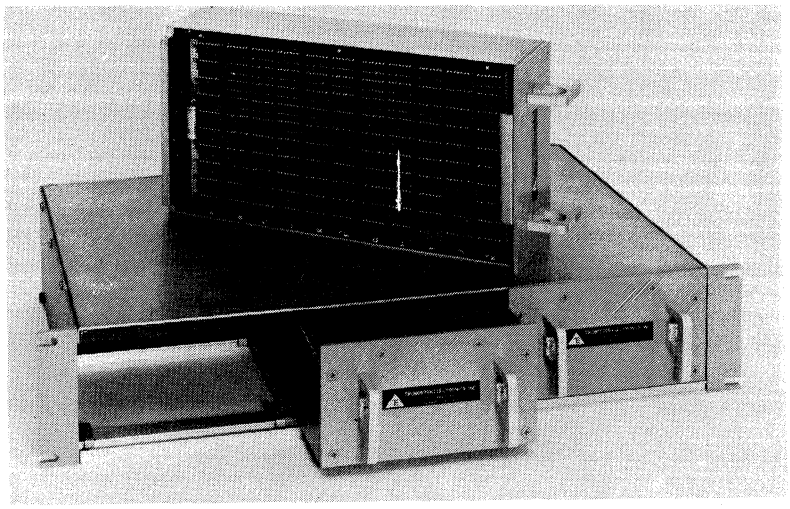
Federal Stock Numbers: Federal Stock and Airforce GEEIA Catalog numbers have been assigned to most Trompeter parts. Each list is available upon request.

The complete Trompeter line includes:
Patch Panels, Patch Cords, Jacks, Looping Plugs, Power Dividers, RF Connectors, Switches, Matrices and Systems.

See EEM pages Vol.3•946 to Vol.3•951for new patching and connector developments.

TROMPETER ELECTRONICS, INC.
8936 COMANCHE AVENUE / CHATSWORTH, CALIFORNIA 91311 / (213) 882-1020

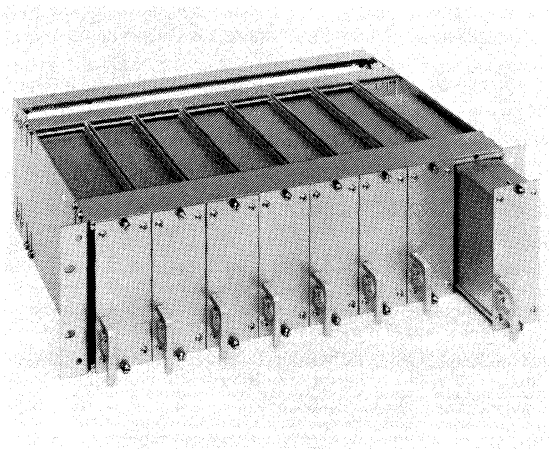
MODULAR COAXIAL SWITCHES AND MATRICIES



10 x 10 COAXIAL MATRIX

This new switching system contains three standard CMAZ10x10B modules packaged to provide a programmable switching unit for use in complex systems, such as high speed component testing, check out systems, automated machine control, etc. Three 10 x 10 modules fit into a 3½" standard 19" rack chassis and the modular construction provides the flexibility needed to meet a wide number of individual applications.

Modules are available with or without interface control logic. The interface control logic provides for decoding, storage, and coaxial relay drive. The standard logic accepts X-Y coordinate 4-bit BCD, plus a strobe latch pulse and a clear-all pulse. Units without the interface control logic are available with or without transient suppression diodes.



1 x 8 COAXIAL SWITCH

TYPICAL SPECIFICATIONS FOR MODULAR UNITS

Frequency	DC to 10 MHz	20 MHz
Crosstalk	≥−95 db	≥−95 db
Isolation	−62 db	−58 db
VSWR	1.35:1	2.0:1
Insertion Loss	0.3 db	0.6 db

Data will vary with the frequency of the test signal and the crosspoint tested.

ACCESSORIES FOR THE MODULAR UNITS

Rack Chassis MC-2: A 3½" by 19" standard rack chassis that can accept up to three 10 x 10 modules including 3 coax connector shells.

I-O Cableing MPCX-L-Z: Coax cable for connecting the customer's equipment to the matrix inputs and outputs. A matrix coax connector on one end and no connector on the other end.

Intercableing MPC-L-Z: Coax cable jumpers for connecting one module to another module to expand the matrix to larger than 10 x 10. eg: 10 x 20.

RACK CHASSIS MC-3: 7" x 19"

Standard Rack Chassis that can accept up to eight 1 x 8 modules including eight coax connertor shells.

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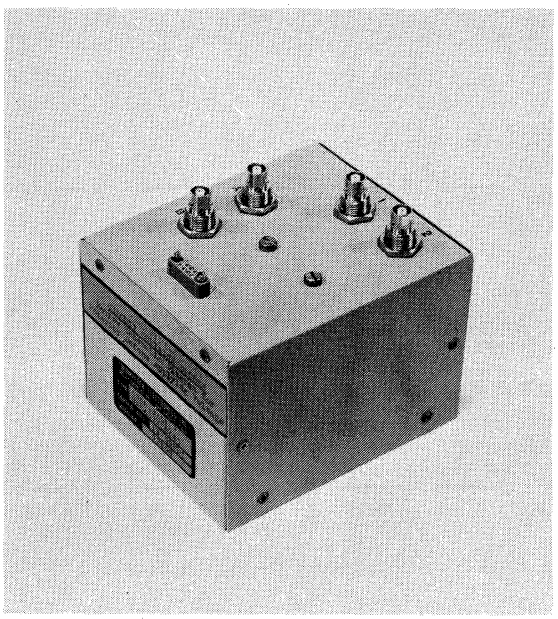
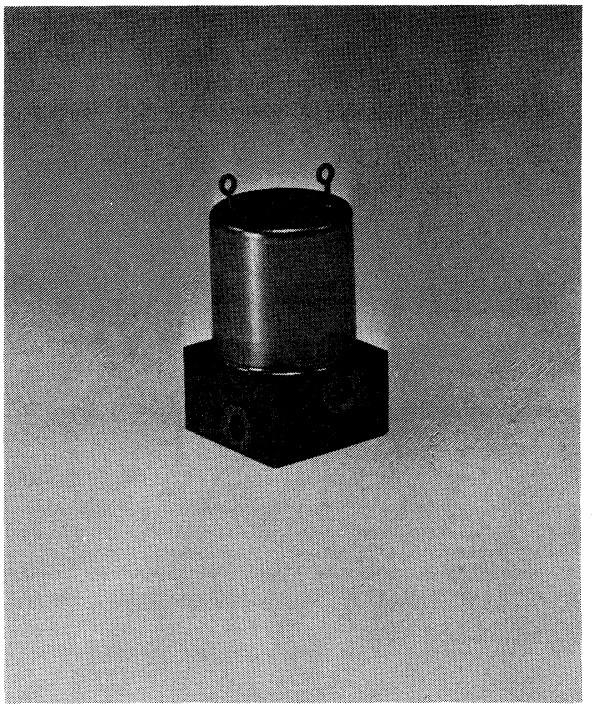
See EEM pages Vol.3•946 to Vol.3•951.

75 OHM BROADBAND DC TO 1GHz SWITCHING





Trompeter Electronics manufactures precision 75 ohm broadband coaxial matrices and multipole, multithrow switches having high isolation and high return loss for use in microwave carrier systems for baseband and I.F. restoration, protection and maintenance switching. These products are also usable in CATV and CCTV R.F. cable distribution systems where origination or routing switching is required. Through the use of optional expansion ports, these matrices may be configured to meet a variety of matrix sizes and will permit future expansion as required.

GENERAL SPECIFICATIONS FOR HIGH-FREQUENCY MATRICES AND SWITCHES

Signal Power:	50 watts carry
Control Voltage:	48 VDC nominal (other voltages available)
Actuation Pull-in Time:	8 milliseconds
Transfer Time:	Less than 5 milliseconds
Signal Connectors:	75 ohms, BNC; N; F; and subminiature snap on
Power Connector:	Winchester (mate is supplied)
Mechanical Life:	1 x 10^6 cycles (electrical life is a function of operating rate and load)

TYPICAL SPECIFICATIONS HFMB3X5B*

Frequency	DC to 10 MHz	60 MHz	80 MHz	260 MHz	500 MHz
Isolation	>−130 db	>−130 db	−120 db	−100 db	−72 db
Crosstalk	>−130 db	>−130 db	>−130 db	>−130 db	>−130 db
VSWR	1.1:1	1.14:1	1.14:1	1.15:1	1.15:1
Insertion Loss	−0.7 db	−1.3 db	−1.5 db	−1.55	−1.65

Data will vary with the size of the matrix and the crosspoint tested.

*See Catalog T-9

TROMPETER ELECTRONICS, INC.
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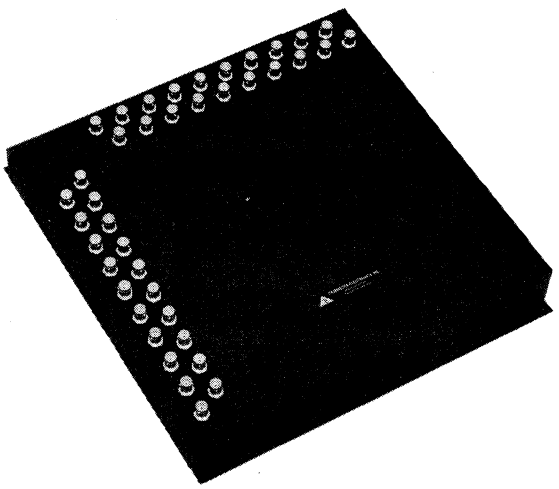
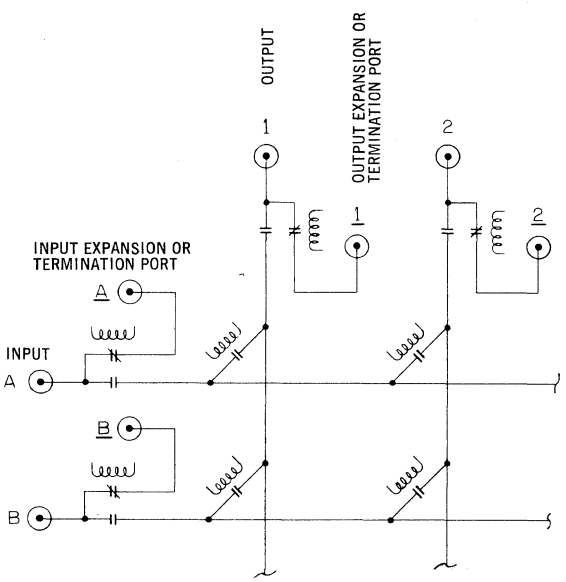
See EEM pages Vol.3•946 to Vol.3•951.

COAXIAL SWITCHING

LOW COST 75 OHM 10×10 VIDEO MATRIX CMAPC10×10B



The 10 x 10 expandable coaxial matrix utilizes microstrip transmission line technology with dry-reed switches to provide excellent performance in the DC to 20 MHz range at very reasonable cost. The microstrip transmission line technique used compensates for the impedance mismatches of the various switching arrangements encountered within the matrix. Special matrix cut-off switches (see schematic) are provided at both the input and output ports to allow the use of additional 10 x 10 modules to make a larger switching unit with minimum of loss and degradation of signal due to stub action.



TYPICAL SPECIFICATIONS CMAPC10X10B

Frequency	DC to 12 MHz
Crosstalk	≥ −47 db
Isolation	≥ −70 db
VSWR	1.15:1
Insertion Loss	0.2 db

Data will vary with the frequency of the test signal and the crosspoint tested.

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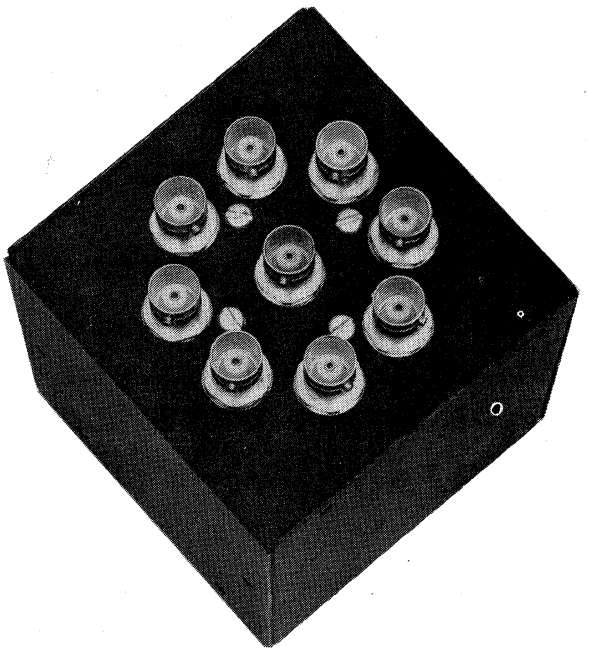
See EEM pages Vol.3•946 to Vol.3•951.

COAXIAL SWITCHING

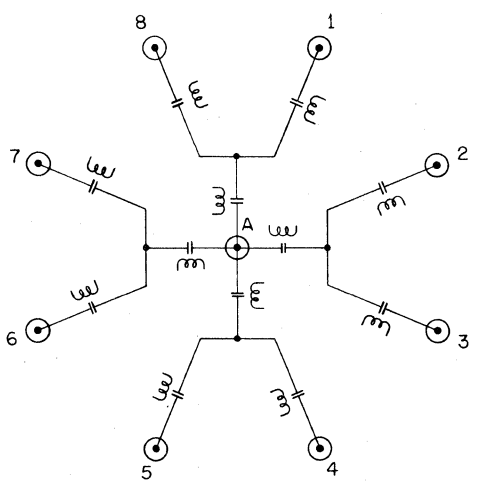
CSAZ1x8B CIRCULAR SWITCH



This 50 ohm circular switch is designed for operation from DC to 700 MHz. Particular attention is given to equalizing line lengths and maintaining constant impedance transmission paths. The CSAZ1x8B includes long life dry reed switches, and is equipped with transient protection diodes to protect logic drive. Available with either BNC or TNC 50 ohm connectors. In addition to the 1 x 8 version, a 1 x 4 (CSAZ1x4B) and a 1 x 6 (CSAZ1x6B) are available.

SCHEMATIC

CIRCULAR SWITCH CSAZ1X8B



TYPICAL SPECIFICATIONS CSAZ1X8B (refer to Catalog T-9)

Frequency	DC to 300 MHz	650 MHz
Isolation†	−39 db	−33 db
Isolation‡	≥−70 db	≥−70 db
VSWR	1.2:1	1.25:1
Insertion Loss	−0.6 db	−1.0 db

Data will vary with the size of the switch and the crosspoint tested.

† Adjacent Port

‡ Non-Adjacent Ports

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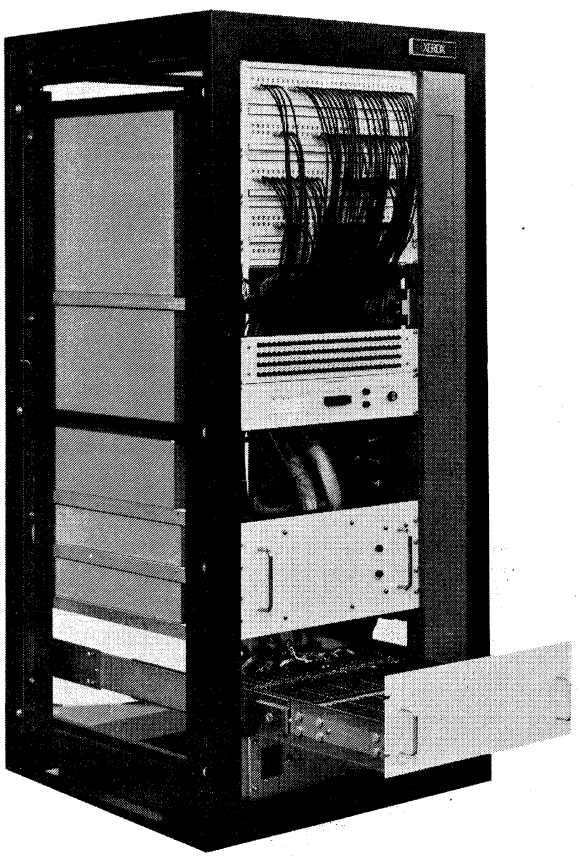
See EEM pages Vol.3•946 to Vol.3•951.

SYSTEMS AND CONTROLS

Trompeter engineers have the capability of designing to customer requirements complete switching and control systems. Complete systems can be assembled using standard Trompeter connectors, patch panels, and matrix switches, plus design of special manual or remote logic controls.

Pictured (below) is a system illustrative of Trompeter's ability to meet a customer's specification — in this case a computer controlled automatic aircraft avionics check out system.



FOR THIS SYSTEM

1. Nine matrices of varying sizes were integrated to simulate a 50 x 50 matrix but without the size, cross-points, cost and problems inherent in a matrix of such massive size.
2. A digital interface was built to handle switching control signals coming from either the computer or the manual control panel.
3. A manual control system was designed using as appropriate, thumbwheel, pushbutton, and rotary switches to provide local control should the binary control signal fail.
4. 5 patch panels of two different sizes were used to provide manual signal path control as additional flexibility and backup in case of complete power failure.
5. A status panel using LEDs was designed and built to give the operators a visible matrix cross-point closure indication.
6. Power source and package integration.

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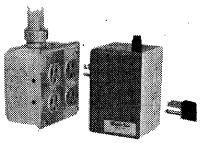
See EEM pages Vol.3•946 to Vol.3•951.

The most complete line of solid-state CIRCUIT PROTECTORS

Low cost, high speed, high quality, solid-state protectors prevent electrical/electronic component, circuit, equipment or system burn-outs, malfunctions, or misregistration of logic information. Protect against all transients arising from hookup, startup, shutdown, switching, stray pickup, lightning. Higher surge capacities, reliability and more accurate trip points than zeners, spark gaps or low voltage relays. Be prepared for forthcoming OSHA requirements against electrical transient pollution.

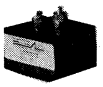


AC TRANSIENT SUPPRESSOR

7200 watts! Permits safe, continued operation of equipment!

Bi-directional suppressor clips incoming surges and prevents your equipment from polluting line with transients. Capable of handling 7200 watts for 10 ms. Clips surge within 500 nS whenever transient reaches 143 Vrms (200V peak). 110 VAC plug-in and OEM models. 50 to 400 Hz, 20 amp rating.

Model ACP-100
Request Bulletin No. 100

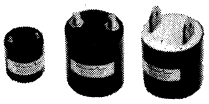


NEW! AC TRANSIENT SUPPRESSOR

Two-stage suppression for low and high energy surges!

Capable of handling 4600 watts for 10 ms. Unique 2-stage unit senses transient, computes suppression required and reacts accordingly. First stage handles transient energy to 1 KW, second stage to 4.6 KW. Clips surge at 143 Vrms (200V peak). 110 VAC, 50 to 400 Hz, 10 amp rating. Standard models for 220 VAC also available.

Model ACP-10
Request Bulletin No. 104

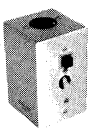


AC CROWBARS

Low cost fault protection against misapplied voltages and regulator failure!

Protects equipment from overvoltages due to generator runaway or misapplied voltages. Higher surge capacity, accuracy and reliability than any others on the market. Complete line of bi-directional, heavy-duty units for 110 or 220 VAC, single or three phase.

Request Bulletin No. 110



AC LOW VOLTAGE PROTECTOR

Plug-in and OEM low AC line protectors

Protect inductive motors, instrumentation, monitoring equipment, series regulated power supplies and other electronics affected by "brownout" conditions. Trips when line remains between 80 and 108 volts for 2 to 5 seconds. Longer response times available. Models with automatic reset or resettable breaker. 110 VAC, 50 to 400 Hz, 20 amp rating. 220 VAC models also available.
Model LV-100
Request Bulletin No. 102

NEW! AC LOW VOLTAGE DETECTOR

Senses "brownout" conditions and provides two signal outputs!

Inexpensive. Accurate. Upon sensing continuous low line between 80 and 108 volts, solid-state switch energizes and provides output signal to operate relay coil, contactor, circuit breaker or alarm. Signal can operate 24, 110 or 220 VAC units. Response time is 2 to 5 seconds. Longer response times available. When line returns to normal switch de-energizes, resetting coil or contactor. 110 or 220 VAC, 50 to 400 Hz.
Model LV-10A
Request Bulletin No. 105

AC units protect against transient pollution which OSHA is moving to regulate.

AC or DC SUPPRESSOR/CROWBAR COMBINATIONS

The ultimate in transient voltage protection!

AC or DC models combine the best features of Transtector Crowbars and Voltage Suppressors. Suppressor portion clips nuisance transients, minimizing fuse or breaker clearing. If transient continues or has sufficient energy, crowbar fires, causing circuit's fuse or breaker to open.

Request Bulletin No. 108

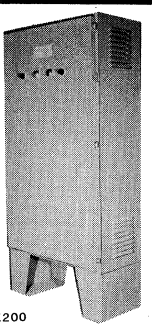
INDUSTRIAL PLANT SURGE SUPPRESSORS

Heavy-duty AC line transient suppressors!

Models available for 110 or 220 VAC, 3-phase, 4-wire lines carrying up to 150 amp service. Capable of dissipating up to 600,000 watts of transient energy for 8.3 ms. Largest suppressor is an automatic variable impedance device which can handle 7 separate 3-phase circuits.

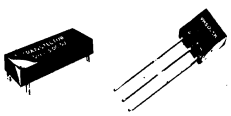
Request Bulletin No. 101 for ACP-1000
Request Bulletin No. 1000 for VZ200

ACP-1000



VZ200

ASK US ABOUT GROUND FAULT INTERUPTERS IN EARLY 1974!

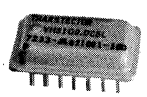


DC HYBRID CROWBARS

Low cost protection for power supplies up to 5 amps!

Thick film hybrid units using thyristor (SCR) crowbar circuitry give maximum protection at minimum cost. Capable of handling 40 amps for 10 ms. When transient reaches trip point, crowbar shunts line to ground within 500 ns, causing circuit's fuse or breaker to open. Recovers automatically when line is restored. Typical standard trip points: 5, 6.5, 14, or 16.5 VDC.

Request Bulletin No. 103



NEW!

Hermetically sealed hybrid crowbar with remote sense and logic output!

Crowbars line when transient reaches trip point, and provides TTL conditioned output signal for light driver circuits or computer command. Can handle 40 amps for 10 ms. For use on 5 amp power supplies. Typical standard trip points: 5, 6.5, 14, 16.5 VDC. 14-pin DIP case for PC mounting. Low cost epoxy case also available.

Model VHS
Request Bulletin No. 106

DC DISCRETE CROWBARS

For power supplies up to 150 amps!

Heavy-duty crowbars have brute strength for handling highest surges. Capable of handling 2000 amps for 10 ms. Typical standard trip points: 5, 6.5, 14 or 16.5 VDC. Adjustable trip point, multiple remote sense, and logic output models available. No other protection device can compare with the surge ratings, accuracy and speed of these units.

Request Bulletin No. 111

NEW! DC SURGE SUPPRESSOR

Clips transients to permit continued operation of IC's!

Specifically designed to protect TTL, ECL, DTL, MOS, and MSI integrated circuits. High quality silicon semiconductors give high speed, high power zener-type protection. Rated for peak pulse power of 1200 watts for 1 ms. ≤ 5 ns response time. Automatically recovers after suppressing transient. Models for IC's operating on 5 or 15 volt power supplies.

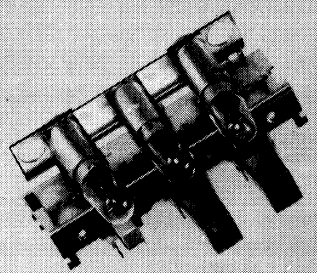
Model VZ
Request Bulletin No. 107

You name the protection problem . . . we'll provide the answer!

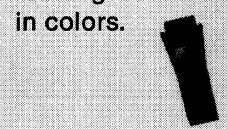
TRANSTECTOR® SYSTEMS ABSOLUTE TRANSIENT PROTECTION
division of Konic International Corporation

532 Monterey Pass Road
Monterey Park, Calif. 91754
Phone: (213) 283-9278

All American Line



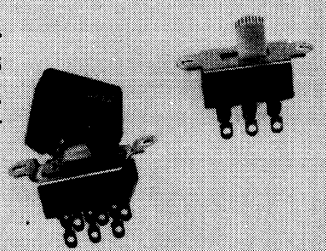
Miniature or rectangular knobs in colors.



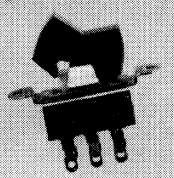
ULTRA-GLOW® ILLUMINATED SWITCHES

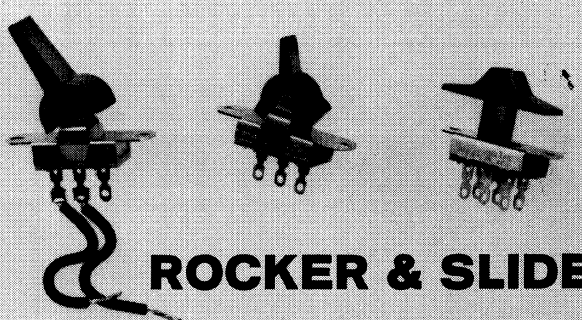
Illuminated pushbutton: available with 1 to 15 stations, 1 to 3 poles and multiple actuations. Basic switch is U.L. listed at 3 or 6 amps at 125v.

as low as **54¢** per station including bulb



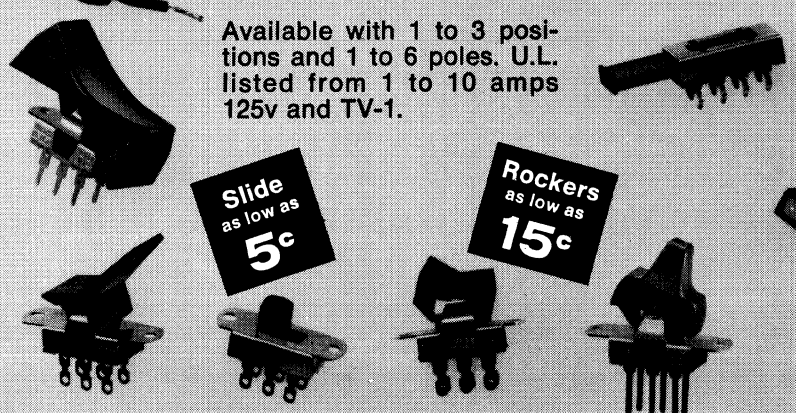
Illuminated slide and rocker: Select from 1 to 3 poles and a variety of colors. U.L. listed from 1 to 10 amps at 125v.





ROCKER & SLIDE

Available with 1 to 3 positions and 1 to 6 poles. U.L. listed from 1 to 10 amps 125v and TV-1.

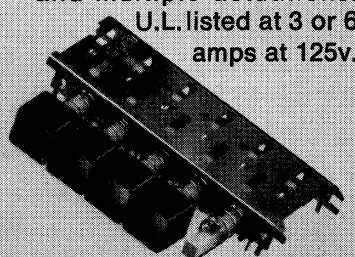


Slide as low as **5¢**

Rockers as low as **15¢**

PUSHBUTTON

You can order from 1 to 15 stations with 1 to 6 poles and multiple actuations. U.L. listed at 3 or 6 amps at 125v.



NEW metal shaft industrial pushbutton

Pushbuttons as low as **16¢** per station

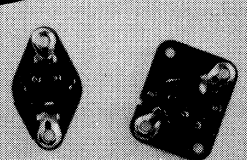
Lowest cost quality U.S. Source!

UID Electronics Corp.

4105 Pembroke Rd., Hollywood, Fla. 33021

Phone: (305) 981-1211 · TWX: 510—954—9810

PC tube sockets: 7 and 9 pin



Transistor sockets: For TO-3 and TO-66 Case

Unimax® Switch

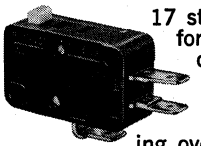
The complete line of snap-acting Standard, Miniature, Subminiature and Miniature Subminiature switches for commercial and military applications.

Basic precision switches

Type 2 HB

The basic switch for close control of electrical circuits requiring combinations of small motions, high repeatability and long life. Switches can be sealed or unsealed and all types of actuators are available. Ratings start at 20 amps to 480 VAC. UL and CSA listed. **Detailed specifications in our Catalog 60.**

Low-Force miniature switches Type TM

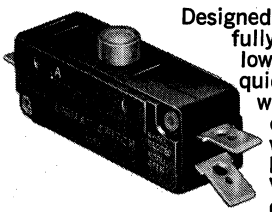


17 standard models feature low operating force with negative force gradient, and a complete line of lever and roller lever actuators. Four terminal styles include ¼" quick-connect. Molded-in overtravel stop limits button movement, preventing overstress and shock loading of blade. Mounting holes are independent of cover for improved electrical insulation and high case strength. Two lever pivot locations provide either low actuating motion or forces as low as 8 grams. Ratings from dry circuit to 15 amps. **Detailed specifications in our Catalog 60.**

Basic subminiature switches Type LM

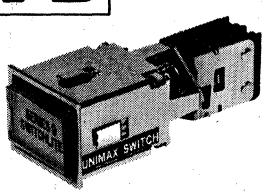
Long life subminiature switches provide reliable switching in limited space. Variations available include integral or auxiliary actuators, ratings to 10 amperes, silver or gold cross bar contacts and choice of four terminal styles. **Detailed specifications in our Catalog 60.**

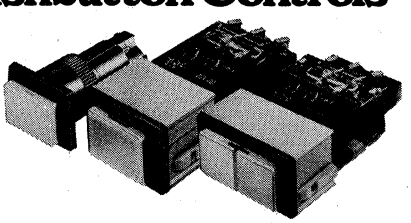
General purpose switches Type A



Designed for applications that require fully enclosed, high performance, low-cost, snap-acting switches with quick-connect terminals. Stall free, with high repeatability. Single or double pole, sealed or unsealed with a full range of actuators. Rated 15 or 25 amps at 125/250 VAC. **Detailed specifications in our Catalog 60.**

LPB Lighted Pushbutton Controls





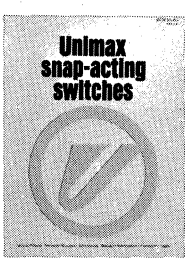
LPB Series 9 Lighted Pushbutton Switches

Unimax LPB Series 9 are four lamp lighted pushbutton panel controls designed to meet the requirements of MIL-S-22885/9-12 (for QPL approved controls designate series 9M). They are offered in a wide range of display styles. Color coding and customized messages can be easily changed or modified in the field. **For more technical information request our Catalog 50.**

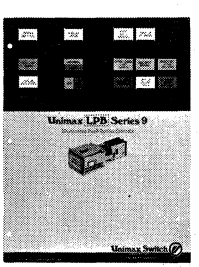
LPB EAO Series Lighted Pushbutton Controls

The EAO Series 01, 02, 03 LPB's offer you an exceptionally large selection of high quality illuminated pushbutton switches with a wide range of styles, capabilities and prices. All models are available in momentary or alternate actions or as indicators only. All EAO Series LPB's are quickly and easily installed, and relampable from the front of the panel. Ratings, and electrical and mechanical performance are uniformly high. The EAO switches provide a complete choice of lens cap colors in all models. **For more technical information request our Bulletin 515.**

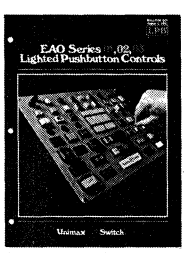
Free Catalogs!
At your request



44 page catalog #60 on snap-acting switches.



12 page catalog #50 on LPB Series 9.



6 page bulletin #515 on EAO Series.

Unimax® Switch CORPORATION
A Riker-Maxson Subsidiary, Ives Road, Wallingford, Connecticut 06492
Phone (203) 269-8701, TWX (710) 476-1397

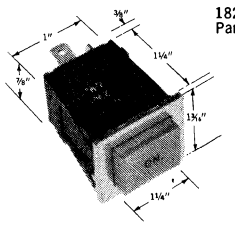
waldom / molex

4633 WEST 53rd STREET / CHICAGO, ILLINOIS 60632 / (312) 585-1212

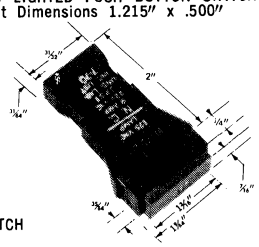
LIGHTED PUSH-BUTTON SWITCHES

The WALDOM/MOLEX 1175 model is a high quality lighted push button switch that's sturdy, well designed and offers a wide choice of features. Bezels are high quality chrome plated. Housings are precision molded of durable phenolic, and the buttons are mar-resistant nylon.

The WALDOM/MOLEX 1820 Model lighted push button switch proves that a switch can be extremely attractive yet meet rigid extraordinary versatility and limitless design possibilities. You can use one switch or gang them together . . . depending on installation requirements. Its housing is made from highest quality nylon, ultrasonically welded for a secure, quality assembly. No rivets or screw heads protrude from the housing. 125 volts are UL & CSA recognized.



1820 SERIES LIGHTED PUSH BUTTON SWITCH
Panel Cut-out Dimensions 1.215" x .500"



1175 SERIES LIGHTED PUSH BUTTON SWITCH
Panel Cut-out Dimensions 1.115" x .915"

Eng. P/N	Switch Action	Volts	Amps	White Button New P/N	Red Button New P/N	Amber Button New P/N	Green Button New P/N	Legend	Price Each 1-9	10-24	25-49	50-99	100 up
117510	PP	6	2	01-10-6001	01-10-6002	01-10-6008	01-10-6003	—	3.38	2.76	2.46	2.34	2.03
117510	MNO	6	2	01-11-6006	01-11-6007	01-11-6001	01-11-6002	—	3.42	2.80	2.49	2.37	2.05
117510	MNC	6	2	01-12-6006	01-12-6007	01-12-6001	01-12-6002	—	3.42	2.80	2.49	2.37	2.05
117520	PP	14	2	01-10-4013	01-10-4014	01-10-4015	01-10-4016	—	3.33	2.73	2.42	2.30	1.98
117520	MNO	14	2	01-11-4003	01-11-4004	01-11-4005	01-11-4006	—	3.38	2.76	2.46	2.34	2.00
117520	MNC	14	2	01-12-4001	01-12-4002	01-12-4003	01-12-4004	—	3.38	2.76	2.46	2.34	2.00
117530	PP	28	2	01-10-3003	01-10-3004	01-10-3005	01-10-3006	—	3.45	2.83	2.51	2.38	2.10
117530	MNO	28	2	01-11-3008	01-11-3009	01-11-3010	01-11-3011	—	3.50	2.86	2.54	2.41	2.12
117530	MNC	28	2	01-12-3002	01-12-3003	01-12-3004	01-12-3005	—	3.50	2.86	2.54	2.41	2.12
117540	PP	125	8.5	01-15-1061	01-15-1062	01-15-1067	01-15-1068	—	3.61	2.95	2.62	2.49	2.03
117540	MNO	125	8.5	01-16-1049	01-16-1050	01-16-1045	01-16-1051	—	3.70	3.02	2.69	2.56	2.06
117540	MNC	125	8.5	01-17-1006	01-17-1007	01-17-1002	01-17-1008	—	3.70	3.02	2.69	2.56	2.06
117560	PP	6	2	01-10-6004	01-10-6009	01-10-6010	01-10-6005	ON	3.62	2.96	2.63	2.50	2.05
117560	PP	6	2	01-10-6006	01-10-6007	01-10-6011	01-10-6012	OFF	3.62	2.96	2.63	2.50	2.05
117560	MNO	6	2	01-11-6009	01-11-6008	01-11-6003	01-11-6004	ON	3.66	3.00	2.66	2.53	2.07
117560	MNO	6	2	01-11-6010	01-11-6011	01-11-6005	01-11-6012	OFF	3.66	3.00	2.66	2.53	2.07
117560	MNC	6	2	01-12-6008	01-12-6009	01-12-6003	01-12-6004	ON	3.66	3.00	2.66	2.53	2.07
117560	MNC	6	2	01-12-6010	01-12-6011	01-12-6005	01-12-6012	OFF	3.66	3.00	2.66	2.53	2.07
117570	PP	14	2	01-10-4017	01-10-4018	01-10-4019	01-10-4020	ON	3.58	2.93	2.60	2.47	1.99
117570	PP	14	2	01-10-4021	01-10-4022	01-10-4023	01-10-4024	OFF	3.58	2.93	2.60	2.47	1.99
117570	MNO	14	2	01-11-4007	01-11-4008	01-11-4009	01-11-4010	ON	3.62	2.96	2.63	2.50	2.01
117570	MNO	14	2	01-11-4011	01-11-4012	01-11-4013	01-11-4014	OFF	3.62	2.96	2.63	2.50	2.01
117570	MNC	14	2	01-12-4005	01-12-4006	01-12-4007	01-12-4008	ON	3.62	2.96	2.63	2.50	2.01
117570	MNC	14	2	01-12-4009	01-12-4010	01-12-4011	01-12-4012	OFF	3.62	2.96	2.63	2.50	2.01
117580	PP	28	2	01-10-3007	01-10-3008	01-10-3009	01-10-3010	ON	3.70	3.02	2.69	2.56	2.12
117580	PP	28	2	01-10-3011	01-10-3012	01-10-3013	01-10-3014	OFF	3.70	3.02	2.69	2.56	2.12
117580	MNO	28	2	01-11-3012	01-11-3013	01-11-3014	01-11-3015	ON	3.74	3.06	2.72	2.58	2.14
117580	MNO	28	2	01-11-3016	01-11-3017	01-11-3018	01-11-3019	OFF	3.74	3.06	2.72	2.58	2.14
117580	MNC	28	2	01-12-3006	01-12-3007	01-12-3008	01-12-3009	ON	3.74	3.06	2.72	2.58	2.14
117580	MNC	28	2	01-12-3010	01-12-3011	01-12-3012	01-12-3013	OFF	3.74	3.06	2.72	2.58	2.14
117590	PP	125	8.5	01-15-1063	01-15-1069	01-15-1070	01-15-1064	ON	3.85	3.15	2.80	2.66	2.04
117590	PP	125	8.5	01-15-1065	01-15-1066	01-15-1071	01-15-1072	OFF	3.85	3.15	2.80	2.66	2.04
117590	MNO	125	8.5	01-16-1052	01-16-1053	01-16-1047	01-16-1048	ON	3.94	3.22	2.86	2.72	2.08
117590	MNO	125	8.5	01-16-1054	01-16-1055	01-16-1046	01-16-1056	OFF	3.94	3.22	2.86	2.72	2.08
117590	MNC	125	8.5	01-17-1009	01-17-1010	01-17-1004	01-17-1005	ON	3.94	3.22	2.86	2.72	2.08
117590	MNC	125	8.5	01-17-1011	01-17-1012	01-17-1003	01-17-1013	OFF	3.94	3.22	2.86	2.72	2.08
1820 SERIES SWITCHES									**For larger quantity pricing, contact Waldom Electronics**				
182010	PP	6	2	01-50-6001	01-50-6002	01-50-6008	01-50-6003	—	3.84	3.14	2.79	2.65	2.57
182010	MNO	6	2	01-52-6006	01-52-6007	01-52-6001	01-52-6002	—	3.99	3.27	2.90	2.76	2.69
182010	MNC	6	2	01-53-6006	01-53-6007	01-53-6001	01-53-6002	—	3.99	3.27	2.90	2.76	2.69
182020	PP	14	2	01-50-4001	01-50-4002	01-50-4003	01-50-4004	—	3.86	3.16	2.81	2.67	2.53
182020	MNO	14	2	01-52-4001	01-52-4002	01-52-4003	01-52-4004	—	4.02	3.29	2.92	2.77	2.57
182020	MNC	14	2	01-53-4001	01-53-4002	01-53-4003	01-53-4004	—	4.02	3.29	2.92	2.77	2.57
182030	PP	28	2	01-50-3002	01-50-3003	01-50-3004	01-50-3005	—	3.84	3.14	2.79	2.65	2.57
182030	MNO	28	2	01-52-3001	01-52-3002	01-52-3003	01-52-3004	—	3.99	3.27	2.90	2.76	2.69
182030	MNC	28	2	01-53-3001	01-53-3002	01-53-3003	01-53-3004	—	3.99	3.27	2.90	2.76	2.69
182040	PP	125	9	01-55-1002	01-55-1003	01-55-1008	01-55-1009	—	3.73	3.05	2.71	2.57	2.33
182040	MNO	125	9	01-57-1006	01-57-1007	01-57-1002	01-57-1008	—	3.88	3.18	2.82	2.68	2.38
182040	MNC	125	9	01-58-1005	01-58-1006	01-58-1001	01-58-1007	—	3.88	3.18	2.82	2.68	2.38
182060	PP	6	2	01-50-6004	01-50-6009	01-50-6010	01-50-6005	ON	4.08	3.34	2.97	2.82	2.66
182060	PP	6	2	01-50-6006	01-50-6007	01-50-6011	01-50-6012	OFF	4.08	3.34	2.97	2.82	2.66
182060	MNO	6	2	01-52-6008	01-52-6009	01-52-6003	01-52-6004	ON	4.24	3.47	3.08	2.93	2.70
182060	MNO	6	2	01-52-6010	01-52-6011	01-52-6005	01-52-6012	OFF	4.24	3.47	3.08	2.93	2.70
182060	MNC	6	2	01-53-6008	01-53-6009	01-53-6003	01-53-6004	ON	4.24	3.47	3.08	2.93	2.70
182060	MNC	6	2	01-53-6010	01-53-6011	01-53-6005	01-53-6012	OFF	4.24	3.47	3.08	2.93	2.70
182070	PP	14	2	01-50-4005	01-50-4006	01-50-4007	01-50-4008	ON	4.10	3.36	2.98	2.83	2.55
182070	PP	14	2	01-50-4009	01-50-4010	01-50-4011	01-50-4012	OFF	4.10	3.36	2.98	2.83	2.55
182070	MNO	14	2	01-52-4005	01-52-4006	01-52-4007	01-52-4008	ON	4.26	3.48	3.10	2.95	2.59
182070	MNO	14	2	01-52-4009	01-52-4010	01-52-4011	01-52-4012	OFF	4.26	3.48	3.10	2.95	2.59
182070	MNC	14	2	01-53-4005	01-53-4006	01-53-4007	01-53-4008	ON	4.26	3.48	3.10	2.95	2.59
182070	MNC	14	2	01-53-4009	01-53-4010	01-53-4011	01-53-4012	OFF	4.26	3.48	3.10	2.95	2.59
182080	PP	28	2	01-50-3006	01-50-3007	01-50-3008	01-50-3009	ON	4.08	3.34	2.97	2.82	2.66
182080	PP	28	2	01-50-3010	01-50-3011	01-50-3012	01-50-3013	OFF	4.08	3.34	2.97	2.82	2.66
182080	MNO	28	2	01-52-3005	01-52-3006	01-52-3007	01-52-3008	ON	4.24	3.47	3.08	2.93	2.70
182080	MNO	28	2	01-52-3009	01-52-3010	01-52-3011	01-52-3012	OFF	4.24	3.47	3.08	2.93	2.70
182080	MNC	28	2	01-53-3005	01-53-3006	01-53-3007	01-53-3008	ON	4.24	3.47	3.08	2.93	2.70
182080	MNC	28	2	01-53-3009	01-53-3010	01-53-3011	01-53-3012	OFF	4.24	3.47	3.08	2.93	2.70
182090	PP	125	9	01-55-1004	01-55-1010	01-55-1011	01-55-1005	ON	3.97	3.25	2.89	2.75	2.35
182090	PP	125	9	01-55-1006	01-55-1007	01-55-1012	01-55-1013	OFF	3.97	3.25	2.89	2.75	2.35
182090	MNO	125	9	01-57-1009	01-57-1010	01-57-1003	01-57-1005	ON	4.13	3.38	3.00	2.85	2.40
182090	MNO	125	9	01-57-1011	01-57-1012	01-57-1004	01-57-1013	OFF	4.13	3.38	3.00	2.85	2.40
182090	MNC	125	9	01-58-1008	01-58-1009	01-58-1002	01-58-1004	ON	4.13	3.38	3.00	2.85	2.40
182090	MNC	125	9	01-58-1010	01-58-1011	01-58-1003	01-58-1012	OFF	4.13	3.38	3.00	2.85	2.40

Engineering Part Nos. are to be used as a Reference No. only. Order by proper 8 digit Part No. shown.
Manufactured by Molex Products Co. These items are made available from leading electronic distributors through Waldom Electronics Inc.
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N.Y. STATE CALL COLLECT (516) 294-0990)

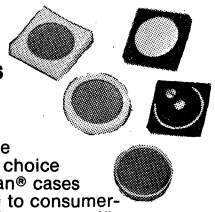
WILD ROVER™

TOUCH ACTIVATED SWITCHES and KEYBOARD FAMILY

The remarkable acceptance of "Touch-activated" switches and keyboards can be attributed to the unique, patented "Electrical grating" contact design. This exclusive development enables transient energy to be distributed evenly over a multiplicity of contact points—a first in switch technology! Add to this extremely small, low profile,contemporary design, sealed packaging and a significant level of economy. This obsoletes all conventional switch devices and opens an unlimited variety of applications for alert design engineers.

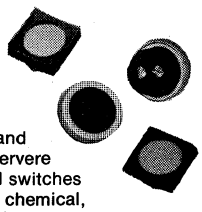
"Touch-activated" switches are a true retrofit for any momentary switch and are basic to our Mono-lithic™ and Mini-lithic™ keyboards. They are rugged, dependable, durable—operating with consistent reliability under rigorous environmental or human abuse conditions. Turn-on/turn-off time is extremely fast and clean. Inductive, dry circuit or low level applications are handled with ease. A wide choice of styles, colors, surface designs, illuminations, legends and mounting possibilities are offered.

TC-1 Standard Touch Switches
Series S



Available in 4 attractive styles, in a wide color choice with unbreakable Lexan® cases and specifically suited to consumer-oriented control functions, e.g., office machines, elevators, vending machines, "panic buttons", etc. They are dust-proof, oil and water resistant. Style S1 offers a finger guiding,contoured face with raised corners for a bumper effect. Style S2 has a more formal, unsculptured appearance and a flat face. Style S3 is a traditional circular switch, compatible with most equipment. Style S4 offers a metallic circular frame to accent function within any product design. LED or incandescent illumination is optional. Legendizing is available in our standard format.
Specifications *Switch Ratings:* 12VAC to 220 VAC, 50ma to 1.6 amp; 12VDC to 24VDC, 200 ma to 1 amp. *Resistance:* 30 milliohms nominal. *Life:* In excess of 10,000,000 cycles, low load; 1,000,000, high load. *Operating Temperature:* -65°F to +167°F. *Size & Weight:* 1"x1"lx ½"; 9gr.

TC-1™ Sealed Touch Switches
Series Se

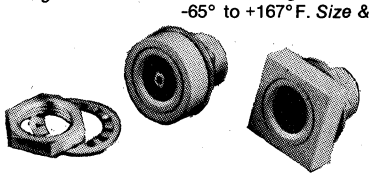


Ideal for industrial use and tested under the most servere conditions, these sealed switches are immune to outdoor, chemical, water-oil-dust-laden environments. They will function under extremes of shock and vibration. Accidental turn-on cannot occur due to a local disturbance and the switches will not support combustion. They are available as Styles Sel, Se2, and Se3 in a wide choice of colors, illumination options and standard legends. Physically, each has the same look, size and weight of the standard touch switches (S1,S2,S3), but they are fully sealed devices.
Specifications *Switch Ratings:* 24VAC to 220 VAC, 50ma to 1.6 amps; 24VDC, 200ma to 1 amp. *Resistance:* 30 milliohms nominal. *Life:* In excess of 10,000,000 cycles, low load; 1,000,000, high load. *Operating Temperature:* -65° to +167°F. *Size & Weight:* 1"x1"x½" 9gr.

TC-1 Mini-Lithic™ Touch Switches
Series M

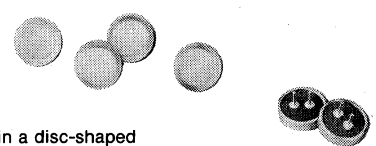
These economical, mini-sized sealed switches are especially useful where space is at a premium and striking appearance plus functional reliability are imperative. They offer ample finger area, no appreciable thickness and are virtually maintenance-free. Inherently sealed, they can withstand severe physical shock and offer "coffee and soda-proof" benefits. Suited to PC board mounting, they offer a broad range of application from intercoms to minicomputers and appliances. In 3 styles: Style M7 is square-shaped; Style M9 is the same, with recessed face; and both can be arrayed into keyboards. Style M8 is round. All are offered in variety of legends and color combinations.
Specifications *Switch Ratings:* 12VAC to 115 VAC, 0.05 amp to 1.6 amps; 12VDC to 24VDC, 0.05 amp to 1.0 amp. *Contract Resistance:* 30 milliohms typical. *Temperature Range:* -50°F to +167°F. *Life:* Conservatively rated at 1,000,000 cycles. *Size & Weight:* .75" x .75" (M7); .75"dia (M8); .875" x .875" (M9); 3gr.

TC-1™ Ruggedized Touch Switches
Series R



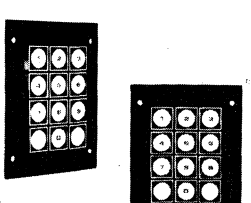
Touch operation in a sealed housing to withstand hammer blows and continuous exposure to rigorous elements! Gloved hand operation! Series R switches are offered in 2 styles suited to heavy duty use, e.g., materials handling, data entry from hazardous areas. They are also useful as machine safety inter-locks, having sealed-in contacts encapsulated into anodized aluminum bodies. The thick recessed aluminum touch plate prevents accidental operation and has a Mylar overlay for various colors and legends. Style R6 has a round frame. The square framed Style R5 is offered with illumination options.
Specifications *Switch Ratings:* 24VAC to 220VAC, 0.5 amp to 6.0 amps; 24 VDC to 220VDC, 0.2 amp to 1 amp. *Resistance:* 30 milliohms typical. *Temperature Range:* -80°F to +200°F. *Size:* 1.50" (square) x 1.50"d (w/threaded body); 1.50"dia. (round) x 1.50"d (w/threaded body).

TC-1™ Switch Capsule
Series C



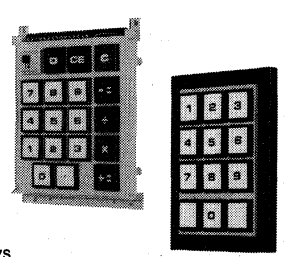
Our basic switch element in a disc-shaped capsule, offering design engineers a low cost, easy-to-install switch without cosmetic frills. If offers a broad range of application and is suited for PC board installation. The switch capsule adapts easily to automatic insertion and flow-soldering techniques, interfacing readily with a variety of actuating systems. It offers the significant advantages of the "electrical grating" principle; is shock and heat resistant; and combines rugged construction with long-term life expectancy. A highly automatable package, it offers an unprecedented combination of outstanding performance and low cost.
Specifications *Switch Ratings:* 12VAC to 220VAC, 50ma to 1.6 amps; 12VDC to 24VDC, 200ma to 1 amp. *Resistance:* 30 milliohms nominal. *Life:* In excess of 10,000,000 cycles, low load; 1,000,000 cycles, high load; *Operating Temperatures:* -80°F to +200°F. *Size & Weight:* .615"dia. x 160"; 1.4gr.

TC-1™ Mini-Lithic™ Keyboard Systems
Series TC-K/M7-12



The unique appearance and functional advantages of Mini-lithic "touch" switches are now in keyboard forms for such space-saving applications as minicomputers, industrial panels, vending machines, etc. Maintenance-free durability, small size, and intrinsic economy are featured. They are also inherently sealed and survive severe physical shock. Keyboard style M7-12 is available in 12 key array and is mounted on a printed circuit board with standard legendizing from 0 to 9. Standard key colors are available at a nominal, non-recurring engineering cost.
Specifications Mini-Lithic Keyboard Systems relate to Switch Style M7 employed in a standard 12 key array. See Series M specifications for specific details.

Microthik™ I & II Moving Key Keyboard Systems



Featured is our patented "Electrical Grating" contact design in a special form that is ideally suited to numerical data entry devices, e.g. pocket calculators, for the Microthik I and for most communications applications with Microthik II. Microthik I is available in standard 17 to 20 key arrays with many options for special formats. Microthik II has a basic 12 keyboard, again with many options. Both offer a full, 1/16" key travel plus an ultra-slim, .330" board profile. Performance and furability is unfailing. Arrayed on a PC board, the keys travel in a smooth linear motion without rocker effect. Operational tactile sense is minimal and typical of the most expensive, 7rger boards. Key and frame assemblies are permanently injection molded. Legendizing is achieved through the use of a double layer of vinyl and mylor for total color and legend flexibility.
Specifications *Switch Rating:* 24VAC/VDC, 200mA. *Resistance:* 30 milliohms, nominal *Transient noise:* 1 msec. *Life:* to 10,000,000 cycles, low duty. *Temperature Range:* -65° to +167°F.

PRODUCT SPECIFICATIONS

Designation	Style	Type of Seal	Code* (Power Rating)	Contact Form**	Contact Imped.	Temp. Range	Termination	Illum Capability
TC-1/S1	Square Concave Face	Moisture Resistant Dust proof	A, B, C, D*, E	A	30 milliohms nominal Code A, B, C, E, 10 milliohms nominal Code D Same Impedance Maintained Switch Life	-65°F to +180°F	Screw or Solder Lug	*†LED or ††INCD
TC-1/S2	Square Flat Face	"	"	A		"	"	"
TC-1/S3	Round Flat Face	"	"	A		"	"	none
TC-1/S4	Round Metal Flat Face	"	"	A		"	"	none
TC-1/SE1	Square Concave Face	Water & Oil Proof (Atmospheric Pressure)	A, C, E	A		"	"	*†LED or ††INCD
TC-1/SE2	Square Flat Face	"	"	A		"	"	"
TC-1/SE3	Round Flat Face	"	"	A		"	"	none
TC-1/R5	Flat Face Square Frame	Water, Oil & Solvent Proof	"	A		-80°F to +200°F	Screw, Solder Lug Leads	*†LED or ††INCD*
TC-1/R6	Flat Face Round Frame	"	"	A		"	"	none
TC-1/M7	Square	Water Dust & Oil Proof	A, B, C D*	A, B C	30 milliohms nominal Code A, B C, E, 10 milliohms nominal Code D Same Impedance Maintained Throughout Switch Life	-50°F to +167°F	Solder pin	none
TC-1/M8	Round	Water, Dust & Oil Proof	A, B, C, D*	A, B, C		-50°F to +167°F	Solder pin	none
TC-1/M9	Rectangular Recessed Key	"	"	A, B, C		"	"	*†LED
TC-1/c	Basic Element .615" Dia. x .130"	Dust Proof	A, B, C, D*, E	A, B, C, 1½**		-80°F to +200°F	Solder Terminal	none
TCK/ Microthik I	½" sq. 17-20 keys	Dust Barrier	C	A		-65°F to +167°F	PC board	none
TCK/ Microthik II	½" sq. 12 keys	"	C	A		"	"	none
TC-K/ M7-12	0.75" sq.	Water, Dust & Oil Proof	C	A		-50°F to +167°F	"	none

*Rated for Inductive Loads
Code A 115 VAC, 1.6 Amp.; 24 VDC, 1 Amp*
Code B 48 VAC, 1.6 Amp.; 24 VDC, 1 Amp*
Code C 24 VAC, 1 Amp.; 24 VDC, 200ma*
Code E 220 VAC, .5 Amp.*

*Code D VAC. 50ma; 12 VDC, 50ma;
(Specifically engineered for dry circuit applications)

**Form A Normally open
Form B Normally closed
Form C Single pole, double throw

**Form 1½—3pole, single throw,
Sequenced A to B then AB to C

*†LED = Light Emitting Diode

††INCD = Incandescent Indicator

WILD ROVER CORP.

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Borg-Warner Thermoelectrics
DEPARTMENT OF BORG-WARNER CORPORATION WOLF AND ALGONQUIN ROADS, DES PLAINES, ILLINOIS 60018, PHONE 312/827-3131

THERMOELECTRIC COOLERS

INTRODUCTION TO THERMOELECTRIC PRODUCTS

Thermoelectric cooling units have many unique advantages over other types of coolers in their application area.

SIZE

They can be tailored to fit the application by easy addition or subtraction of modules to fill the need accurately and avoid waste.

POWER INPUT

Due to tailored modular construction, power requirements can be reduced to a minimum. Power is provided through a single pair of leads.

RELIABILITY

There are no parts that wear or clog, and no delicate moving parts. Gases, corrosive liquids or chemicals that will leak or dissipate with age are also eliminated. These features result in greatly reduced maintenance requirements.

LOGISTICS

There are no requirements at the load for pumping refrigerant or for a source of coolant such as liquid nitrogen to be added during operation of the system.

REMOTE CONTROL

The unit and heat sink are required in the cooling area; the power supply and most other control equipment can be mounted and operated remotely.

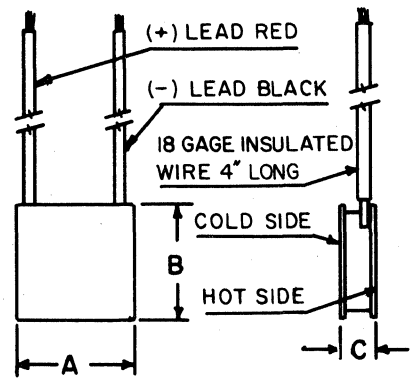
COOLING RANGE

Thermoelectric coolers are capable of operating from any heat-sink temperature from +100°C to −100°C.

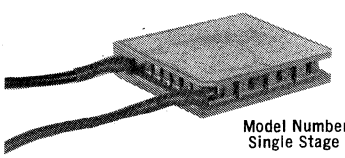
TEMPERATURE CONTROL

Simple electronic control schemes allow control within a fraction of a degree of desired load temperatures above or below ambient.

SINGLE STAGE MODULE SPECIFICATION CHART — T_H 27°C IN VACUUM

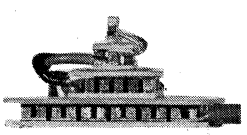


MODULE MODEL	MAX. ΔT $Q_C = 0$ ΔT — °C	MAX. Q_C ΔT = 0 Q_C — Watts	MAX. CURRENT AMPS.	MAX. VOLTAGE VOLTS	DIM A	DIM. B	DIM. C
920-3	68	1.8	8.5	.34	.26	.51	.22
920-7	68	4.3	8.5	.80	.51	.51	.22
920-15	68	9.2	8.5	1.70	.51	1.10	.22
920-31	68	19.0	8.5	3.50	1.20	1.20	.22
930-7	68	1.8	3.7	.84	.34	.34	.21
930-11	68	2.9	3.7	1.30	.34	.51	.21
930-17	68	4.5	3.7	2.00	.51	.51	.21
930-35	68	9.4	3.7	4.20	.51	1.10	.21
930-71	68	19.0	3.7	8.50	1.20	1.20	.21
940-3	66	3.0	14.0	.34	.26	.51	.18
940-7	66	6.7	14.0	.80	.51	.51	.18
940-15	66	14.5	14.0	1.70	.51	1.10	.18
940-31	66	30.0	14.0	3.60	1.20	1.20	.18
950-7	66	3.0	6.0	.90	.34	.34	.17
950-11	66	4.6	6.0	1.40	.34	.51	.17
950-17	66	7.2	6.0	2.20	.51	.51	.17
950-35	66	14.7	6.0	4.50	.51	1.10	.17
950-71	66	30.0	6.0	9.20	1.20	1.20	.17
837-8	68	1.2	1.75	1.00	.25	.35	.16
838-8	68	1.5	2.75	1.00	.25	.35	.12
840-31	68	3.3	1.00	3.00	.53	.60	.19

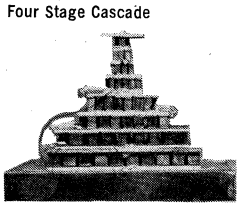


Model Number 920-31
Single Stage Module

Model Number 932-70-17
Standard Two Stage Cascade



Model Number
954-70-16-4-1 Standard
Four Stage Cascade



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High Performance Cascade

CASCADE THERMOELECTRIC COOLERS

STANDARD

2 - 5 Stages
From T_H 27°C
T_C to 180°K

Over 7000 Optimized Cascade Designs Using Partial Standard Borg-Warner Thermoelectric modules

- — Custom Design at Standard Cooler Prices
- — Lowest Price Per Watt of Heat Pumped
- — Quick Delivery, Usually one Week ARO

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2 - 14 Stages
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T_C to 130°K

Individual Computer Aided Cascade Design Using Standard or High Performance Thermoelectric Materials

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- — Lowest Power Input

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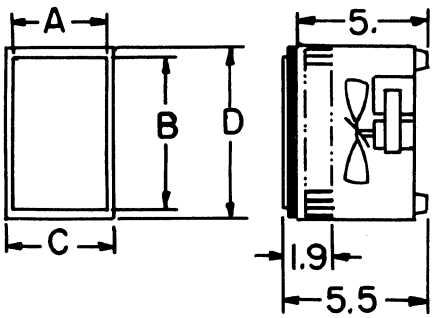
SPECIFY: Q_C — Active Heat Load to be Pumped
T_H — Ambient or Hot Side Temperature
T_C — Cold Side Temperature Required
V — Operating Voltage Desired
P — Max. Power Available
Environment — Vacuum or Dry Air
Size Requirements

STANDARD THERMOELECTRIC DEVICES

BORG WARNER

HEAT PUMP SPECIFICATION CHART T_H 77°F IN DRY AIR



	950HP-1	940HP-2	940HP-4	950HP-6	950HP-9
Max Heat Pumping $\Delta T = 0$, Q_C — Watts	20	50	100	150	225
Max ΔT, $Q_C = 0$ ΔT — °F	72	72	72	72	72
Input Current Amps	6	14	14	12	18
Input Voltage Volts	9	7	14	28	28
Dimension A	1.5	1.5	3.8	3.8	6.0
Dimension B	2.0	3.8	3.8	6.0	6.0
Dimension C	4.1	4.1	4.1	4.1	6.6
Dimension D	4.1	4.1	4.1	6.6	6.6

Other Borg-Warner Heat Pumps are available that will operate with larger or smaller heat pumping capacities and current and input voltage. Power supplies, on/off temperature controllers with set point, and proportional reverse controllers are available to fit these pumps. Please contact our representative or the factory for further information.

HEAT SINKS

The design of the heat sink or heat exchanger is a very important aspect of a good thermoelectric system.

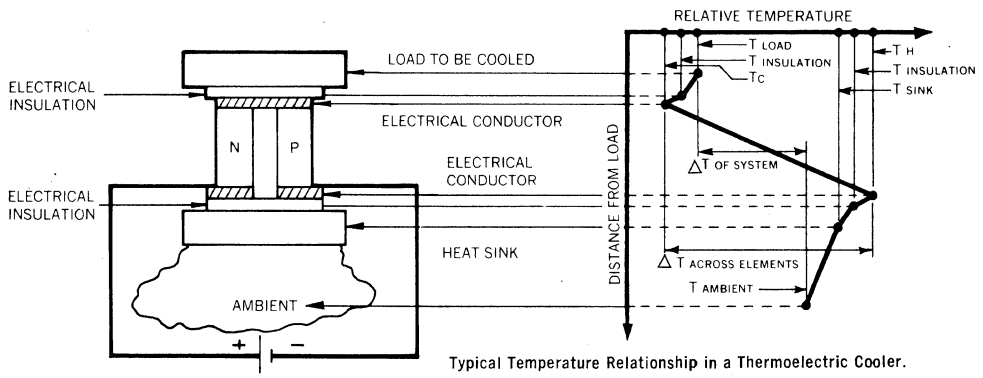
Figure below illustrates the steady-state temperature profile across a typical thermoelectric device from the load side to the ambient.

The total steady-state heat which must be rejected by the heat sink to the ambient may be expressed as follows:

heat rejected (Q_s) = heat absorbed from load (Q_e) + power input (V I) + heat leakage (Q_l)

If the heat sink is not capable of rejecting the required Q_s from a given system, the temperature of the entire system will rise and the load temperature will increase. If the thermoelectric current is increased to maintain the load temperature, the COP ends to decrease. Thus, a good heat sink contributes to improved COP.

Energy may be transformed to or from the thermoelectric system by three basic modes: conduction, convection, and radiation. The values Q_e and Q_l may easily be estimated; their total along with the power input gives Q_s, the energy the hot-junction tin must dissipate.



Typical Temperature Relationship in a Thermoelectric Cooler.

TIME TO COOL OR HEAT VARIOUS MATERIALS

Figure below shows the heat transfer required to cool or heat a given weight of known material in one hour without a change of state. When a change of state occurs (freezing, melting or vaporizing) the additional heating or cooling capacity required can be estimated by multiplying the weight of the given material by the appropriate latent heat. The equation ploted in Figure is:

$$Q\ \Delta T = m\ Cp\ \Delta T \qquad (2)$$

- ΔT — required temperature change (°F)
- Cp — average specific heat (BTU/lb-°F)
- m — weight of material (lbs)
- 1 — time interval (assume = to 1 hour)
- Q — heat removed or supplied (BTU/hr)

Using this formula, it is easy to design a photographic bath for processing film rapidly. The bath consists of 2 lbs of water in a 1 lb stainless steel container. The bath must be cooled from 110°F to 60°F in 1 hour. How much heat must be removed?

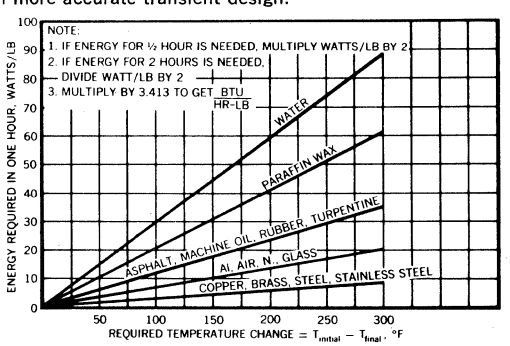
The temperature change is (110-60) = 50°F.

Enter Figure below on the horizontal axis at 50°F. Move vertically to the stainless steel and water curves and read on the vertical axis:

15 watts/lb × 2 lbs of water = 30 watts
1.6 watts/lb × 1 lb of stainless = 1.6 watts

Thus, for 1 hr, 31.6 watts are required.

The time provided by this graph is based on a constant heat transfer during the one hour period. Actually, a thermoelectric cooler would not pump heat at a constant level due to change in ΔT and this should be taken into account in a design. An effective heat pumping capacity of a thermoelectric cooler can be estimated as the heat pumping capacity at a temperature difference equal to one-half of the final operating ΔT (usually, initial $\Delta T = 0$). Borg-Warner can provide assistance in more accurate transient design.



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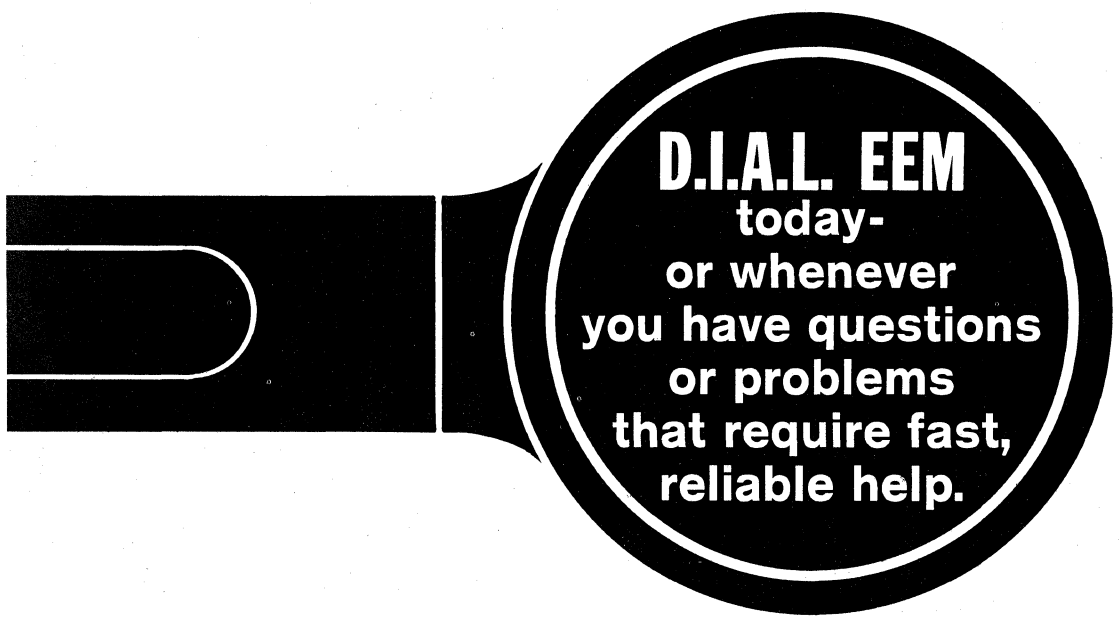

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CARBORUNDUM THERMISTORS

MEDIUM AND HIGH SENSITIVITY NTC RODS

Carborundum thermistors are temperature dependent resistors, offered in a wide variety of resistance-temperature characteristics. NTC (negative temperature coefficient) thermistors are available with temperature coefficients at 25°C ranging from −0.3%/°C to −5.4%/°C; PTC (positive temperature coefficient) thermistors have temperature coefficients of 10%/°C and higher over limited ranges. These parts are made from ceramic materials, bonded in a high-temperature firing process into disc and rod configurations. They are available in a large range of sizes, thermal characteristics, resistance values, and temperature coefficients to suit the needs of many types of electrical and electronic circuits.

Carborundum offers long experience in the design of special resistance devices. This together with expertise in the field of ceramic technology, assures a stable and uniform product to meet your thermistor requirements. All materials used in the manufacture of Carborundum thermistors are of the highest quality. Strict quality control is maintained over all stages of manufacture, and a minimum of two calibrations at the specified reference temperature is standard.

On Carborundum rod thermistor product lines, insulating coatings, color codes, and crimped and/or bent leads are available as options.

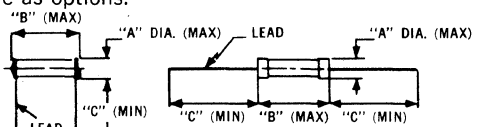


FIGURE 1

FIGURE 2

Style	Figure	Dimensions (inches) A	B	C	AWG	Dissipation Constant (mw/°C)	Time Constant (seconds)
0325F5- 0325H5-	1	0.12	0.30	1.00	24	6.0	10
0540F4- 0550H4-	2 2	0.20 0.20	0.50 0.63	1.25 1.25	20 20	9.5 11.0	22 25
0550F5- 0550H5-	1	0.22	0.63	1.38	20	11.0	25
1099F5-	1	0.38	1.13	1.38	20	24.0	90

TEMPERATURE COEFFICIENTS

Of a variety of possible ways in which temperature coefficients may be expressed, "Beta" (β) is chosen as being the most nearly universal. It is defined in the equation

$$R_1/R_2 = \epsilon^{\beta(1/T_1 - 1/T_2)}$$

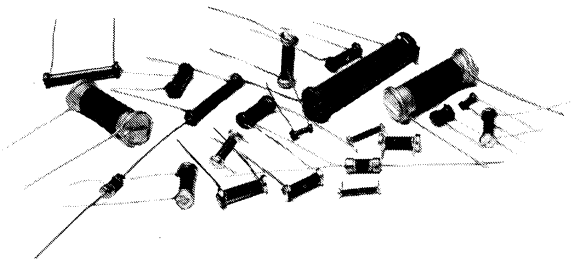
where ϵ is the base of natural logarithms and β, T_1, and T_2 are in Kelvin.

Although this relationship allows prediction of resistance over a wide range of temperature, β does not remain exactly constant as temperature is varied. To avoid ambiguity, it is wise to specify the temperatures for measurement when beta is computed: these are 25.0°C and 73.2°C.

Several other means of expressing temperature coefficients are resistance ratio and alpha (α). Alpha, the temperature coefficient of resistance, is highly dependent upon temperature; it is usually expressed in percent per degree C. The table below relates ratio and α to various values of β.

TYPICAL RESISTANCE-TEMPERATURE CHARACTERISTICS (Nominal)

	Beta (β)	α at +25°C	α at −40°C	α at 100°C	R @ −40°C / R @ 25°C	R @ 0°C / R @ 25°C	R @ 75°C / R @ 25°C	R @ 125°C / R @ 25°C
TYPE "F"	1300	-1.43	-2.4	-0.93	3.8	1.56	0.535	0.336
	1450	-1.60	-2.7	-1.04	4.1	1.59	0.497	0.294
	1600	-1.76	-2.9	-1.15	4.5	1.64	0.463	0.262
	1800	-1.98	-3.3	-1.30	5.2	1.72	0.420	0.219
	2000	-2.20	-3.7	-1.44	6.2	1.83	0.382	0.182
	2200	-2.42	-4.0	-1.58	7.5	1.95	0.347	0.152
TYPE "H"	3000	-3.3	-5.5	-2.1	20.	2.51	0.236	0.074
	3400	-3.8	-6.3	-2.4	24.	2.84	0.194	0.055
	3800	-4.2	-7.0	-2.7	30.	3.21	0.160	0.039
	4100	-4.5	-7.5	-3.0	36.	3.47	0.139	0.030
	4400	-4.9	-8.1	-3.2	45.	3.71	0.120	0.023

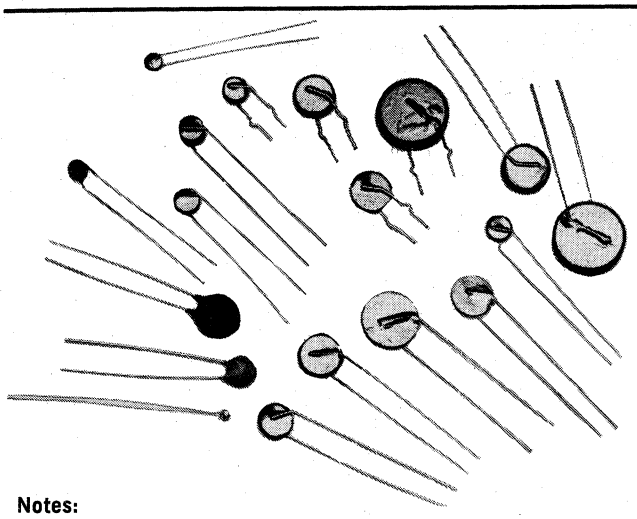


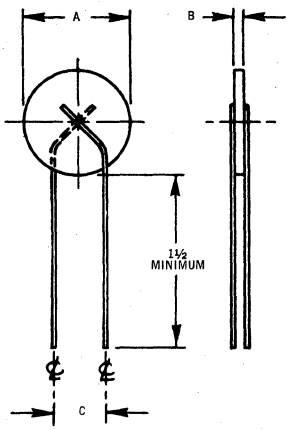
Resistance Ohms ±10% @ 25°C	Dash Number	MEDIUM TEMPERATURE COEFFICIENT Type "F" Rods Beta ±10% Style 0325F5	Styles 0540F4-0550F5-	Style 1099F5-	HIGH TEMPERATURE COEFFICIENT Type "H" Rods Beta ±5% Style 0325H5-	Styles 0550H4-0550H5-
2.2	-402	—	—	1300	—	—
3.3	-403	—	—	1350	—	—
4.7*	-404	—	1300	1400	—	—
6.8	-406	—	1350	1450	—	—
10.0*	-410	1300	1400	1500	—	—
15.0	-411	1350	1450	1550	—	—
22.0*	-412	1400	1500	1600	—	—
33.0	-413	1450	1550	1600	—	—
47.0*	-414	1500	1600	1650	—	—
68.0	-416	1550	1600	1650	—	—
100*	-420	1600	1650	1700	—	—
150	-421	1600	1650	1700	—	—
220*	-422	1650	1700	1750	—	—
330	-423	1650	1700	1750	—	—
470*	-424	1700	1750	1800	—	—
680	-426	1700	1750	1800	—	—
1,000*	-430	1750	1800	1850	—	3000
1,500	-431	1750	1800	1850	—	3100
2,200*	-432	1800	1850	1900	3000	3150
3,300	-433	1800	1850	1900	3100	3200
4,700*	-434	1850	1900	1950	3150	3300
6,800	-436	1850	1900	1950	3200	3400
10,000*	-440	1900	1950	2000	3300	3500
15,000	-441	1900	1950	2000	3400	3600
22,000*	-442	1950	2000	2050	3500	3700
33,000	-443	1950	2000	2050	3600	3800
47,000*	-444	2000	2050	2100	3700	3900
68,000	-446	2000	2050	2100	3800	4000
100,000*	-450	2050	2100	2150	3900	4100
150,000	-451	2050	2100	2150	4000	4150
220,000*	-452	2100	2150	2200	4100	4200
330,000	-453	2100	2150	2200	4150	4250
470,000*	-454	2150	2200	2200	4200	4300
680,000	-456	2150	2200	—	4250	4350
1,000,000*	-460	2200	2200	—	4300	4400
1,500,000	-461	2200	—	—	4350	—
2,200,000	-462	2200	—	—	4400	—

Order by the style number followed by the dash number. For example, part number 0540F4-404 is a thermistor of style 0540F4-, of 4.7 ±10% ohms resistance, and with a beta of 1300 ±10% K.

STOCK ITEMS, carried by Carborundum distributors, are styles 0540F4- and 0550H4- of those resistance values marked with an asterisk (*).

CARBORUNDUM THERMISTORS
HIGH SENSITIVITY NTC DISCS





Notes:

1. Dielectric coating and marking are extra-cost options.
2. Kinked leads for printed circuit use available upon request.

Specifications	Type A	Type B	Type C	Type D	Type M
R @ 25°C / R @ 125°C	28.5	14.2	18.7	35.3	62.0
β (K) ±5% (25.0°C - 73.2°C)	3980	3070	3415	4200	4900
Temp. Coef. (α) %/°C @ 25°C	−4.4	−3.4	−3.8	−4.7	−5.4

TYPICAL PARTS

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "A" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
A3305J-16	40 ±20%	0.82	0.05	3/8	18	29.0	100
*A3306J-16	50 ±20%	0.82	0.06	3/8	18	29.0	100
A2606J-16	75 ±20%	0.65	0.06	3/8	20	20.0	80
A2004J-16	100 ±10%	0.50	0.04	1/4	20	15.0	60
A3311J-16	100 ±20%	0.82	0.11	3/8	18	29.0	150
*A2207J-16	120 ±20%	0.55	0.07	1/4	20	17.0	75
*A3312J-16	120 ±20%	0.82	0.12	3/8	18	29.0	150
A1604J-16	150 ±10%	0.40	0.04	1/4	20	9.0	38
*A1203J-16	200 ±10%	0.30	0.03	1/4	24	8.0	30
A2612J-16	200 ±20%	0.65	0.12	3/8	20	22.0	100
*A1204J-16	300 ±10%	0.30	0.04	1/4	24	8.0	30
*A0803J-16	500 ±10%	0.20	0.03	1/8	24	7.0	20
A1612J-16	500 ±10%	0.40	0.12	1/4	20	11.0	60
*A0805J-16	750 ±10%	0.20	0.05	1/8	24	7.0	23
*A0807J-16	1,000 ±10%	0.20	0.07	1/8	24	7.2	26
A1212J-16	1,000 ±10%	0.30	0.12	1/4	24	9.0	40
A0809J-16	1,500 ±10%	0.20	0.09	1/8	24	7.5	30
A0810J-16	2,000 ±10%	0.20	0.10	1/8	24	7.5	30
A0405H-16	3,000 ±10%	0.10	0.05	0	26	4.0	9
A0407H-16	5,000 ±10%	0.10	0.07	0	26	4.0	10

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "B" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
B3305J-16	1.5 ±20%	0.82	0.05	3/8	18	29.0	100
*B3306J-16	2.0 ±20%	0.82	0.06	3/8	18	29.0	100
B2605J-16	3.0 ±20%	0.65	0.05	3/8	20	20.0	80
*B1804J-16	3.8 ±20%	0.45	0.04	3/8	22	12.0	48
*B2004J-16	5.0 ±10%	0.50	0.04	1/4	20	15.0	60
B3312J-16	5.0 ±20%	0.82	0.12	3/8	18	29.0	150
*B1604J-16	7.5 ±10%	0.40	0.04	1/4	20	9.0	38
*B1203J-16	10.0 ±10%	0.30	0.03	1/4	24	8.0	30
B2612J-16	10.0 ±20%	0.65	0.12	3/8	20	22.0	100
*B1205J-16	15.0 ±10%	0.30	0.05	1/4	24	8.5	35
*B1206J-16	20.0 ±10%	0.30	0.06	1/4	24	8.5	35
B2012J-16	20.0 ±10%	0.50	0.12	1/4	20	16.0	80
*B0804J-16	30.0 ±10%	0.20	0.04	1/8	24	7.0	20
B0807J-16	50.0 ±10%	0.20	0.07	1/8	24	7.2	26
B1212J-16	50.0 ±10%	0.30	0.12	1/4	24	9.0	40
B0809J-16	75.0 ±10%	0.20	0.09	1/8	24	7.5	30
B0810J-16	100.0 ±10%	0.20	0.10	1/8	24	7.5	30
B0405H-16	150.0 ±10%	0.10	0.05	0	26	4.0	9
B0407H-16	200.0 ±10%	0.10	0.07	0	26	4.0	10

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "C" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
C3305J-16	7.5 ±20%	0.82	0.05	3/8	18	29.0	100
*C2604J-16	10.0 ±10%	0.65	0.04	3/8	20	20.0	80
C2004J-16	15.0 ±10%	0.50	0.04	1/4	20	15.0	60
C1603J-16	20.0 ±10%	0.40	0.03	1/4	20	9.0	38
C3312J-16	20.0 ±20%	0.82	0.12	3/8	18	29.0	150
C1605J-16	30.0 ±10%	0.40	0.05	1/4	20	9.0	38
*C1205J-16	50.0 ±10%	0.30	0.05	1/4	24	8.5	35
C2012J-16	50.0 ±10%	0.50	0.12	1/4	20	16.0	80
*C0803J-16	75.0 ±10%	0.20	0.03	1/8	24	7.0	20
*C0804J-16	100.0 ±10%	0.20	0.04	1/8	24	7.0	20
C1612J-16	100.0 ±10%	0.40	0.12	1/4	20	11.0	60
*C0807J-16	150.0 ±10%	0.20	0.07	1/8	24	7.2	26
C0808J-16	200.0 ±10%	0.20	0.08	1/8	24	7.2	26
C1212J-16	200.0 ±10%	0.30	0.12	1/4	24	9.0	40
C0810J-16	300.0 ±10%	0.20	0.10	1/8	24	7.5	30
C0405H-16	500.0 ±10%	0.10	0.05	0	26	4.0	9
C0407H-16	750.0 ±10%	0.10	0.07	0	26	4.0	10

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "D" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
D3305J-16	75 ±20%	0.82	0.05	3/8	18	29.0	100
D2604J-16	100 ±20%	0.65	0.04	3/8	20	20.0	80
D2003J-16	150 ±10%	0.50	0.03	1/4	20	15.0	60
D1804J-16	200 ±10%	0.45	0.04	1/4	20	12.0	48
D3312J-16	200 ±20%	0.82	0.12	3/8	18	29.0	150
D1604J-16	300 ±10%	0.40	0.04	1/4	20	9.0	38
*D1204J-16	500 ±10%	0.30	0.04	1/4	24	8.0	30
D2612J-16	500 ±20%	0.65	0.12	3/8	20	22.0	100
D1206J-16	750 ±10%	0.30	0.06	1/4	24	8.5	35
*D1207J-16	1,000 ±10%	0.30	0.07	1/4	24	8.5	35
D1612J-16	1,000 ±10%	0.40	0.12	1/4	20	11.0	60
*D0806J-16	1,500 ±10%	0.20	0.06	1/8	24	7.0	23
*D0807J-16	2,000 ±10%	0.20	0.07	1/8	24	7.2	26
D1212J-16	2,000 ±10%	0.30	0.12	1/4	24	9.0	40
*D0810J-16	3,000 ±10%	0.20	0.10	1/8	24	7.5	30
D0405H-16	5,000 ±10%	0.10	0.05	0	26	4.0	9
D0407H-16	7,500 ±10%	0.10	0.07	0	26	4.0	10

Carborundum Part Number	Resistance at 25°C in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "M" HIGH NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS							
M2005J-16	3,000 ±10%	0.50	0.05	1/4	20	15.0	60
*M1604J-16	5,000 ±10%	0.40	0.04	1/4	20	9.0	38
*M1203J-16	7,500 ±10%	0.30	0.03	1/4	24	8.0	30
*M1204J-16	10,000 ±10%	0.30	0.04	1/4	24	8.5	35
M2012J-16	10,000 ±10%	0.50	0.12	1/4	20	16.0	80
*M1207J-16	15,000 ±10%	0.30	0.07	1/4	24	8.5	35
*M0803J-16	20,000 ±10%	0.20	0.03	1/8	24	7.0	20
M1209J-16	20,000 ±10%	0.30	0.09	1/4	24	9.0	40
*M0805J-16	30,000 ±10%	0.20	0.05	1/8	24	7.0	23
*M0809J-16	50,000 ±10%	0.20	0.09	1/8	24	7.5	30
*M0810J-16	75,000 ±10%	0.20	0.10	1/8	24	7.5	30

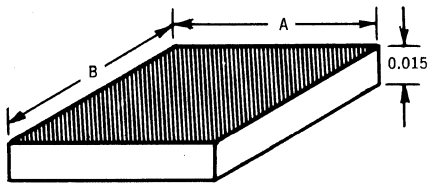
* Disc thermistors carried by Carborundum distributors are indicated by asterisk.

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

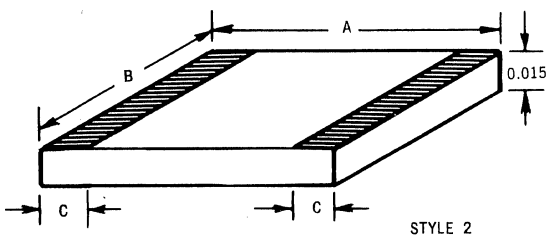
CARBORUNDUM The Carborundum Company, Electronics Plant, Niagara Falls, N. Y. 14302, 716–278-2521

CARBORUNDUM THERMISTORS

NTC CHIPS AND PTC DISCS



STYLE 1



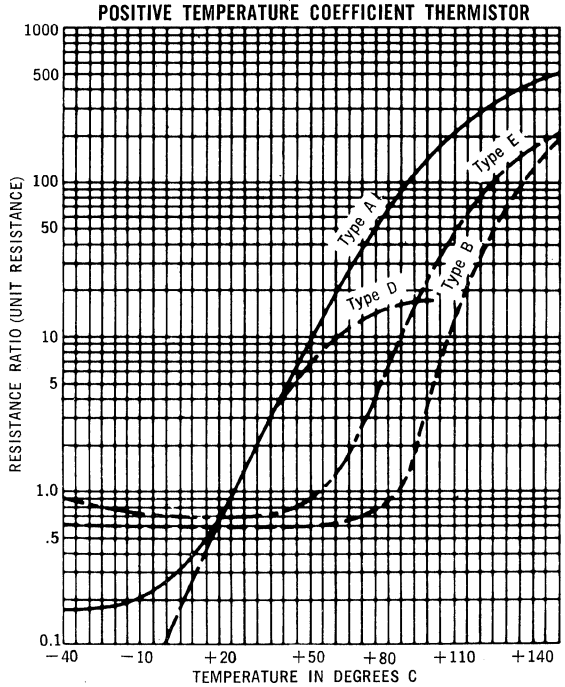
STYLE 2

Notes:

1. Time and dissipation constants measured using 26 ga. tinned copper leads attached with solder.
2. Standard parts furnished without leads. Leads optional at extra cost.
3. Contacts — 8032 DuPont conductive silver.
4. See facing page (NTC Disc Thermistors) for resistance-temperature characteristics.

Carborundum Part Number	Resistance at 25°C in Ohms	Nominal Dimensions A	B	C	Style	Dissipation Constant mw/°C	Time Constant Seconds
TYPE "A" NTC CHIP THERMISTORS							
A1515C-1	300 ±10%	0.15	0.15		1	4.5	8.5
A1010C-1	680 ±10%	0.10	0.10		1	3.0	6.0
A0505C-1	2,800 ±10%	0.05	0.05		1	1.5	4.0
A1005D-1	53,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
A2010D-1	53,000 ±10%	0.20	0.10	0.030	2	6.0	18.0
TYPE "B" NTC CHIP THERMISTORS							
B1515C-1	26 ±10%	0.15	0.15		1	4.5	8.5
B1010C-1	60 ±10%	0.10	0.10		1	3.0	6.0
B0505C-1	240 ±10%	0.05	0.05		1	1.5	4.0
B1005D-1	3,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
B2010D-1	3,000 ±10%	0.20	0.10	0.030	2	6.0	18.0
TYPE "C" NTC CHIP THERMISTORS							
C1515C-1	55 ±10%	0.15	0.15		1	4.5	8.5
C1010C-1	130 ±10%	0.10	0.10		1	3.0	6.0
C0505C-1	520 ±10%	0.05	0.05		1	1.5	4.0
C1005D-1	9,200 ±10%	0.10	0.05	0.015	2	2.5	5.0
C2010D-1	9,200 ±10%	0.20	0.10	0.030	2	6.0	18.0
TYPE "D" NTC CHIP THERMISTORS							
D1515C-1	500 ±10%	0.15	0.15		1	4.5	8.5
D1010C-1	1,100 ±10%	0.10	0.10		1	3.0	6.0
D0505C-1	4,400 ±10%	0.05	0.05		1	1.5	4.0
D1005D-1	88,000 ±10%	0.10	0.05	0.015	2	2.5	5.0
D2010D-1	88,000 ±10%	0.20	0.10	0.030	2	6.0	18.0

POSITIVE TEMPERATURE COEFFICIENT THERMISTOR



Specifications	Type A	Type B	Type D	Type E
Ratio:	R60°C/ R25°C = 14 ±6	R125°C/ R90°C = 45 ±15	R25°C/ R0°C = 7.2 ±2.5	R90°C/ R60°C = 14 ±6
Temp. Coeff.	8%/°C @ 37.8°C	10%/°C @ 125°C	8%/°C @ 25°C	8.5%/°C @ 90°C

Notes:

1. Dimensions A and B are maximum over coating; dimension C is nominal. Dimensions apply to disc thermistor figure on facing page.
2. Dielectric coating and marking are extra-cost options.
3. Kinked leads for printed circuit use available upon request.
4. First letter in Carborundum Part Number denotes Type.

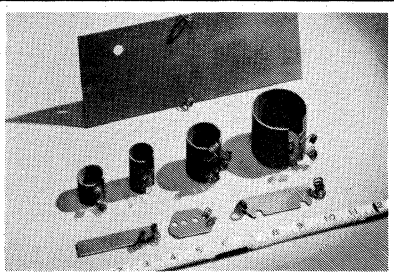
POSITIVE TEMPERATURE COEFFICIENT THERMISTORS — TYPICAL PARTS

Carborundum Part Number	Resistance in Ohms	Dimensions A	B	C	Lead Wires AWG	Dissipation Constant mw/°C	Time Constant Seconds
A1406P-13	250 ±20% @ 25°C	0.45	0.20	¼	24	12	75
A0905P-10	450 ±20% @ 25°C	0.32	0.20	⅛	24	10	60
A0910P-14	850 ±20% @ 25°C	0.32	0.25	⅛	24	12	75
A0610P-13	2,000 ±20% @ 25°C	0.25	0.25	⅛	24	8	45
B1406P-10	20 ±25% @ 90°C	0.45	0.20	¼	24	12	75
B0906P-10	48 ±25% @ 90°C	0.32	0.20	⅛	24	10	60
D1406P-10	8,000 ±20% @ 25°C	0.45	0.20	¼	24	12	75
D0904P-12	24,000 ±20% @ 25°C	0.32	0.20	⅛	24	10	60
D0910P-10	50,000 ±20% @ 25°C	0.32	0.25	⅛	24	12	75
D0610P-10	100,000 ±20% @ 25°C	0.25	0.25	⅛	24	8	45
E1406P-10	50 ±40% @ 60°C	0.45	0.20	¼	24	12	75
E0606P-09	115 ±30% @ 60°C	0.32	0.20	⅛	24	7	40

FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)

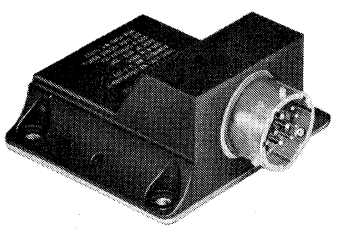
TEMPERATURE CONTROL FOR INDUSTRY AND AEROSPACE

Since 1950 Cox & Company, Inc. has been a pioneer in virtually all new types of aerospace heaters and temperature control systems. Since the middle fifties we have been a major supplier of electrical ice-protection equipment for aircraft. Today, having produced military and space qualified hardware in thousands of different designs, Cox is a leader in the aerospace temperature control field. Our design, testing and manufacturing facilities are in many respects unequaled in the custom temperature control field. We believe that our products have performance and reliability records that are unrivaled.



HEATING ELEMENTS

Cox-designed heating elements can be made to fit virtually any surface, including surfaces with compound curvature. They can be made with any desired wattage distribution, with densities as high as heat transfer conditions permit. Cox heaters are made from a wide variety of materials and processes, the choices depending on the characteristics of the parts to which they will be mounted and on customer specifications.

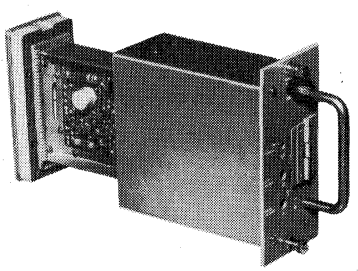


TEMPERATURE CONTROLLERS AND SENSORS

Cox solid-state controllers in a wide range of designs have been qualified for many military and aerospace applications.

Cox produces a variety of temperature sensors, including designs that combine mechanical flexibility and unusual ruggedness with high stability. If desired, a sensing element can be combined integrally with a heating element.

Cox has also developed precision mercury-in-glass thermostats, large numbers of which have been successfully tested for over 50 million on-off cycles and at over 500 G's. Thousands of these thermostats have been used in aircraft navigation systems. They are also used on Apollo, Skylab and other manned space programs.

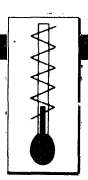


OVENS FOR CRYSTALS AND COMPONENTS

Cox is a major source for custom ovens to meet previously unobtainable performance requirements, such as a warm-up of under 2 minutes for temperature excursions exceeding 150°C. Ovens can be supplied with stability of ±.001°C over a 60°C ambient range.

COX #28 ADHESIVE

Cox #28 is the original room temperature-curing two-part adhesive. It was originally formulated as a heating element adhesive. Additional uses are for mounting thermostats, thermistors, and temperature sensors, and for general areospace assembly applications. At temperatures over 225°F the adhesive does not flow, but softens sufficiently so that disassembly of delicate equipment is feasible.



COX & COMPANY, INC.

TEMPERATURE CONTROL FOR INDUSTRY AND AEROSPACE

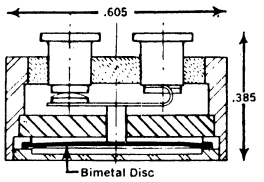
215 Park Avenue South, New York, N. Y. 10003 • (212) 674-4727

ELMWOOD SENSORS SUB-MINIATURE SNAP-ACTION THERMOSTATS

Elmwood thermostats are engineered for quick thermal response. Their heart is the bimetallic snap-acting disc which has proven highly reliable and serviceable over hundreds of thousands of cycles. Elmwood precision thermostats are manufactured and tested to conform to military specifications MIL-E-5272. Nickel plating is standard; other plating available. A variety of brackets and studs, as shown, are standard.

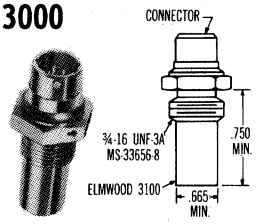
- **Many mounting arrangements**
- **Exposure from —65°F to +550°F**
- **Proven Military and Civilian Performance Record**
- **Narrow or Wide Differential**
- **Rated to 15 Amps.**
- **Immediate Delivery from Stock**
- **Custom Packaging**

When contacts are closed, current passes from terminal to terminal through the stationary contact to the movable contact, which is actuated by the snap movement of bimetal disc. This disc, which is fully insulated from the switch chamber by the pin and disc retainer, is affected by surface or ambient temperature changes only. Upon reaching the opening temperature, the disc snaps from a concave to a convex shape, releasing the pin which opens the contacts. The open circuit allows the temperature to drop and causes the disc to snap to its original position, closing the contacts. A thermostat which closes on a rise in temperature operates in a similar manner, but in reverse action.



ELMWOOD #3100

DESCRIPTION	ELECTRICAL RESISTIVE VOLTS	AMPS	THERMAL RANGE	DIFFERENTIAL	TOLERANCE
3001 **Terminal T-123** Precise, reliable unit for electronic communications, missile and aircraft controls, heater blanket controls and crystal ovens. This inexpensive unit is factory-calibrated, has the highest quality operating parts, a phenolic base and metal closure. These assure maximum dust protection and high thermal and electrical dependability. It is available with a variety of mountings and terminals.	30 AC/DC	6	+0°F to +350°F	Wide 12°F or more STD	Wide ±5°F STD
	125 AC	6		Narrow 6°F Max. Avail. 80 to 200°F	Narrow ±3°F Min.
	250 AC	3			
3100 **Terminal T-116** This thermostat is hermetically sealed with high compression glass and heliarc welded steel case. It is so constructed as to withstand the severest environmental conditions such as altitude, shock, vibration and corrosive atmosphere. It has been extensively tested by government agencies, and has been used for many government and civilian purposes, such as aircraft warning controls, de-icing equipment, etc. Ideal for packaging in special enclosures.	30 AC/DC	6	−10°F to +500°F	Wide 12°F or more STD	Wide ±5°F STD
	125 AC	6		Narrow 6°F Max. Avail. 80 to 200°F	Narrow ±3°F Min.
	250 AC	3			
3150 **Terminal T-109** Low silhouette SPST switch, hermetically sealed, available narrow or wide differential as standard. Temperature calibrations pre-set at factory, 100% inspected. Open or close on temperature rise. Heliarc welded in steel housing, glass-to-metal seal at terminal junction. Maximum resistance to shock and vibration. Ideal for use in heater blankets, computers, crystal ovens, electronic and radar equipment, gyros, airborne de-icers, etc.	30 AC/DC	4	−10°F to +350°F	Narrow 6°F Max. Avail. 50 to 225°F	Narrow ±3°F STD
	125 AC	4		Wide 12°F or more STD	Wide ±5°F STD
3450 **Terminal T-101** This inexpensive control unit is designed with either phenolic (up to 300°F) or ceramic base, and has a tight-fitting dust-proof metal closure. It is recommended for applications where its heavy electric construction makes it ideal to control high amperage uses. Also available for European applications that require 4mm or 8mm spacing.	30 AC/DC	15	+0°F to +350°F	15°F or more	±8°F STD
	125 AC	15			±5°F Min.
	250 AC	8			
3400M **Terminal T-101** Manual reset snap-acting non-adjustable thermostat designed for computers, electrical equipment and military applications. Opens on rise only. Once opened, it will not recycle automatically at room temperature until the reset button is pushed, snapping the disc and closing the circuit. Dustproof, with a high-temp phenolic base protected by metal closure. 100% temperature inspected. Also available for European applications requiring 4mm spacing.	30 AC/DC	12.5	+100°F to +350°F	Manual Reset	±15°F STD
	125 AC	12.5			±6°F Min. at 150°F or less
	250 AC	6.25			
3305 **Terminal T-133** Sub-miniature SPST, snap-action switch measuring only .430" in diameter, with narrow (±3°F) tolerance and narrow (6°F) differential. Hermetically sealed steel housing, glass-to-metal seal, all welded construction. Fast, reliable, excellent for crystal ovens, gyro platforms, heater blankets, computers, test equipment, etc. Three terminals and two brackets available. Temperature calibrations are factory preset. 100% thermally and mechanically inspected.	30 AC/DC	2	+100°F to +250°F	Wide 20°F Max.	Wide ±8°F
	125 AC	2		Narrow 6°F Max.	Narrow ±3°F

3000 

Custom designed package houses a non-adjustable, snap action Elmwood Sensors #3100 single-pole single-throw or #3700 single-pole double-throw thermostat. Performance characteristics are outlined in #3100 and #3700 information above. Housing material is stainless steel, all-welded construction. Customized connectors, size, and threads may be designed to suit requirements. Qualified by many military and aircraft applications; complete proposals are available upon request.

NOTE: Electrical ratings, life cycles and performance characteristics have been established after testing and review of standard operating conditions. The specifications outlined in this bulletin suggest the performance characteristics when the units are subject to these standard conditions. To ensure that our laboratory test conditions duplicate the performance requirements for the application, all thermostats should be tested for each application. For special narrower tolerances, differentials, brackets, terminals and set points which are not specified or standard, please consult the factory. Warranty is limited as provided in Elmwood Sensors Inc. standard terms of sale.

AVAILABLE MOUNTING BRACKETS

FIG. B208

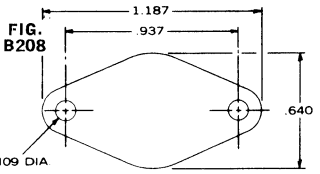


FIG. B209

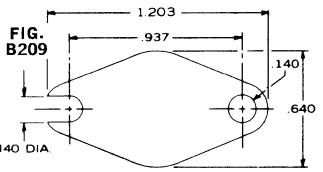


FIG. B210

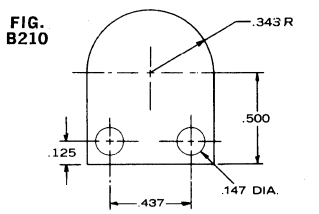


FIG. B211

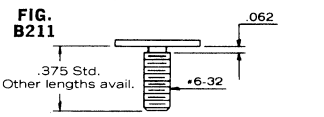


FIG. B212

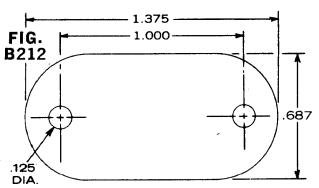
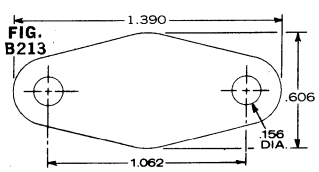
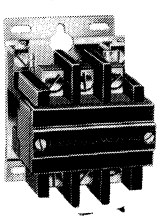


FIG. B213



Samples and Ordering — please furnish complete information on application, exposure, electrical requirements, and temperature set points to facilitate the furnishing of proper samples.



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1. Glass Coated Beads — used where small size, fast response, high precision, stability, and temperatures to 600°F are required.

2. Glass Probes — medium-small in size. Many of the advantages of beads but rugged, more easily mounted, useful in liquid media.

3. Iso-Curve*Interchangeable Thermistors — these units available in bead or glass probe configurations, follow standard curves over wide temperature range, and are completely interchangeable. Units match standard curves as close as ±¼% of resistance or as required.
*R.T.M.

4. Discs — used where medium power dissipation is a requirement and space not a problem. Useful to 300°F.

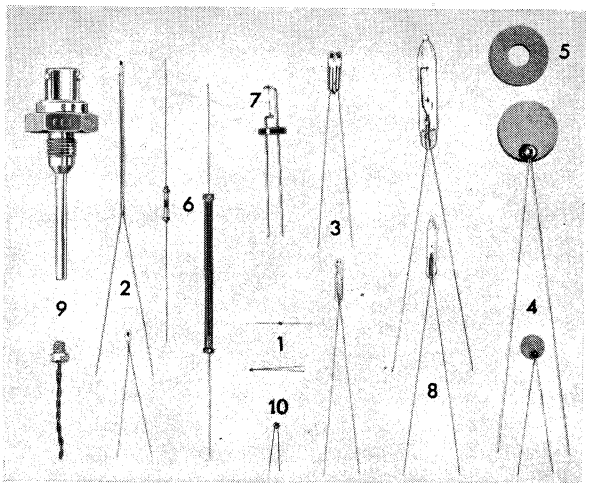
5. Washers — used where high power dissipation is a prime requirement.

6. Rods — these units have power dissipation intermediate between discs and washers and are also used where their physical shape is an asset.

7. Mounted Beads — provide ease in using glass beads in such applications as gas chromatography, flow and vacuum measurement, etc.

8. Vacuum and Gas Filled Assemblies — high power sensitivity for specialized circuit applications.

9. Probe Assemblies — standard catalog types or built to specific military or commercial requirements. We are experienced in design of probe assemblies for all fields of application including industrial control and indication,



aerospace — specializing in telemetry applications, and oceanographic — featuring fast response, very high pressure, and interchangeability using our Iso-Curve Thermistors.

10. NEW "LOW COST" Uni-Curve* Interchangeable Thermistors — completely interchangeable units having an accuracy of ±0.2°C over a temperature range of 0°C to 70°C and available on special order to other tolerances and ranges.
*TM

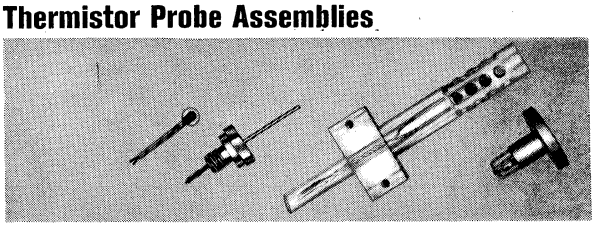
ISO-CURVE® Interchangeable Thermistors

F.E. Iso-curve* thermistors are special bead and glass probe thermistors that have been precision matched at the factory to standardized resistance-temperature curves. They have the unique and valuable characteristic of complete electrical interchangeability. In addition they offer all of the functional advantages associated with standard thermistors, including large resistance change per degree of temperature change which provides high accuracy and resolution.

Thermistors are normally rated by the value of their resistance at 77°F Standard units having the same rated resistance, however, will not exhibit identical resistance-versus-temperature characteristics over their full temperature range. Iso-curve thermistors, on the other hand, will match a specified R-T curve over full temperature range required. Iso-curve thermistors are available at the present time in six standardized R-T curve values: 500, 1K, 2K, 4K, 15K, and 100K ohms. These standard curves represent permanent specifications and an F.E. Iso-curve thermistor purchased five years from now will be perfectly interchangeable with one of the same value purchased today.

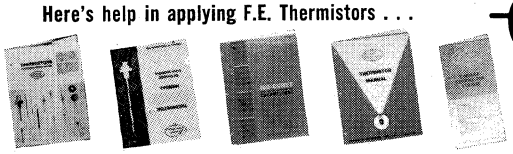
*MADE UNDER PAT. 3109227 AND OTHERS. ISO-CURVE IS A TRADEMARK OF F.E.I.

Thermistor Probe Assemblies



Standardized thermistor assemblies, provided in complete, ready-to-mount housings, enable you to take advantage of the precision and interchangeability of Fenwal Electronics thermistors. A complete line of thermistor probes is available for a variety of missile, aircraft, and industrial applications, including liquid level indication and control, temperature measurement and control of fluids and gases and many other applications. Precise calibration can be supplied with individual probes at all desired temperatures. Completely interchangeable probes with identical resistance-temperature curves are available to any desired tolerance down to 0.1°C over the full temperature range. Most of these housings can be made to meet military specifications if required.

Here's help in applying F.E. Thermistors . . .



"Thermistors: Their Characteristics and Uses." Detailed bulletin gives basic information and many applications. Bulletin 1-1.

Thermistor Housing Manual (L-5). Detailed information on how Fenwal Electronics can build thermistor sensor assemblies to fit your requirements.

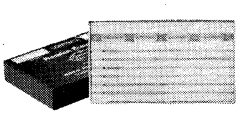
Iso-Curve Thermistors (L-2). Complete data on patented interchangeable units with identical resistance/temperature curves.

Thermistor Manual (EMC-5). Most complete up-to-date listing of thermistors available. Theory, engineering data, complete specifications.

New 24-page Capsule Thermistor Course Book. A complete primer on thermistors, their characteristics and uses.

Fenwal Electronics

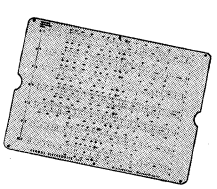
G-200. Kit contains 12 different thermistors with complete specs. PRICE $19.95.



THERMISTOR EXPERIMENTAL KITS

G-700. (Above) Kit contains 4 thermistors. PRICE $4.95.

Now available . . . UNI-CURVE G-500 KIT containing 6 completely interchangeable thermistors ranging from 3K to 100K ohms. PRICE $19.95.



Thermistor Data & Curve Computer—(G300A) Provides resistance temperature characteristics for all F.E. Thermistors. Simplifies selection of the right thermistor for every application. PRICE $1.50.

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PROPORTIONAL TEMPERATURE CONTROLS

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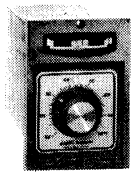
- ★ **HIGH POWER: From a few watts to 300 KW; single phase or three phase; 115, 230, or 480 volts.**
- ★ **ANY TEMPERATURE RANGE: Control either heaters or coolers from −200° to +1100°C.**



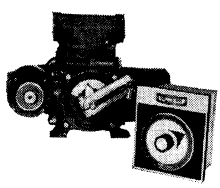
SINGLE TURN DIAL: Convenient direct reading dial for general purpose use.

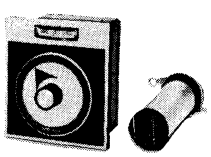
TEN-TURN, DIRECT READING DIAL: Higher sensitivity than above plus 10-turn setting potentiometer for even closer temperature control. Direct read-out of temperature on large, 4½" dial.

DIGITAL DIAL: Ten-turn potentiometer plus digital dial with 15/32" high numerals readable from 30 ft. away! Includes front panel on-off switch, pilot light and power output meter.

PROPORTIONAL VALVE CONTROLS

For process control applications where temperature is varied by means of motor-driven proportional valves. Three mode, heavy duty construction.





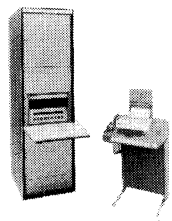
INFRARED SENSING

Where temperature must be controlled without touching the controlled body. Temperature ranges 25°C to 3000°C.

FIXED TEMPERATURE CONTROLLERS HIGH RELIABILITY MILITARY TYPES

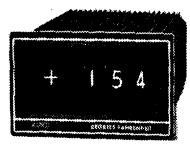
Precision temperature control to a single selected temperature. Ideal for close temperature control of floated gyros, delay lines, or other military or industrial applications. Available for operation from a-c or d-c. Output true proportional or RFI-free.

COMPUTER CONTROLLED SYSTEMS



Complete computer control and monitoring systems of temperature, pressure, time sequencing, etc. in an entire plant full of extruders, injection molding machines, environmental test equipment, etc.
PLUS — tape programmers, arbitrary function programmers, cam programmers and switching type programmers.

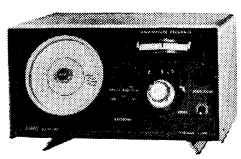
TEMPERATURE INDICATORS



DIGITAL STYLE:
Direct digital read-out of temperature in large, 9/16" numerals. Automatic polarity change. BCD electrical output optional. Also available in conventional meter style.

TEMPERATURE RECORDERS

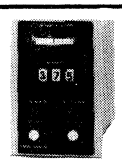
LABORATORY TYPE: Expanded scale readout spreads ranges as small as ⅔°C over entire scale. Eleven ranges give 0.02% accuracy.



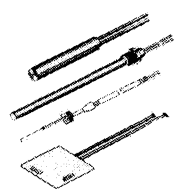
PANEL MOUNT, STRIP CHART TYPE: For continuous indication and recording of temperature at remote points.

TEMPERATURE ALARMS

Continuous monitoring of temperature at a remote point. Initiates high or low alarm whenever temperature deviates more than a prescribed amount.

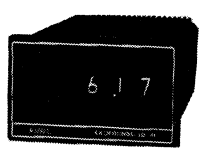


TEMPERATURE SENSORS



Wire type resistance sensors provide maximum sensitivity, linearity, & long term stability. Available in patch type for surface measurement, tubular styles, bayonet mount styles, or for air sensing.

PRESSURE INSTRUMENTATION



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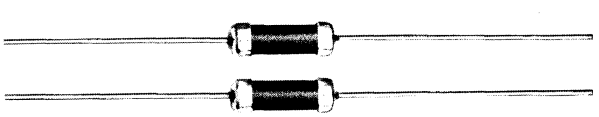
CRYOGENIC THERMISTORS

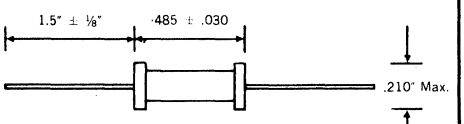
Low Temperature Types—Designed for operation in various cryogenic liquids these units are especially useful for liquid level detection. In this type of application the thermistor is slightly self-heated by passing a small current through the unit. The heat developed in the unit is dissipated more rapidly in the liquid than when the thermistor is above the liquid. The resulting change in body temperature results in a change in resistance which is easily detected because of the high temperature coefficient of the thermistor. The units listed in the table are standard low temperature thermistors.

TYPE	For Operation In Liquids	Resistance	Temperature Coefficient
RL10X04-10K-315-S5	Oxygen Nitrogen	10K 31.5K	− 8.4%/°C −10.4%/°C
RL06X0628-31.7K-315-S5	Oxygen Nitrogen	31.7K 100K	− 8.4%/°C −10.4%/°C
L0904-6.6K-H-T2	Hydrogen	6.6K	−13.0%/°C
L0904-125K-H-T2	Hydrogen	125K	−17.0%/°C
L0904-180K-H-T2	Hydrogen	180K	−18.0%/°C
L0904-100K-HE-T2	Helium	100K	−275 %/°C
L0904-3meg-HE-T2	Helium	3 meg.	−300 %/°C

Physical size of these units is approximately .1" diameter, and .04" thick, except the RL06X0628, which is a rod, .06" square and .28" long. Units are also available in TO-5 can mountings.

ROD TYPE THERMISTORS





Leads: T.C. AWG #20 **Dissipation Constant:** 9MW/°C Approx. **Time Constant:** 45 seconds approx.
Tolerance: ±10% at 25°C **Max. Operating Temperature:** 125°C

TYPE	RESISTANCE AT °C 0	25	37.8	50	75	104.4	125	BETA ±10% (37.8-104.4°C)	R @ 25°C / R @ 125°C	Neg. Temp. Coef. @ 25°C
LOW/MEDIUM TEMPERATURE COEFFICIENT										
15-20-35-S1	30.6	20	16.4	13.8	9.90	7.01	5.65	1500	3.5	1.59
15-50-42-S1	80.6	50	40.1	32.9	22.6	15.3	11.9	1700	4.2	1.78
15-100-42-S1	161	100	80.2	65.8	45.3	30.6	23.8	1700	4.2	1.78
15-200-42-S1	322	200	160	132	90.6	61.2	47.7	1700	4.2	1.78
15-500-50-S1	847	500	391	314	206	133	100	1900	5.0	1.98
15-1K-50-S1	1690	1K	782	628	413	266	201	1900	5.0	1.98
15-2K-52-S1	3430	2K	1560	1240	808	515	387	1950	5.2	2.03
15-5K-54-S1	8680	5K	3860	3060	1980	1240	924	2000	5.4	2.07
15-10K-54-S1	17.4K	10K	7730	6130	3950	2480	1850	2000	5.4	2.07
15-20K-59-S1	35.6K	20K	15.3K	12K	7560	4640	3400	2100	5.9	2.17
15-50K-62-S1	90K	50K	37.9K	29.5K	18.5K	11.2K	8120	2150	6.2	2.22
HIGH TEMPERATURE COEFFICIENT										
15-1K-139-S1*	2500	1K	656	451	227	111	71.9	3150	13.9	3.38
15-2K-139-S1*	4990	2K	1310	902	454	222	144	3150	13.9	3.38
15-5K-181-S1	13.7K	5K	3150	2100	979	450	276	3425	18.1	3.74
15-10K-192-S1	28.2K	10K	6240	4100	1890	855	520	3500	19.2	3.83
15-20K-292-S1	67.2K	20K	11.6K	7140	2920	1190	685	4000	29.2	4.46
15-50K-292-S1	168K	50K	28.9K	17.8K	7320	2980	1710	4000	29.2	4.46
15-100K-404-S1	372K	100K	55K	32.4K	12.2K	4540	2080	4400	40.4	4.86
15-200K-424-S1	753K	200K	109K	63.9K	23.9K	8740	4720	4450	42.4	4.91
15-500K-482-S1	1.95meg	500K	268K	154K	55.6K	19.7K	10.4K	4600	48.2	5.03
15-1meg-583-S1	4.06meg	1meg	523K	294K	100K	33.7K	17.1K	4830	58.3	5.22

*Supplied with ±20% tolerance at 25°C only.

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Thermistor Division • St. Marys, Pa. 15857
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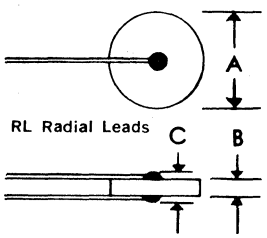
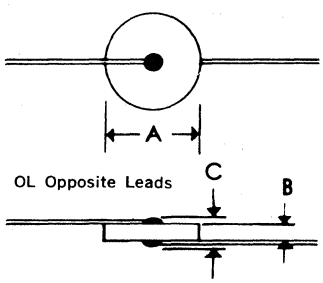
MAX. WATTAGE RATING (WATTS)		0.36		0.82		0.88		1.00			
DISSIPATION CONSTANT (MW/°C)		2.9		6.6		7.0		8.0			
TIME CONSTANT (SECONDS)		10		45		50		60			
THERMISTOR DIA. (IN.) A		.10 ±.010		.12 ±.010		.20 ±.020		.30 ±.020			
THERMISTOR THK. (IN.) B		.03 ±.010		.15 ±.025		.06 ±.015		.06 ±.015			
MAX. THK. OVER LEADS (IN.) C		.100		.290		.180		.180			
LEAD SIZE (A.W.G.)		30		24		24		24			
TEMPERATURE °C		37.8	25	37.8	25	37.8	25	37.8	25	37.8°C/ 104.4°C	%/°C @25°C
	1	196	311.0	682	1082	98.0	155.4	43.6	69.1	7.0	3.74
	2	248	397.5	862	1382	124	198.8	55.0	88.2	7.3	3.83
	3	304	492	1060	1717	152	246.0	67.5	109.4	7.6	3.92
	4	356	581	1240	2020	178	290.5	79.0	128.8	7.8	3.98
	5	432	712	1500	2470	216	356.0	95.9	158.0	8.1	4.06
	6	489	811	1700	2820	244	405	109	180.8	8.3	4.12
	7	600	1006	2090	3500	300	503	133	223.0	8.6	4.20
	8	718	1215	2500	4230	359	607	160	270.5	8.9	4.28
	9	860	1469	2990	5110	430	734	191	326.0	9.2	4.35
	10	993	1712	3460	5970	497	857	221	381.0	9.5	4.43
	11	1070	1850	3720	6430	535	925	238	412	9.7	4.46
	12	1340	2330	4650	8100	668	1163	297	517	10.0	4.51
	13	1550	2710	5390	9430	774	1354	344	602	10.2	4.55
	14	1930	3400	6730	11850	966	1701	429	755	10.5	4.60
	15	2240	3960	7800	13800	1120	1981	498	881	10.7	4.63
	16	2600	4620	9040	16060	1300	2310	577	1025	10.9	4.67
	17	3010	5370	10500	18730	1510	2695	669	1193	11.1	4.70
	18	3490	6250	12200	21850	1740	3115	776	1390	11.3	4.73
	19	4050	7280	14100	25350	2020	3630	899	1616	11.5	4.76
	20	5050	9140	17600	31850	2520	4560	1120	2025	11.8	4.81
	21	5860	10640	20400	37050	2930	5320	1300	2360	12.0	4.84
	22	7310	13350	25500	46600	3660	6680	1620	2960	12.3	4.88
	23	8470	15520	29500	54000	4240	7770	1880	3445	12.5	4.91
	24	10600	19510	36800	67700	5290	9740	2350	4330	12.8	4.94
	25	13200	24400	46000	85100	6600	12210	2940	5440	13.1	4.98
	26	16500	30650	57400	106700	8240	15320	3660	6800	13.4	5.01
	27	20600	38450	71600	133700	10300	19230	4570	8530	13.7	5.05
	28	25700	48200	89400	167600	12800	24000	5710	10710	14.0	5.08
	29	32100	60400	112000	211000	16000	30100	7130	13420	14.3	5.11
	30	40000	75600	139000	263000	20000	37800	8900	16830	14.6	5.14
	31	46400	88000	162000	307000	23200	44000	10300	19530	14.8	5.16
	32	53800	102300	187000	355500	26900	51100	12000	22800	15.0	5.18
	33	62300	118700	217000	414000	31200	59500	13900	26500	15.2	5.20
	34	77900	149000	271000	518000	38900	74400	17300	33100	15.5	5.22





Units on this list are available in the two lead configurations shown above. Standard tolerance is ±10% at 37.8°C, with ±10% @ 25°C also available. Tolerance on resistance ratio is ±.3. Maximum operation temperature is 150°C. To specify a unit on this list, first indicate RL or OL for lead configuration. Next list the row number, the column number and the number 1 for series "1". If the tolerance is to be at 25 rather than 37.8, add a "T". For example, an RL23SIT is a unit having radial leads and a resistance of 54000 ohms ±10% at 25°C.

Keystone also supplies larger size disc units up to and including 1.00 inch in diameter. For more information on these larger discs, request the complete Keystone catalog.

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Keystone CARBON COMPANY

DISC TYPE THERMISTORS WITH CROSSED LEADS

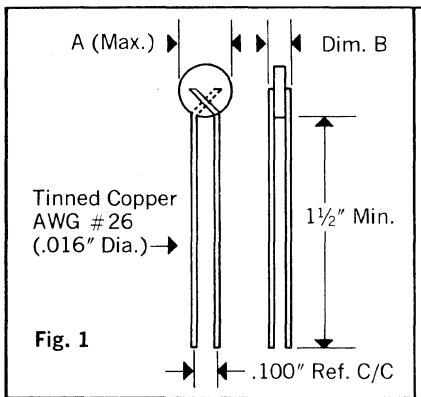

Fig. 1

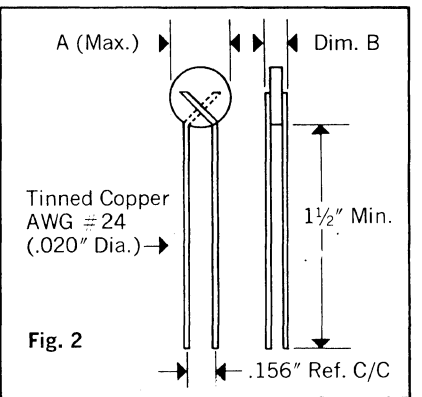

Fig. 2

- Improved stability at higher temperatures
- Fast time response
- Low cost reliable unit for intermediate power ranges

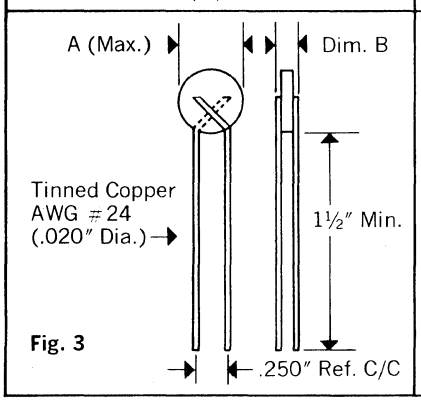

Fig. 3

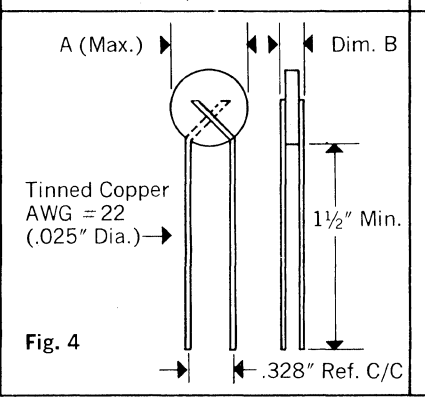

Fig. 4

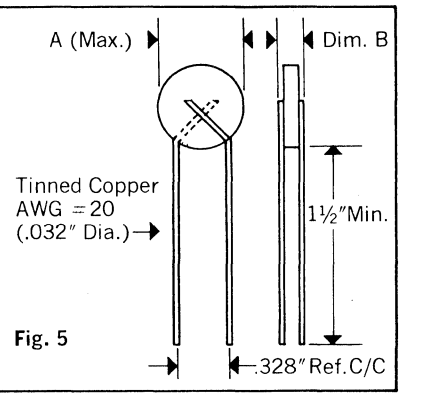

Fig. 5

All parts dip soldered

KCC TYPE	R @ 25°C	Fig. 1	A Max.	B Max.	Ratio R @ 25°C/R @ 125°C	Temp. Coef. % per °C at 25°C
RL1004-65.6-59-D1	100 ohms ±20%	1	.110"	.120"	13.91	−3.38
RL1003-312-73-D1	500 ohms ±10%	1	.110"	.110"	19.22	−3.83
RL1007-624-73-D1	1000 ohms ±10%	1	.110"	.160"	19.22	−3.83
RL1013-1248-73-D1	2000 ohms ±10%	1	.110"	.225"	19.22	−3.83
RL1003-1746-97-D1	3000 ohms ±10%	1	.110"	.110"	29.28	−4.39
RL1004-2910-97-D1	5000 ohms ±10%	1	.110"	.120"	29.28	−4.39
RL1009-5820-97-D1	10000 ohms ±10%	1	.110"	.180"	29.28	−4.39
RL2004-16.4-59-D1	25 ohms ±20%	2	.220"	.125"	13.91	−3.38
RL2007-32.8-59-D1	50 ohms ±20%	2	.220"	.165"	13.91	−3.38
RL2003-62.4-73-D1	100 ohms ±10%	2	.220"	.115"	19.22	−3.83
RL2005-124.8-73-D1	200 ohms ±10%	2	.220"	.140"	19.22	−3.83
RL2008-187.1-73-D1	300 ohms ±10%	2	.220"	.175"	19.22	−3.83
RL2013-312-73-D1	500 ohms ±10%	2	.220"	.230"	19.22	−3.83
RL2004-582-97-D1	1000 ohms ±10%	2	.220"	.125"	29.28	−4.39
RL2007-1164-97-D1	2000 ohms ±10%	2	.220"	.165"	29.28	−4.39
RL2010-1746-97-D1	3000 ohms ±10%	2	.220"	.195"	29.28	−4.39
RL3004-6.56-59-D1	10 ohms ±20%	3	.320"	.125"	13.91	−3.38
RL3504-31.2-73-D1	50 ohms ±10%	3	.370"	.125"	19.22	−3.83
RL4004-174.6-97-D1	300 ohms ±10%	3	.420"	.125"	29.28	−4.39
RL4504-3.28-59-D1	5 ohms ±20%	4	.475"	.130"	13.91	−3.38
RL4504-15.6-73-D1	25 ohms ±10%	4	.475"	.130"	19.22	−3.83
RL4504-116.4-97-D1	200 ohms ±10%	4	.475"	.130"	29.28	−4.39
RL7605-6.24-73-D1	10 ohms ±20%	5	.795"	.150"	19.22	−3.83
RL7605-58.2-97-D1	100 ohms ±10%	5	.795"	.150"	29.28	−4.39

Maximum operating temperature: 125°C

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FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200
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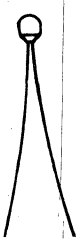
MOLDED-IN-LEAD BEAD AND ROD THERMISTORS

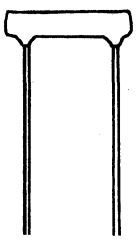
Using a technique developed at Keystone, these units feature leads which are molded directly into the body of the thermistor. This technique yields a more reliable thermistor and by eliminating several operations permits lower prices. These units are particularly intended for applications where small size and fast response are major requirements.



Physical size: .065" dia. max., .085" long max.
Leads: .004"platinum, ½" long
Dissipation Constant: 0.6 MW/°C Approx.
Time Constant: 7.5 seconds Approx.
All units are coated with a protective green glaze.

TYPE	RESISTANCE AT °C:						
	0	25	37.8	75	104.4	150	260
L0504-329-59-M2	1245	500	329	114	56	22.4	*
L0504-550-71-M2	2480	878	550	169	77	29	5.5
L0504-1220-81-M2	6210	2000	1220	344	151	53	9
L0504-1248-73-M2	5520	1984	1248	376	171	62	*
L0504-1500-85-M2	8010	2515	1500	409	176	61	10.5
L0504-5000-95-M2	27.7K	8560	5000	1290	526	168	23.4
L0504-33.3K-125-M2	221K	60.4K	33.3K	7380	2665	711	70.6
L0504-55K-120-M2	360K	100K	55K	12.5K	4.58K	1246	127.6

* These units processed for operation to 150°C maximum; All others, to 260°C Max.
"M2" in the above type numbers designates ±10% tolerance on resistance at 25°C.



Physical size: .120" dia. max. .420" long max.
Leads: .010" platinum, ¾" long
Dissipation Constant: 2.8 MW/°C Approx.
Time Constant: 35 seconds Approx.
Maximum Operating Temperature: 260°C.
All units are coated with a protective green glaze.

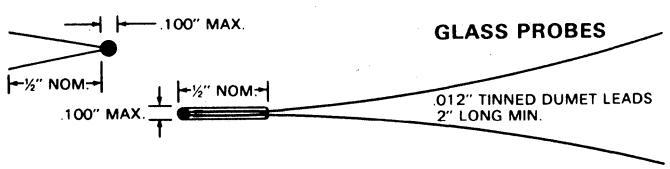
TYPE	RESISTANCE AT °C:						
	0	25	37.8	75	104.4	150	260
L060637-6K-85-M2	31.8K	10.1K	6000	1640	706	242	40.7
L060637-10K-85-M2	52.2K	16.7K	10K	2750	1175	403	67.8
L060637-22K-95-M2	122K	37.5K	22K	5700	2315	739	104
L060637-45K-103-M2	266K	78.2K	45K	11.1K	4370	1314	166
L060637-60K-103-M2	355K	104K	60K	14.8K	5830	1750	222
L060637-200K-120-M2	1.3 meg	363K	200K	45K	16.7K	4520	520
L060637-350K-125-M2	2.35 meg	637K	350K	76.5K	28K	7630	793
L060637-1.4 meg-145-M2	10.2 meg	2.62 meg	1.4 meg	284K	96.6K	23.8K	2070

"M2" in the above type numbers designates ±10% tolerance on resistance at 25°C.

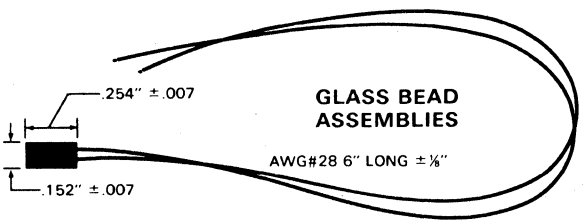
GLASS BEADS • GLASS PROBES • GLASS BEAD ASSEMBLIES

Glass bead thermistors are exceptionally stable because the glass seal protects the thermistor from hostile environments.

GLASS BEADS



GLASS PROBES



RESISTANCE/TEMPERATURE CHARACTERISTICS

TYPE	−21.5°C	0°C	25°C	37.8°C	50°C	104.4°C	150°C	232°C	TEMP. COEFF. AT 25°C
RL0504-614.8-71-G___*	7687	2775	1K	614.8	398.8	86.59	32.85	8.865	−3.88%
RL0504-8783-95-G___*	154.5K	48.48K	15K	8783	5484	924.5	290.3	59.55	−4.36%
RL0504-16.92K-112-G___	370.3K	105.3K	30K	16.92K	10.18K	1511	426.9	83.08	−4.67%
RL0504-27.76K-120-G___	643.1K	182.2K	50K	27.76K	16.50K	2313	642.0	109.7	−4.80%
RL0504-55.53K-120-G___	1.286 meg	364.5K	100K	55.53K	32.99K	4628	1284	219.5	−4.80%
RL0504-111.3K-125-G___	2.699 meg	743.5K	200K	111.3K	65.78K	8904	2415	407.4	−4.85%
RL0504-272.6K-142-G___	7.391 meg	1.976 meg	500K	272.6K	158.6K	19.20K	4706	682.0	−5.04%
RL0504-530.5K-148-G___	15.04 meg	3.939 meg	1 meg	530.5K	301.7K	35.84K	8780	1252	−5.14%

*Not presently available in Glass Probes.
Tolerance on resistance values ±20% @25°C. Closer tolerances available.

HOW TO ORDER

First select the basic type number from the table above and suffix the appropriate G number" from this list:

-**G1** for Glass Beads with platinum leads
-**G15** for Glass Probes
-**G20** for Glass Bead Assemblies

Example: An RL0504-16.92K-112-**G15** is a Glass Probe having a resistance value of 30K @ 25°C.

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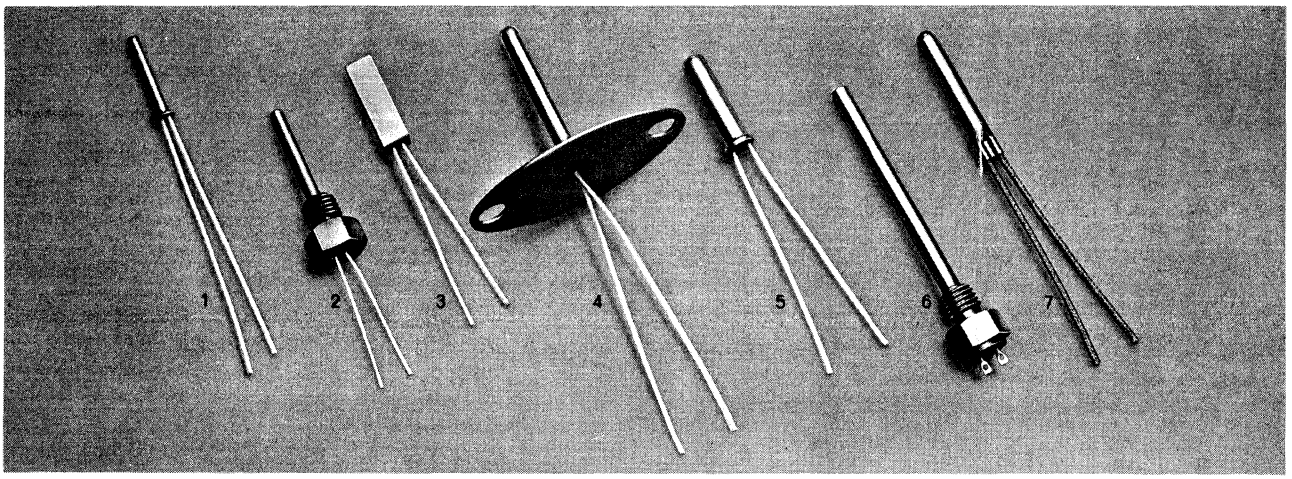


VERSATILITY YOU CAN USE IN THERMISTOR PROBES

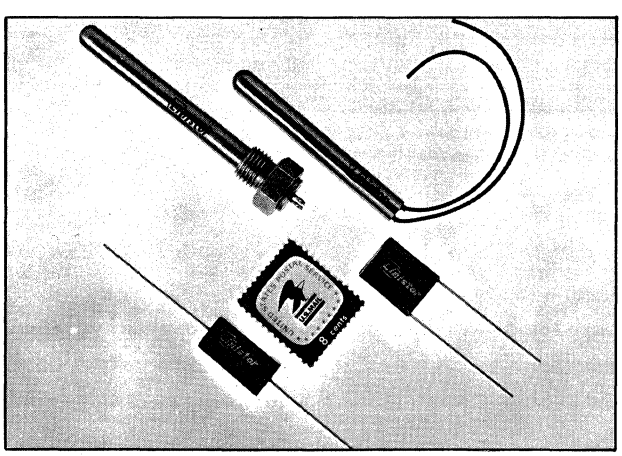
The probes illustrated above include stainless steel, aluminum, and chrome plated materials in a variety of configurations. Any thermistor listed in the table can be provided in one or all of the probes pictured. In addition, a variety of other designs are available. These probes are used in conjunction with solid state circuitry for liquid level measurement, and for use as sensors to measure the temperature of liquids or surface temperatures. For full particulars, write detailing your proposed application.

KEYSTONE TYPE	THERMISTOR RESISTANCE					
	0°C	25°C	37.8°C	104.4°C	150°C	232°C
370603-62.66-71-S	282.6	100	62.66	8.825	3.308	.8910
370603-119.1-85-S	631.2	200	119.1	14.01	4.800	1.174
370603-375.3-95-S	2132	650	375.3	39.48	12.76	2.826
0503-630-71-S	2750	1K	630.0	88.80	33.26	8.800
370603-1145-103-S	6733	2K	1145	111.1	33.78	6.607
370603-2801-120-S	18.23K	5K	2801	233.6	64.42	11.18
370603-4452-125-S	29.74K	8K	4452	356.2	96.61	16.29
060337-6266-71-S	28.26K	10K	6266	882.5	330.8	89.10
060337-11910-85-S	63.12K	20K	11.91K	1401	480.0	117.4
0503-16920-112-S	105.3K	30K	16.92K	1511	426.4	83.20
060337-37.53K-95-S	213.2K	65K	37.53K	3948	1276	282.6
0503-55.3K-125-S	361.0K	100K	55.30K	4420	1153	189.6
060337-114.5K-103-S	673.3K	200K	114.5K	11.11K	3378	660.7
060337-280.1K-120-S	1.823 meg	500K	280.1K	23.36K	6442	1118
060337-445.2K-125-S	2.974 meg	800K	445.2K	35.62K	9661	1629
050446-556.5K-125-S	3.717 meg	1 meg	556.5K	44.52K	12.08K	2037

All parts 260°C Max. operating temperature.

LINISTOR™ ASSEMBLIES

Keystone developed Linistor Assemblies to give an accurate resistance response over a temperature span of 0°C to 100°C. Because Linistor Assemblies have flattened out the thermistor resistance curve to a constant and predictable straight-line plot, they are valuable in a wide range of applications. Four standard encasements are available.



Linear Negative Temperature Coefficient	Resistance/Temperature Characteristic				
	0°C	25°C	50°C	75°C	100°C
20 ohms/°C	3392	2892	2392	1892	1392
40 ohms/°C	6995	5995	4995	3995	2995
60 ohms/°C	10224	8724	7224	5724	4224
80 ohms/°C	13506	11506	9506	7506	5506
100 ohms/°C	17002	14502	12002	9502	7002
200 ohms/°C	32800	27800	22800	17800	12800
400 ohms/°C	64693	54693	44693	34693	24693

Tolerance on Resistance at 25°C is ± 2%

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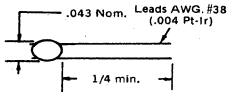
NL INDUSTRIES

NTC THERMISTORS

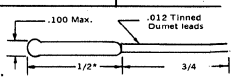
BEAD



Glass coated bead Thermistors. These are small size with fast response, and improved high-temperature stability up to 400ºC. ±20% Tol. Leads are fired-in platinum iridium.

Cat. No.	Zero Power Resistance at 25°C,	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	Time Const.
81B-202	2,000	19.8		
81B-503	50,000	35.0	0.7	2 Sec.
81B-154	150,000	39.7		
81B-504	500,000	46.5		
81B-105	1,000,000	51.5		

BEAD PROBES

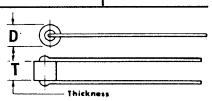


Rugged glass bead probes. Tinned Dumet leads. Max. temp. 400ºC, ± 20% Tol.

*Bead probes also available in 2" lengths.

Cat. No.	Zero Power Resistance at 25°C,	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	Time Const.
81G-20250	2,000	19.8		
81G-50350	50,000	35.0	1.0	25 Sec.
81G-15450	150,000	39.7		
81G-50450	500,000	46.5		
81G-10550	1,000,000	51.5		

DISCS



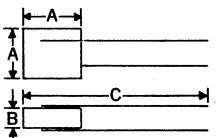
Disc shaped Thermistors with Close Electrical Tolerances.

Cat. No.	Resistance 25°C ± 10%	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	Time Const. (sec.)	D (Norm)	T (Norm)
4D051	200,000	48.78		4.5		0.048
4D053	100,000	48.78		3.5		.024
1D051	20,000	29.85		4.5		.048
1D053	10,000	29.85	2	3.5	0.050	.024
2D052	2,000	19.80		4		.034
2D054	1,000	19.80		3		.017
3D052	200	12.95		4		.034
3D054	100	12.95		3		.017
1D101	10,000	29.85		12		.095
1D103	5,000	29.85		8		.048
2D102	1,000	19.80	4	10	0.1	.070
2D104	500	19.80		6		.035
3D102	100	12.95		10		.070
3D104	50	12.95		6		.035
1D201	3,000	29.85	8	34		.114
1D203	1,000	29.85	7.5	19		.038
2D202	300	19.80	8	28	0.2	.084
2D204	100	19.80	7.5	16		.028
3D202	30	12.95	8	28		.084
3D204	10	12.95	7.5	16		.028
1D301	3,000	29.85	11.5	85		.256
1D303	1,000	29.85	9.0	48		.086
2D302	300	19.80	10.5	75	0.3	.189
2D304	100	19.80	8.5	38		.063
3D302	30	12.95	10.5	75		.189
3D304	10	12.95	8.5	38		.063
1D401	1,000	29.85	15.5	80		.152
1D403	250	29.85	14	35		.038
2D402	100	19.80	15.5	70		.112
2D404	25	19.80	14	25	0.4	.028
3D402	10	12.95	15.5	70		.112
3D404	2.5	12.95	14	25		.028
1D501	1,000	29.85	19	140		.238
1D503	500	29.85	16.5	90		.119
2D502	100	19.80	17.5	120	0.5	.175
2D504	50	19.80	15.5	70		.088
3D502	10	12.95	17.5	120		.175
3D504	5	12.95	15.5	70		.088
1D751	250	29.85	26	150		.134
1D753	100	29.85	22	80		.053
2D752	25	19.80	24	120	0.75	.098

DISCS (Contd.)

Cat. No.	Resistance 25°C ± 10%	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	Time Const. (sec.)	D (Norm)	T (Norm)
2D754	10	19.80	20	50		.039
3D752	2.5	12.95	24	120	0.75	.098
3D754	1.0	12.95	20	50		.039
1D901	250	29.85	37	260		.238
1D903	100	29.85	32	155		.095
2D902	25	19.80	34	230	1.0	.175
2D904	10	19.80	30	120		.070
3D902	2.5	12.75	34	230		.175
3D904	1.0	12.75	30	120		.070

CHIPS

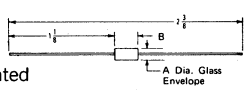


Chip size thermistors available as: electroded, electroded with leads, electroded with leads and insulated coating.

Cat. No.	Resistance 25°C +10%	Cat. No.	Resistance 25°C +10%	Cat. No.	Resistance 25°C +10%
NCT 101	100	NCT 202	2,000	NCT 303	30,000
NCT 201	200	NCT 302	3,000	NCT 403	40,000
NCT 301	300	NCT 402	4,000	NCT 503	50,000
NCT 401	400	NCT 502	5,000	NCT 603	60,000
NCT 501	500	NCT 602	6,000	NCT 703	70,000
NCT 601	600	NCT 702	7,000	NCT 803	80,000
NCT 701	700	NCT 802	8,000	NCT 903	90,000
NCT 801	800	NCT 902	9,000	NCT 104	100,000
NCT 901	900	NCT 103	10,000		
NCT 102	1,000	NCT 203	20,000		

A (Nom)	B (Nom)	C (Nom)	Time Const (sec)	Diss Const in M W/°C
0.04-0.10	0.012-0.035	1.97	1-8	1-4

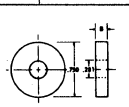
H SERIES



Small, rugged, hemetically sealed. Gold plated Dumet leads. Use up to 400ºC.

Cat. No.	Resistance 25°C ± 10%	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	Time Const. (sec.)
1H104	100,000	29.85		
1H503	50,000	29.85	2	8
1H203	20,000	29.85		
2H103	10,000	19.80		
2H502	5,000	19.80		
2H202	2,000	19.80		

WASHERS



Large size rugged Thermistors where large mass is required.

Cat. No.	Resistance 25°C ± 10%	Res. Ratio 25°C/125°C	Diss. Const. in W/°C	B (Norm)
4W751	4,150	48.78		.191
4W753	3,150	48.78		.145
4W755	1,000	48.78		.046
1W751	415	29.85		.191
1W753	315	29.85		.145
1W755	100	29.85	55	.046
2W752	41.5	19.80		.140
2W754	31.5	19.80		.106
2W756	10	19.80		.034
3W752	4.15	12.95		.140
3W754	3.15	12.95		.106
3W756	1	12.95		.034

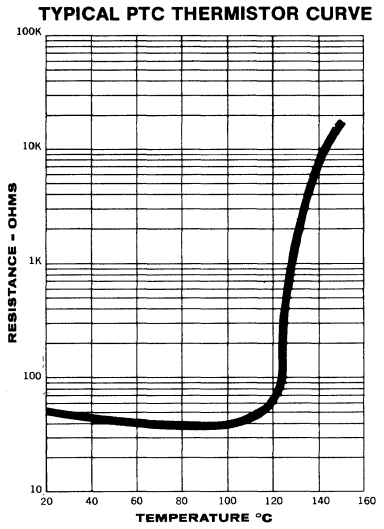
These washers may also be obtained in either bolted or soldered assemblies.

NL INDUSTRIES

P T C THERMISTORS

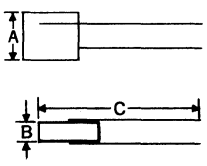
VARISTORS

The Positive Way to SENSE MEASURE CONTROL REGULATE PROTECT



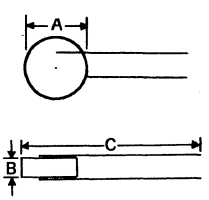
Positive Temperature Coefficient Thermistors (PTC) as manufactured by NL Industries Electronics Department are doped Barium Titanate solid state semiconductor devices. They are available in various configurations all with or without leads and with or without protective coating.

CHIPS



Featuring a range of sizes as low as forty-mil square. Chips are ideally utilized as temperature sensors in motor windings or similar equipment, where over-heating causes equipment damage. The PTC chip features a fast increase of resistance, which linked with associated circuitry could cause a relay to open or a triac shutdown to save your equipment when overheating begins.

DISCS

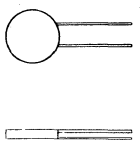


PTC Discs range in diameters of 0.2" to 0.5" and are ideally used in switching or time delay applications. An increase of up to two decades of resistance over just a few degrees of temperature increase is possible. The switching emperature can be tailored for a given device over the range of -20ºC to +125ºC. The base resistance can be chosen within limits, as well as the slope after switching. PTC Discs can also be used as a time delay by use of inherent self-regulation in the high resistance mode.

HEATER

A unique, low-cost, highly stable application of the PTC Thermistor is the component oven heater. In this application, the device is placed outside or inside a component oven and deliberately self heated to operate in the high resistance mode. They can be produced to give as close as plus or minus one degree Centigrade temperature regulation. The same device can also be used as a solid state thermostat to sense and regulate the oven temperature when a resistance coil is used as the heater, and it will produce the same regulation as if a heater itself.

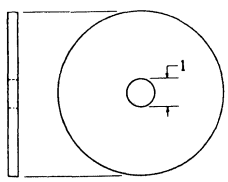
DISCS



NL Industries varistors protect circuits and components from inductive voltage surges by limiting peak discharge voltage to a safe value when AC or DC magnetic or inductive circuit current is suddenly interrupted. Black dielectric coating applied after impregnation for moisture protection.

Catalog Number	Continuous Operating Volts DC	AC	Continuous Power Watts	Discharge Capacity Watts—Seconds
70D-5010	150	135	.25	30
68D-5010	60	54	.25	30
67D-5010	30	27	.25	30
65D-5010	15	13.5	.25	30
71D-7000	150	135	.75	50
68D-7000	60	54	.75	50
66D-7000	30	27	.75	50
63D-7000	15	13.5	.75	50
71D-10000	300	270	1.5	275
68D-10000	150	135	1.5	275
66D-10000	60	54	1.5	275
63D-10000	30	27	1.5	275

WASHERS



NL Industries varistors protects circuits and components from inductive voltage surges by limiting peak discharge to a safe value when AC or DC magnetic or inductive circuit current is suddenly interrupted. Silicone impregnation provided to insure protection against moisture.

Order Number	Continuous Operating Volts DC	AC	Continuous Power Watts	Discharge Capacity Watt-Seconds
71W-30100	1500	1350	3.5	9,250
69W-30100	300	270	3.0	5,100
68W-30100	150	135	3.0	5,100
67W-30100	60	54	3.0	1,700
66W-30100	30	27	3.0	1,700
63W-30100	15	13.5	3.0	1,350
62W-30100	7	6.3	3.0	1,100
69W-60100	275	250	10	22,500
68W-60200	200	180	10	22,500
68W-60100	150	135	10	22,500

ASSEMBLIES

NL Industries varistors protect circuits and components from inductive voltage surges by limiting peak discharge voltage to a safe value when AC or DC magnetic or inductive circuit current is suddenly interrupted.

These assembles have one or more NL Industries washers connected in series or parallel. Washers are bracket-mounted on a horizontal bolt with spring lock washer for contact pressure. Washers are insulated from central bolt and mounting brackets. Bracket mounted assemblies available for stud mounting. Substitute "C" for "A" in type number. All varistors moisture protected with silicone impregnation.

Catalog Number	DC Operating Volts	Power Loss in Oper. Watts	Discharge Capacity Watts—Seconds
9RV3A10	50	12	6800
9RV3A12	150	3	5100
9RV3A14	300	3	5100
9RV3A15	600	6	10200
9RV3A52	3000	7	18500
9RV3A53	4500	10.5	27750
9RV6A1	150	10	22500
9RV6A2	150	20	45000
9RV6A6	275	10	22500
9RV6A7	275	20	45000
9RV6A8	275	30	67500
9RV6A9	275	40	9000

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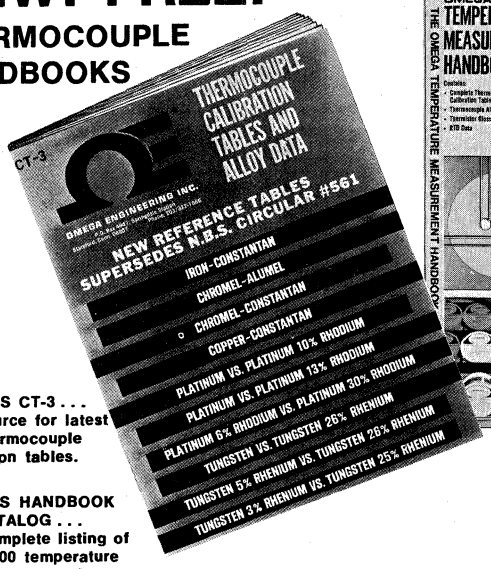
THERMOCOUPLE HANDBOOKS



OMEGA'S CT-3 . . . only source for latest NBS thermocouple calibration tables.

OMEGA'S HANDBOOK and CATALOG . . . Most complete listing of over 5,000 temperature measurement products. All prices included.

THERMOCOUPLES AND ASSEMBLIES

OMEGA produces a broad range of thermocouples, probes and assemblies, including a full line of sub-miniature probes, bare wire-type thermocouples with a diameter as fine as 0.0005 inches, quick-disconnect type assemblies, replacement probes and thermocouple assemblies with a variety of heads and terminations. All are available for IMMEDIATE DELIVERY. Refer to FREE catalog for complete listing and prices. **Prices start at $2.00 per thermocouple.**

SURFACE PROBES AND PYROMETERS

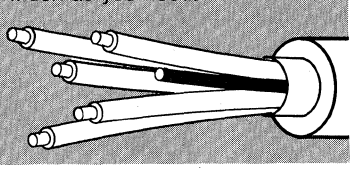
OMEGA offers a number of unique, patented thermocouple probes designed for measuring the precise temperature of moving and stationary surfaces. Also available are companion readout meters, portable pyrometers and companion probes for heavy duty service. New miniature thermometer and its companion probes are in stock also. ALL OFF-THE-SHELF. **Prices start at $6.00 per probe.**

YOUR THERMOCOUPLE PROBLEMS RECEIVE REALISTIC SOLUTIONS AT OMEGA

Most thermocouple problems can be solved using Omega's "off-the-shelf" thermocouple products. But, if you have that SPECIAL problem requiring exotic thermocouples, multi-point/profile thermocouples, motorized switches, or anything unusual in thermometry, just send us a print. Omega will quote you realistically. Our years of experience and technology assure you QUICK DELIVERY and the right temperature sensor for the job. AND, WE KEEP OUR PROMISES.

THERMOCOUPLE WIRE

OMEGA's broad range of thermocouple wire encompasses just about every conceivable type available, including bare wire, teflon coated wire, metal-sheathed wire, all types of asbestos, glass, plastic covered and enameled wire in sizes from 0.0005" diameter on up. Even tungsten-rhenium, platinum and base metal alloys, plus various extension wire types . . . all ON HAND for IMMEDIATE DELIVERY. Buy as little or as much as you need!

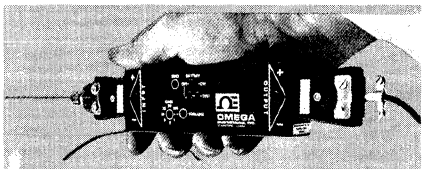


FOR IMMEDIATE OFF-THE-SHELF DELIVERY

Ask about "Speed Service": orders shipped within 24 hours when requested. Minimum Order: $10.00.

THERMOCOUPLES

YOUR OFF-THE-SHELF THERMOCOUPLE REQUIREMENTS...



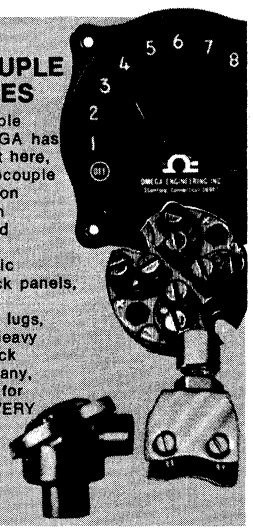
"OMNI-AMP" THERMOCOUPLE AMPLIFIERS

Just plug a thermocouple into Omega's unique new miniature, portable amplifier. A choice of ranges will enable you to boost any millivolt signal from unity to 100 times. Low cost and inexpensive operation from two small mercury batteries eliminates need for thermocouple and meter impedance matching. Drives any readout device with 1000 ohms or greater input impedance. Lab models too! NOW . . . OFF-THE-SHELF! Nothing like it is available from any other source.

Prices start at only $85.

THERMOCOUPLE ACCESSORIES

If it's a thermocouple accessory . . . OMEGA has it! Too many to list here, they include thermocouple insulators, protection tubes, compression fittings, color-coded connectors, high temperature ceramic connectors and jack panels, selector switches, thermocouple alloy lugs, connector heads, heavy duty miniature quick disconnects and many, many more . . . all for IMMEDIATE DELIVERY off-the-shelf.

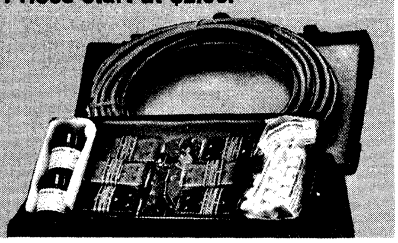


THERMOCOUPLE ASSEMBLY KITS

CEMENTS AND LACQUERS

OMEGA offers an expanded variety of kits to cement fine gage thermocouples in place and to build a variety of thermocouple probes and assemblies in only minutes. Available OFF-THE-SHELF.

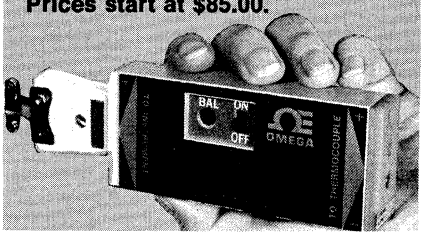
Prices start at $2.00.

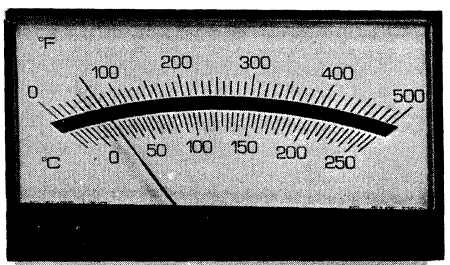


COMPENSATORS AND ICE POINT REFERENCES

OMEGA's thermocouple references and cold junction compensators include electrical bridge networks, thermoelectric refrigeration and heated oven reference types available in a complete range of calibrations. All are rugged, versatile and low priced. All for IMMEDIATE DELIVERY.

Prices start at $85.00.





METERS, AMPLIFIERS AND READOUTS

OMEGA's expanded line of readout meters, digital readouts for thermocouples, thermistors and RTD's, plus thermocouple amplifiers are available now for IMMEDIATE DELIVERY.

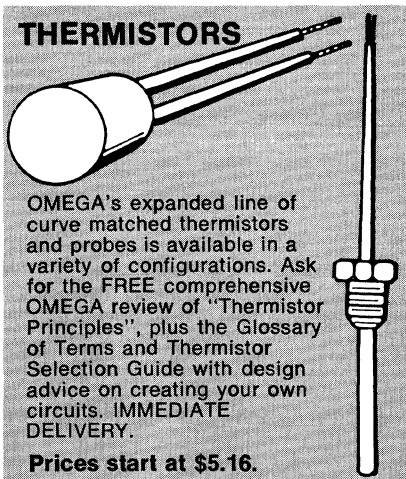
Meter prices start at $36.00.

TEMPERATURE SENSITIVE PAINTS, LACQUERS, CRAYONS, SPRAYS AND PELLETS

If you require any markers to be used as high quality surface temperature indicators, OMEGA has a vast variety of convenient forms, including paints, lacquers, crayons, sprays and pellets OFF-THE-SHELF.

Prices start at $1.00.

THERMISTORS



OMEGA's expanded line of curve matched thermistors and probes is available in a variety of configurations. Ask for the FREE comprehensive OMEGA review of "Thermistor Principles", plus the Glossary of Terms and Thermistor Selection Guide with design advice on creating your own circuits. IMMEDIATE DELIVERY.

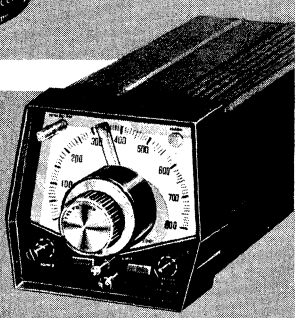
Prices start at $5.16.

RTD's

PLATINUM RESISTANCE THERMOMETERS

Offering a variety of lead configurations and sizes, with compression fittings, and a choice of compression heads and quick disconnects, the OMEGA line of platinum resistance thermometers is available for IMMEDIATE DELIVERY.

Prices start at $39.00 for single units.



TEMPERATURE CONTROLLERS

OMEGA's solid state plug-in electronic indicating temperature controllers feature full plug-in construction; plug-in relays; full-time, full-scale indication; thermocouple break protection; heating and cooling lights and easy screw terminal wiring. 3 lbs. Available for IMMEDIATE DELIVERY. **Price: $135.00.**

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THERMOCONTROL DIVISION

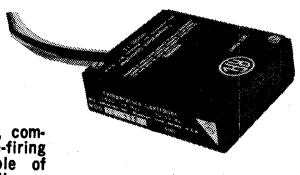
Since 1922

Temperature Measurement and Control Equipment

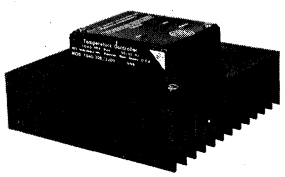
MINIATURE COMPONENT-TYPE PROPORTIONAL CONTROLLERS

RFL Models 70 and 72 are compact, nonindicating units capable of precision control of electrically energized heating applications. Units feature proportional bandwidth and coarse and fine temperature set point adjustments. Current to heating load is controlled by all solid-state components for reliable long life performance. Operates into resistive loads ranging from 1 to 15 amperes using a negative temperature coefficient sensor (Thermistor) as the sensing element.

LOW COST ZERO-VOLTAGE-FIRING CONTROLLER



RFL MODEL 75 is a low cost, completely solid-state zero-voltage-firing proportional controller capable of precision control of electrically energized heating applications. The Model 75 features an internal set point adjustment, or can also be used with an external temperature set point adjustment without unit modification. The unit minimizes RFI generation while controlling resistive loads from 1 to 15 amperes.



9200 WATTS AT LESS THAN A PENNY PER WATT

RFL MODEL 7040 is a completely solid-state, high load capability, proportional controller. The controller, while small in size, will control resistive loads from 100 to 9,200 watts. Thermistor sensors operating between 8000 ohms and 100 ohms are used providing an operating range of −70°C to +325°C.

Model	Overall Range (°C)	Accuracy to	Load	Probe Resistance	Sensors	Price (less probe) 115V	208/230V
70	−70 to +325	±0.05°C	to 3 kW	8000 to 100 ohms	Series 27687	$37.80	$45.00
71	0 to +500	±0.05°C	to 3 kW	RTD Type (100 Ohm) Sensor	24928	70.00	75.00
72	−90 to +325	±0.1°C	to 3 kW	30,000 to 300 ohms	Series 27687	60.00	62.50
75	−70 to +325	±0.2°C	to 3 kW	8000 to 100 ohms	Series 27687	39.50	42.00
7040	−70 to +325	±0.05°C	to 9.2 kW	8000 to 100 ohms	Series 27687	—	90.00
7870	− 5 to +325	±0.05°C	to 1.2 kW	8000 to 100 ohms	Series 35960	90.00	—
7872	−30 to +325	±0.1°C	to 1.2 kW	30,000 to 300 ohms	Series 35960	105.00	—

Also — Custom Temperature Control and Monitoring Systems

LAB TYPE CONTROLLERS WITH CONVENIENCE OUTLET

RFL MODEL 7870 (phase firing) and 7872 (zero voltage firing) are solid-state nonindicating proportional controllers. Both models precisely deliver power required to maintain desired temperatures to control resistive loads from 1 to 10 amperes. Both units include line cord, grounded outlet for load, power switch, power indicating light, output monitor light, sensor jack, and 10-to-1 tandem shaft set point adjustment potentiometer. Grounded metal case supported by rubber feet.

DIRECT-SETTING, RTD (WIRE) SENSING, PRECISION CONTROLLER

Direct-setting control dial

RFL MODEL 71 is a completely solid-state, null balance, visual set point, proportional temperature controller. The controller is capable of precisely controlling resistive heaters with one RTD type sensor throughout a visual set point temperature range of 0°C to +500°C(+32°F to +932°F). The controller, while small in size, will control resistive loads from 100 to 3000 watts.

RFL SENSORS

SENSOR NO.	RANGE (°C)		PRICE
24928	0 to +500		$40.00
	Models 70, 75, 7040	**Model 72**	
27687-3	−5 to +120	−30 to +80	9.50
27687-5	+30 to +160	+10 to +130	11.00
27687-7	+80 to +250	+40 to +200	11.00
27687-13	+220 to +325	+165 to +325	19.00
27687-15	−70 to +10	−90 to +10	19.00
	Model 7870	**Model 7872**	
35960-3	−5 to +120	−30 to +80	12.80
35960-7	+80 to +250	+40 to +200	14.00
35960-13	+220 to +325	+165 to +325	20.00

34739 Stainless Steel Immersion Adaptor (for Models 70, 72, 75 & 7040) ..... $ 5.00
37746 Direct Setting Control Dial (For Model 71) 20.00

DIRECT READING ELECTRICAL THERMOMETER Available in °C or °F

Highly accurate indicating thermometer provides measurement span of −60°C (−76°F) to +130°C (+266°F) in 3 ranges selected by push buttons color-coded to the multiple scale taut-band meter. Built-in calibration check and adjustment assures long-term accuracy. Storage well in panel assures probe availability. Probe selector module (optional) accommodates 5 probes, selected by 5 push buttons.

Model 290 (with 35500 probe) ..... $ 99.95
Probe selector module 35065 ..... $ 35.00
Liquid immersion adaptor well 34739 for 35500 probe ..... $ 5.00

SPECIFICATIONS
Accuracy: ±1.5°C (±2.5°F) with ambient temperatures at 25°C ±10°C
Ranges: (3) overlapping scales: −60°C to +10°C, 0°C to +70°C, and +60°C to +130°C.
Indicator: 4½" Taut-band meter
Power Source: 9-volt "transistor" battery
Size: 8½" W x 4" H x 7" D
Weight: 1¾ lbs.

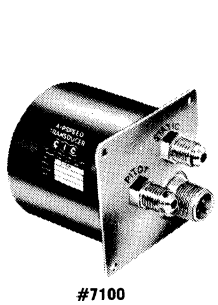
Probes:
35500 General Purpose ..... $ 17.00
35501 Surface Temperature ..... $ 28.00
35502 General Purpose Immersion ..... $ 28.00
35503 Fast Response ..... $ 28.00

RFL Industries, Inc.
Thermocontrol Division • Boonton, New Jersey 07005 • U.S.A.
Tel. (201) 334-3100 / TWX: 710-987-8352 / CABLE: RADAIRCO, N. J.

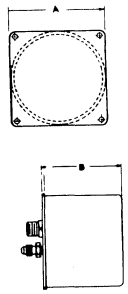
See Vol.1•497 Instrumentation Division Metrology, Magnetics

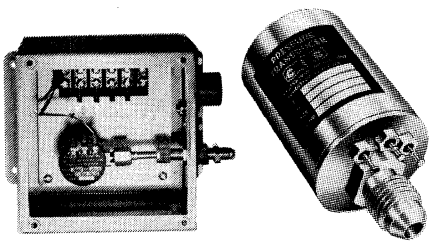
PRECISION PRESSURE TRANSDUCERS / TRANSMITTERS

LINEAR WITH PRESSURE / ALTITUDE / AIRSPEED / FLOW / SQUARE ROOT

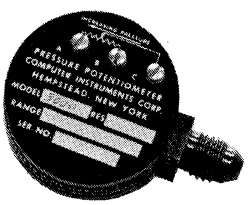


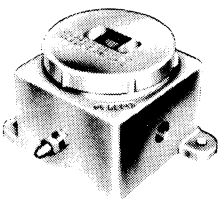
#7100
Air Speed Transducer





WEATHER-PROOF
(Available in All Models)





EXPLOSION-PROOF
(Available in All Models)

Model No.	Pressure Range	Gage, Absolute, Differential	Pressure Media	Linearity	Repeat-ability	Temp.	Dia. A	Lgth. B	Case Press.	Weight	Temp. Range
1000 & 1100	0-10 to 0-500 PSI Gage, Absolute, Differential	Gage, Absolute, Differential	Absolute, Differential Air or Oil — Non-corrosive Gage: Any media compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.156	1.55	200 PSIA	2 oz.	−55°C to +85°C
1200	0-300 to 0-10,000 PSI	Gage, Absolute	Any media compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.00	2.00	200 PSIA	4 oz.	−55°C to +85°C
1300	0-15 to 0-500 PSI	Gage	Any compatible with Inconel X-750	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.156	2.60	500 PSIA	6 oz.	−55°C to +85°C
2000	0-10 to 0-500 PSI	Gage, Absolute, Differential	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.01%/C°	1.25 Hex.	1.75	500 PSIA	3 oz.	−55°C to +85°C
3000	0-100 to 0-10,000 PSI	Gage, Absolute	Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	1.62	.71	—	3 oz.	−55°C to +85°C
3200	0-100 to 0-10,000 PSI	Gage, Absolute	Any compatible with Ni-Span-C	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.38	.72	—	3 oz.	−55°C to +85°C
4000	0-3 to 0-200 PSI	Gage, Absolute, Differential	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	2.06	2.16	200 PSIA	12 oz.	−55°C to +85°C
4105 & 4120	0-2 to 0-10,000 PSI Current Output	Gage, Absolute, Differential 1-5 or 4-20 M.A.D.C.	Absolute, Differential: Air or Oil, Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.5% F.S.	±.1% F.S.	±.02%/C°	5.00 Explosion or Weather-proof	4.625	200 PSIA	6 lb.	−40°F to +150°F
4500	0-2 to 0-200 PSI	Differential	High side: Any compatible with Ni-Span-C. Low side: Any compatible with isolating diaphragm	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.00	3.20	1000 PSIA	14 oz.	−20°C to +85°C
4500F	0-3 to 0-200 PSID Flow transmitter	Linearity of Voltage Output (Proportional to $\sqrt{\Delta P}$)	High side: Any compatible with Ni-Span-C. Low side: Any compatible with isolating diaphragm	To ±.5% F.S.	±.1% F.S.	±.02%/F°	2.00	3.20	1000 PSIA	14 oz.	0°F to +185°F
4600	0-200 to 0-10,000 PSI	Differential	High side: Any compatible with Ni-Span-C. Low side: any compatible with isolating diaphragm	To ±.3% F.S.	±.1% F.S.	±.02%/C°	2.63	2.18	1000 PSIA	14 oz.	−20°C to +85°C
6000	0-.1 to 0-2 PSI	Gage, Differential; 0-0.5 to 0-5 PSI Absolute	Absolute, Differential: Air or oil — Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	3.20	2.84	100 PSIA	12 oz.	−55°C to +85°C
6100	0-2 to 0-200 PSI	Gage, Differential; 0-5 to 0-200 PSI Absolute	Absolute, Differential: Air or oil — Non-corrosive; Gage: Any compatible with Ni-Span-C	To ±.3% F.S.	±.05% F.S.	±.02%/C°	2.63	2.84	150 PSIA	10 oz.	−55°C to +85°C
6200	0-50 to 0-10,000 PSI	Gage, Absolute, Differential	Gage, Absolute: Any compatible with Ni-Span-C. Differential: Air, oil — Non-corrosive	To ±.3%	±.05%	±.02%/C°	2.63	1.09	500 PSIA	6 oz.	−55°C to +85°C
7000	0 to 80,000 feet	Altitude	Absolute: Air	To ±.3%	5 feet	±.02%/C°	2.63	2.84	—	10 oz.	−55°C to +85°C
7100	0 to 1,000 knots	Airspeed	Differential: Air	To ±.3%	±.15 knots	±.02%/C°	2.63	2.84	—	10 oz.	−55°C to +85°C

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HOW TO USE eem

electronic engineers master

1973-74

Need directory information?

EEM contains four complete directories which provide the most up-to-date information available. These directories are listed and described at the right. They appear in all three volumes, with the exception of the Trade Mark Directory which appears only in Volume 1. Directory references to Volume 4 indicate the 1973 edition, which you received in January. That copy of Volume 4 should be retained to complete the 4-volume set.

Add Volume 4/1973 to your copies of Volumes 1, 2 and 3 to make a complete set of **EEM** for 1973-74.

Included in this volume are:

The Product Index and Directory

The Product Index and Directory (green section, page 9) lists more than 6,000 types of electronic products alphabetically, by product. Under each product heading is a complete, alphabetical listing of manufacturers who make that product. **Bold face** listings indicate which manufacturers have provided catalog data on that product in the white pages.

The Manufacturers and Sales Office Directory

The Manufacturers and Sales Office Directory (starts yellow section of each volume) lists more than 3,000 manufacturers of electronic components, materials, instruments, assemblies, systems, and key services. Provided are complete addresses, phone numbers, sales managers' names, names of application engineers, TWX numbers where applicable, selected distributors. **Bold face** listings indicate that manufacturers have provided catalog data in the white pages and that sales offices are listed.

The Distributor Directory

The Distributor Directory (yellow section, page 1594, with black edge marking) lists more than 1,000 electronic distributors and branch locations, alphabetically by distributor's name, geographically by state and city.

Need catalog information?

For complete catalog information on any product, refer to the Product Index and Directory (green section, page 9, all volumes) which provides a complete listing of all the manufacturers who supply a particular product. Those manufacturers listed in bold face with page and volume number references have provided catalog data on this product in the catalog section (white pages) where you can find the information you need. References to Volume 4 indicate the Volume 4 you received in January and which should be retained to complete your 4-volume set of EEM.

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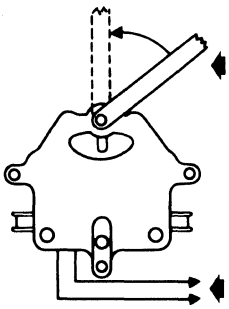
Two special telephone services are being maintained for EEM users to provide extra information you need. If you need to determine a local source of supply, just **D.I.A.L. EEM.** This toll-free service (**D**istributor **I**nformation **A**nd **L**istings), provides you with the name of a sales office or distributor in your area who can provide a needed product.
For up-to-the-minute listings of manufacturers who provide certain IC functions, **call the IC UPDATE HOTLINE.** Listings of IC functions are updated daily by manufacturers throughout the country. For information in a hurry, **just D.I.A.L. EEM** — call toll-free 800-645-9200 (in N. Y. State call collect (516) 294-0990). Or **call The IC UPDATE HOTLINE,** Dial toll-free 800-645-9201.

Need additional assistance?

Contact the EEM editorial staff, at United Technical Publications, Inc., 645 Stewart Avenue, Garden City, N. Y. 11530, or phone (516) 248-9700.

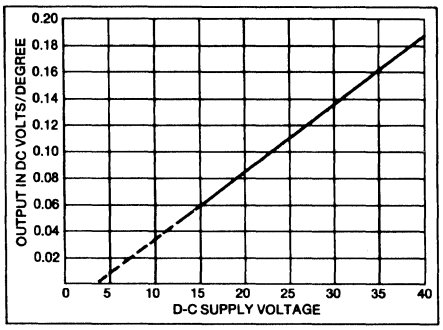
UNITED TECHNICAL PUBLICATIONS

The Metrisite Angular Position Transducer from Brush.



A change in angular position here

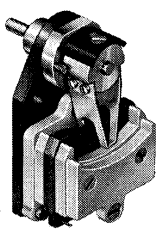
gives a proportional voltage output here.



- Low Torque (practically zero)
- Excellent linearity
- No contacts
- Extremely stable
- Low price

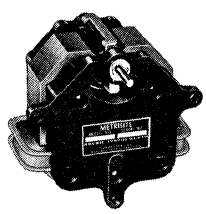
This direct position sensing transducer is the most perfect combination of ideal transducer characteristics you can buy. It gives you extreme resolution. It will measure one ten-millionth of an inch with ease. And its minute operating force gives you an absolute minimum of bearing friction. The reactive force is almost negligible at a fraction of a milligram. You also get true linearity with a proven accuracy of 1/10%. Electrical output is high — up to 100 volts without amplification. Whatever shape or size you need, the rugged Metrisite will meet your needs.

Specifications
Models:
31-38-05
31-38-10



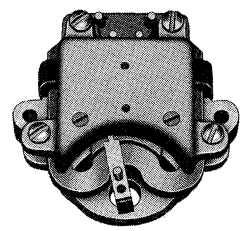
Displacement	±20°
Repeatability	.01%
Linearity	0.1% ±10°
Scale factor	0.28 volts/degree
Impedance	
input	60 + j 310 ohms @ 20KHz
output	320 + j 1370 ohms @ 20KHz
Load	10 K or higher @ 20KHz
Restoring forces	$< 7 \times 10^{-5}$ oz in
Dimensions	05: 1 3/16" wide 5/8" high 1 3/4" long 10: 1 3/16" wide 1 3/8" high 2 1/16" long
Weight	05: 3/4 oz 10: 2 oz

Specifications
Model TA 34



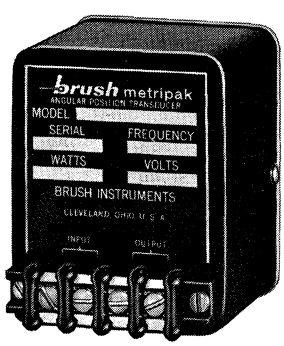
Displacement	±40°
Repeatability	.01%
Linearity	0.1% ±10°
Impedance	
input	250 + j 140 ohms
output	930 + j 550 ohms
Load	10K (at 40°)
Restoring forces	$< 6 \times 10^{-3}$ oz in
Dimensions	3" x 2 5/8" x 1 7/8"
Weight	20 oz

Specifications
Type 19

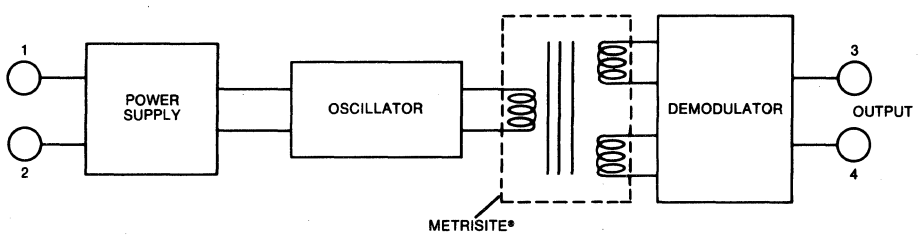


Displacement	±45°
Repeatability	.01%
Linearity	>1%
Scale factor	0.013 volts/degree
Impedance	
input	300 + j 4300 ohms
output	11 + j 29
Restoring forces	< .04 dyne cm/degree
Dimensions	2 3/4" x 2 5/8" x 1 1/4"
Weight	5 1/2 oz

Custom designs on request.



You can also buy the Metripak, consisting of the Metrisite and its associated electronic apparatus.



BRUSH INSTRUMENTS

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GOULD

VARIABLE RELUCTANCE TRANSDUCERS

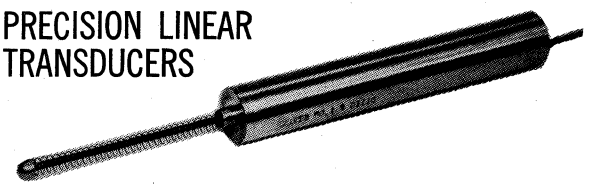
Since pioneering variable reluctance transducer measurement in 1938, Moxon Inc./SRC Division (Crescent Technology) has continually paced the industry by developing new transducer types and systems. The expanded line presently includes a complete range of precision sensors in the following types. ROTARY POSITION • LINEAR POSITION • VELOCITY • TORQUE.

SRC transducers are currently used in the following programs: ATLAS, CENTAUR, SPARTAN, MINUTEMAN, C-5A, F-14, F-15, B-1, MBT-70 and SPACE SHUTTLE.

In addition to the transducer line, SRC producers a complete line of complimentary electronic components. While the standard systems fit most applications, SRC engineers have the know-how to develop custom systems for special requirements.

To find the right transducer system for your application, simply contact the factory giving specs. and qtys. Drawings and price quotations will be supplied in return.

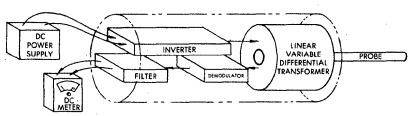
PRECISION LINEAR TRANSDUCERS



The SRC DC-DC Linear Variable Differential Transformer type (LVDT) Transducer, Models 1104 and 1110 have the advantage of DC voltage operation with the accuracy of devices that are more expensive and which require more support circuits and equipment.

A regulated DC Power Supply is all that this instrument needs to operate, along with a method of reading, recording, or otherwise using its output. Output power is sufficient to operate meters, analog to digital converters, recorders and many other instruments or control circuits.

These instruments have become increasingly popular as direct replacements of potentiometers. The advantages are great, such as, infinite resolution, sealed electronics, high speed response and no friction (by use of an isolated core) or electrical wearing parts (brushes or slip rings) which means the transducer life will far exceed the associated mechanical hardware.



SYSTEM BLOCK DIAGRAM SHOWING INTERNAL ELECTRONICS

SPECIFICATIONS

ELECTRICAL	MODEL 1104 **MODEL 1105***	MODEL 1110 MODEL 1111*
Excitation	24 VDC Regulated	6 VDC Regulated
Sensitivity, at Full Stroke into a 500 K ohm load	±5.000 VDC ±1.0%	±.400 VDC ±1.0%
Linearity	0.25% of Full Range (.1% Optional*)	
Ripple	50 mv RMS	4 mv RMS
Output Impedance	Less than 4 K ohms	Less than 1 K ohms
Insulation Resistance	50 Megohms @ 50 VDC	100 Megohms @ 50 VDC
Dielectric Strength	100 VAC, RMS, 60 Hz for 60 Seconds	
Shielding	Electromagnetic and Electrostatic	
Temperature Coefficient	.02% per °F	.01% per °F
Repeatability	0.01%	

* The 1105 and 1111 have .1% linearity. All other specs remain as shown.

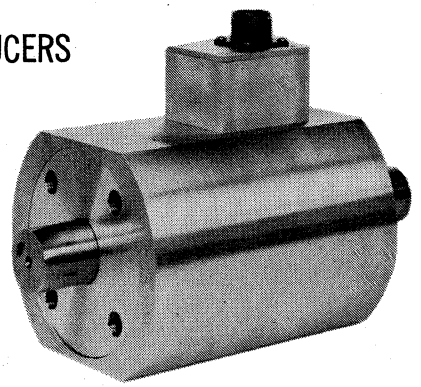
MECHANICAL	
Construction	Corrosion Resistant Steel — .75 Inch Diameter
Lead Wires	26 AWG, Teflon, 12 Inches Long
Probe Extension	3/32 Inch Diameter with a 2-56 Threaded End

ENVIRONMENTAL	
Operating Temperature	−20°F to +250°F
Storage Temperature	−65°F to +250°F

PRICE

	Stroke (Inches)	Housing Length (Inches)	Input Current ma. 1104	Input Current ma. 1110	1-5 Quan.	6-10 Quan.	Additional for 1105 and 1111
−1	±0.050	3.00	45	40	$107.00	$ 94.00	+ $25.00
−2	±0.100	3.00	35	40	$114.00	$105.00	+ $29.00
−3	±0.250	3.50	30	35	$146.00	$127.00	+ $33.00
−4	±0.500	4.25	25	35	$169.00	$145.00	+ $38.00
−5	±1.000	5.00	25	30	$180.00	$158.00	+ $42.00
−6	±2.000	9.00	25	30	$209.00	$182.00	+ $46.00
−7	±3.000	14.00	25	25	$239.00	$212.00	+ $50.00

TORQUE TRANSDUCERS



SRC Torque Transducers are precision electronic torque measuring instruments for making static and dynamic measurements. They employ a linear variable reluctance principle to provide an AC or DC output signal proportional to the amount of torque applied.

The DC versions contain an integral electronic package. A nominal 24 volt DC excitation voltage generates an output of 0-5 VDC proportional to the torque applied. For high temperature requirements an AC Transducer with a SRC Model 1501T Signal Conditioner can be used to obtain a DC output.

FEATURES

NO SLIP RINGS, NOISE OR WEAR • INFINITE LIFE • INFINITE RESOLUTION • COMPACT • EASY TO USE

TYPICAL APPLICATIONS

Automotive, process control, earth moving, oil drilling, nuclear reactors, farm equipment and manufacturing, aircraft, shipboard, chemical, baking etc. industries.

PHYSICAL CHARACTERISTICS

TORQUE RANGE: 10 to 100,000 inch-lbs.
OVERLOAD RANGE: 200% of full scale.
TEMPERATURE RANGE: −65° F to 200°F.
SPEED: 0 to 6000 RPM STD; optional to 25,000 RPM.

ELECTRICAL	DC	AC
Excitation	22-34 VDC unregulated	5 Vrms 400 to 1,000 Hz
Sensitivity	5 VDC ±10 mV full range	15 to 20 mV/V full range
Ripple	Less than 20 mV	N/A
Linearity	0.25% half-range, 0.75% full range	
Hysteresis	Less than 0.25%	
Repeatability	Better than 0.15%	
Resolution	Infinite	
Output Impedance	Less than 100 ohms	
Thermal Sensitivity Shift	Less than 0.02%/F	
Shielding	Electromagnetic	

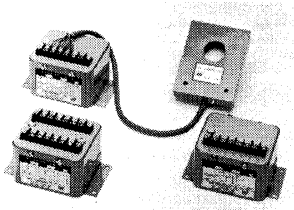
STANDARD SIZES AVAILABLE

TORQUE IN INCH POUNDS	AC-AC MODEL 1202	DC-DC MODEL 1203
10, 50, 100, 300	$ 860	$1,200
500, 1000, 3000	940	1,290
5,000, 10,000 20,000	1,220	1,490
50,000, 100,000	1,450	1,750

MOXON INC. / SRC DIVISION • **2222 Michelson Drive** • **Irvine, California 92664** • **(714) 833-2000** • **(213) 623-1892**

Sensors—Wattmeter, Current and Magnetic Field. Thermoelectric Devices and Energy Conversion Materials.

WATTMETER TRANSDUCERS

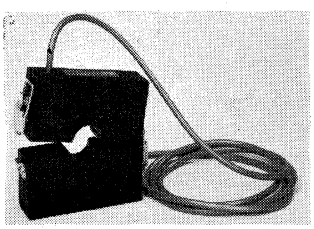


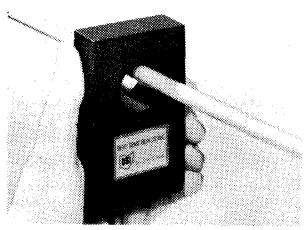
Halltron Wattmeter Transducers, when used with a meter, indicate true power consumed in single or three-phase circuits. The isolated d.c. output, proportional to EI cos θ, or true power, can be used for monitoring or control purposes. Units have fast response needed for sinusoidal or chopped waveforms. Four of our 36 standard models for power and industrial requirements are listed.

MODEL	APPLICATION	(Volts) VOLTAGE	(Ampere) CURRENT	(Millivolts) OUTPUT
PC-51	1ϕ 2 Wire	120	5	50 @ .5KW
PC-54-3	3ϕ 3 Wire	440	5	100 @ 4KW
PC-C2	1ϕ 2 Wire	240	100	50 @ 20KW
PC-C4-3	3ϕ 3 Wire	440	100	100 @ 80KW

Stock Amplifier Units are available to provide high level d.c. output. Wattmeter transducers can be tailored to meet special customer requirements.

HALLTRON d.c. to Kilohertz CURRENT TRANSDUCERS

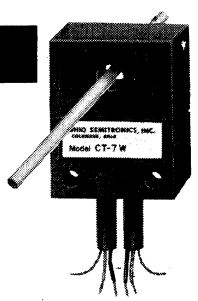




These Halltron Current Transducers provide flat d.c. to 5 Kilohertz response and require no electrical connection to the circuit being monitored. The circuit isolation makes many measuring and control applications simple, especially where conductors are at high voltage with respect to measuring or control circuits.

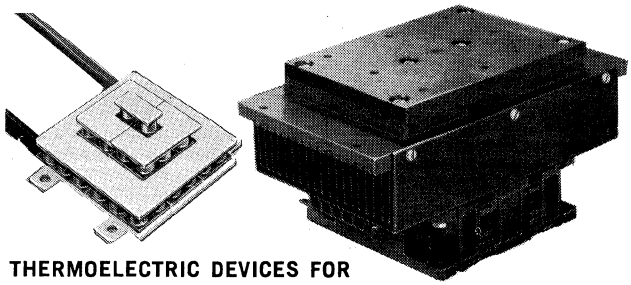
Models with better than 1% linearity and temperature effects less than 1% are stock items in current ranges to 2000 Amperes. Special units for higher currents or split-core configuration can be supplied for specific requirements. Auxiliary amplifier-power supply units are available to provide 10 volt output when desired instead of 50 millivolt output of transducer alone.

WIDEBAND d.c. to Megahertz CURRENT SENSORS



CT Series Current Transducers introduce negligible circuit interaction and require no physical or electrical connection to circuit being measured. An output voltage is provided which is directly proportional to the instantaneous current flow through the window. The flat d.c. to Megahertz frequency response together with the less-than-1-microsecond-risetime makes the units ideally suited for monitoring, control, or analysis of d.c., steady-state or transient currents.

MODEL	PEAK CURRENT AMPERES	BIAS CURRENT MILLIAMPERES	FULL SCALE OUTPUT MILLIVOLTS
CT-7W	30	100	60
CT-100W	100	100	60
CT-200W	200	100	100
CT-600W	600	100	60
CT-1000W	1000	100	60



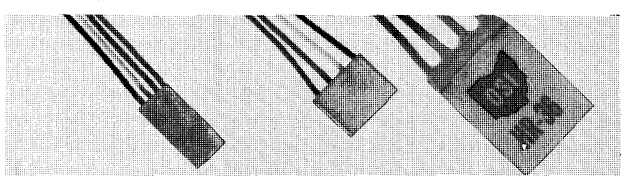
THERMOELECTRIC DEVICES FOR COOLING AND TEMPERATURE CONTROL

O.S.I. offers a variety of thermoelectric cooling units ranging from the TC Series, used in spot-cooling applications where up to 115 degree Centigrade temperature depression is needed, to the TA Series which can remove up to 85 watts from chemical bath, electronic package, or enclosure. The controllable, reversible heat pumping properties of thermoelectric devices make them ideally suited for temperature control.

MODEL	ΔT DEG. C.	HEAT PUMP WATTS	INPUT CURRENT AMPERES
TM-12	65	3	30
TM-20	65	20	30
TM-20M	65	20	30
TC-44	90	6	30
TC-1851	115	3	25
TA-6F	55*	85	30

* Specified as cold plate temperature depression from ambient air temperature.

HALLTRON, MAGNETIC FIELD SENSORS



A wide variety of Hall effect probes for use in magnetic sensing or measuring applications are maintained in stock. Units feature high-linearity, low-noise, excellent stability and ruggedness. Physical size/device characteristic combinations permit optimum use of O.S.I. sensors in critical applications.

MODEL	TYPE	CONTROL CURRENT MILLI-AMPERES	OUTPUT IN 10 Kg. MILLIVOLTS	DIMENSIONS INCHES
HP-325	Miniature	25	200	.187/.075/.015
HP-330	Micro	25	150	.040/.040/.012
HP-340	Gaussmeter	100	100	.280/.125/.020
HR-36	High-linearity	350	350	.500/.375/.025
HR-66	Low-cost	200	500	.200/.250/.028
HR-72	High-sensitivity	100	700	.200/.250/.028
HS-84	Low Temperature*	350	30,000	.500/.375/.015

* The HS-84 is designed for high sensitivity at −196°C.

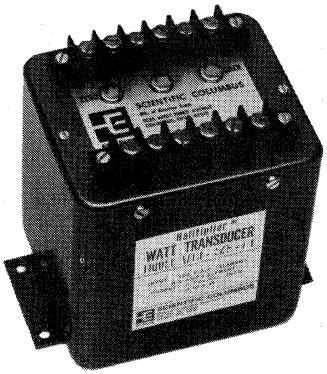
ENERGY CONVERSION MATERIALS AND SENSORS

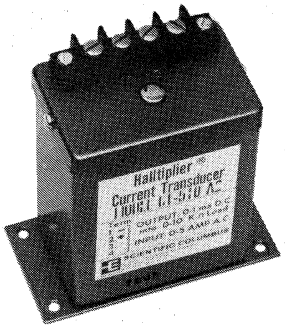
High purity elements, optimized energy conversion materials and infrared sensors of the following types are available:

• Indium Arsenide and Indium Antimonide for magnetic sensors and infrared filters • Bismuth Telluride alloys for thermoelectric cooling and power generation • Lead Telluride for high quality optical and infrared coatings • Model RS Radiation Sensors which offer self-generating and wideband characteristics at low cost • Research grade Bismuth, Indium, Arsenic, Tellurium and Antimony.

OHIO SEMITRONICS, INC.
1205 CHESAPEAKE AVENUE • COLUMBUS, OHIO 43212 • PHONE: 614-486-9561
PIONEER IN SOLID STATE ENERGY CONVERSION MATERIALS, DEVICES and SYSTEMS
See Current and Power Monitoring Equipment in VOL. I

Instrumentation to Measure All Electric Power Parameters





Halltiplier (TM) Watt Transducers

- Utility Tested and Approved
- Voltage or Current Outputs
- Minimal Space Requirements
- Calibrated Output

Scientific Columbus can provide off-the-shelf delivery of Halltiplier™ transducers to measure all of your parameters . . . volts, amps, watts, power factor, phase angle, and frequency. We also offer voltage outputs, especially calibrated to your requirements, or the popular constant current outputs of 0-1ma, 1-5ma, 4-20ma or 10-50ma, which simplifies your own calibrating or scaling networks.

WATT TRANSDUCERS

(Calibration instructions, typical characteristic curves and application assistance are available on request).

	Full Scale	Nominal Voltage Input	Voltage Range	Voltage Overload	Voltage Burden	Nominal Current Input	Current Overload	Current Burden	Frequency Range (HZ)	Power Factor Range	Temperature Range (°C)	Maximum Temperature Effects on Accuracy	Accuracy/ Linearity @ 25°C (% of F.S.)	Output at Full Scale (d.c.)	Output Load Required	A.C. Component (peak)	Response Time (to 99%)	Calibrate Adjustment	Zero Adjustment	External Amplifier Power Required	Dielectric Test
6512	500/1000/ 2000 W	120/ 240V	135/270V	50%	1VA	5/10A	250A/1 Sec.	3VA	60	0-1-.7	− 0°/+50°	±1%	±1%	110 MV	100 Ω	100%	<5 MS	NONE	NONE	NONE	1500 VRMS
WT5C5	500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	50 MV	100 Ω	100%	<5 MS	±10%	NONE	NONE	1500 VRMS
WT5C5A1	500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	50 MV	≥50 KΩ	<1%	<400 MS	0-110%	NONE	NONE	1500 VRMS
WT5C5A2	500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	85-135V/60HZ 2W	1500 VRMS
WT5C5A3	500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	85-135V/60HZ 2W	1500 VRMS
WT5C5A4	500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	NONE	1500 VRMS
WT5C5A5	500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	NONE	1500 VRMS
WT3-1K5	1000 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	100 MV	100 Ω	up to 100%	<5 MS	±10%	NONE	NONE	1500 VRMS
WT3-1K5A1	1000 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	100 MV	≥50 KΩ	<1%	<400 MS	0-110%	NONE	NONE	1500 VRMS
WT3-1K5A2	1000 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	85-135V/60HZ 2W	1500 VMRS
WT3-1K5A3	1000 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	85-135V/60HZ 2W	1500 VRMS
WT3-1K5A4	1000 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	NONE	1500 VRMS
WT3-1K5A5	1000 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	NONE	1500 VRMS
WT3-1K5 2½	1000/ 1500 W	120V	0-135V	150V	3VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	66.7/100 MV	100 Ω	up to 100%	<5 MS	±10%	NONE	NONE	1500 VRMS
WT3-1K5 2½A1	1000/ 1500 W	120V	0-135V	150V	3VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	66.7/100 MV	≥50 KΩ	<1%	<400 MS	0-110%	NONE	NONE	1500 VRMS
WT3-1K5 2½A2	1000/ 1500 W	120V	0-135V	150V	3VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	0.667/1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	85-135V/60HZ 2W	1500 VRMS
WT3-1K5 2½A3	1000/ 1500 W	120V	0-135V	150V	3VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	0.667/1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	85-135V/60HZ 2W	1500 VRMS
WT3-1K5 2½A4	1000/ 1500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	0.667/1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	NONE	1500 VRMS
WT3-1K5 2½A5	1000/ 1500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	0.667/1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	NONE	1500 VRMS
WT34-2K5	1500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	150 MV	100 Ω	up to 100%	<5 MS	±10%	NONE	NONE	1500 VRMS
WT34-2K5A1	1500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	150 MV	≥50 KΩ	<1%	<400 MS	0-110%	NONE	NONE	1500 VRMS
WT34-2K5A2	1500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	85-135V/60HZ 2W	1500 VRMS
WT34-2K5A3	1500 W	120V	0-135V	150V	2VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	85-135V/60HZ 2W	1500 VRMS
WT34-2K5A4	1500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	±10%	±2%	NONE	1500 VRMS
WT34-2K5A5	1500 W	120V	85-135V	150V	4VA	5A	250A/1 Sec.	2VA	50-70	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0-10 KΩ	<1%	<400 MS	0-110%	±2%	NONE	1500 VRMS

VAR TRANSDUCERS

	Full Scale	Nominal Voltage Input	Voltage Range	Voltage Overload	Voltage Burden	Nominal Current Input	Current Overload	Current Burden	Frequency HZ	Power Factor Range	Temperature Range (°C)	Maximum Temperature Effects on Accuracy	Accuracy/ Linearity @ 25°C (% of F.S.)	Output at Full Scale (d.c.)	Output Load Required	A.C. Component (peak)	Response Time	Calibrate Adjustment	Zero Adjustment	External Amplifier Power Required	Dielectric Test
VT5C5	500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	50 MV	100 Ω	100%	<5 MS	±10%	NONE	NONE	1500VRMS
VT5C5A1	500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	50 MV	≥50 K Ω	<1%	<400 MS	0 to 110%	NONE	NONE	1500VRMS
VT5C5A2	500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	85-135V/60 HZ 2W	1500VRMS
VT5C5A3	500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	85-135V/60 HZ 2W	1500VRMS
VT5C5A4	500 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	NONE	1500VRMS
VT5C5A5	500 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	NONE	1500VRMS
VT3-1K5	1000 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	100 MV	100 Ω	up to 100%	<5 MS	±10%	NONE	NONE	1500VRMS
VT3-1K5A1	1000 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	100 MV	≥ 50 K Ω	<1%	<400 MS	0 to 110%	NONE	NONE	1500VRMS
VT3-1K5A2	1000 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	85-135V/60 HZ 2W	1500VRMS
VT3-1K5A3	1000 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	85-135V/60 HZ 2W	1500VRMS
VT3-1K5A4	1000 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	NONE	1500VRMS
VT3-1K5A5	1000 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	NONE	1500VRMS
VT34-2K5	1500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	150 MV	100 Ω	up to 100%	<5 MS	±10%	NONE	NONE	1500VRMS
VT34-2K5A1	1500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	150 MV	≥ 50 K Ω	<1%	<400 MS	0 to 110%	NONE	NONE	1500VRMS
VT34-2K5A2	1500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	85-135V/60 HZ 2W	1500VRMS
VT34-2K5A3	1500 VARS	120V	0-135V	150V	2 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	85-135V/60 HZ 2W	1500VRMS
VT43-2K5A4	1500 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	±10%	±2%	NONE	1500VRMS
VT34-2K5A5	1500 VARS	120V	85-135V	150V	4 VA	5A	250A/1 Sec.	0.5 VA	60	0-1-0	−20°/+60°	±1%	±0.5%	1 MA	0 to 10 K Ω	<1%	<400 MS	0 to 110%	±2%	NONE	1500VRMS

CURRENT AND VOLTAGE TRANSDUCERS

	Full Scale	Nominal Voltage	Overload	Burden @ 120 v	Frequency Range HZ	Temperature Range (°C)	Maximum Temperature Effects on Accuracy	Accuracy/ Linearity @ 25°C	Output at Full Scale (D.C.)	Output Load Required	A.C. Component	Response Time	Calibration Adjustment	Dielectric Test
CT-510	5a	—	250A/1 Sec.	1 va	50-70	−20°/+60°	±1% of F.S.	±0.5%	10 volts	1 K Ω	48%	<5 ms	NONE	1500 rms
CT-510A2	5a	—	250A/1 Sec.	1 va	50-70	−20°/+60°	±1% of F.S.	±0.5%	1 ma	0 to 10 K Ω	<1%	<400 ms	±10%	1500 rms
CT-510A3	5a	—	250A/1 Sec.	1 va	50-70	−20°/+60°	±1% of F.S.	±0.5%	3 ma	0 to 10 K Ω	<1%	<400 ms	±10%	1500 vrms
VT-110	150 v	120 v	180 v	4 va	50-70	−20°/+60°	±1%	±0.5%	10 volts	1 K Ω	48%	<5 ms	NONE	1500 vrms
VT-110A2	150 v	120 v	180 v	2.5 va	50-70	−20°/+60°	±1%	±0.5%	1 ma	0 to 10 K Ω	<1%	<400 ms	±10%	1500 vrms
VT-110A3	150 v	120 v	180 v	2.5 va	50-70	−20°/+60°	±1%	±0.5%	3 ma	0 to 10K Ω	<1%	<400 ms	±10%	1500 vrms

SCIENTIFIC COLUMBUS

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SCIENTIFIC COLUMBUS, 1035 WEST THIRD AVENUE, COLUMBUS, OHIO 43212 TELEPHONE 614-294-5671

Amperex Instrument Cathode Ray Tubes

Flat-faced, mono-accelerator CRT's intended primarily for use in inexpensive oscilloscopes, read-outs, and monitors for industrial and medical instrumentation.

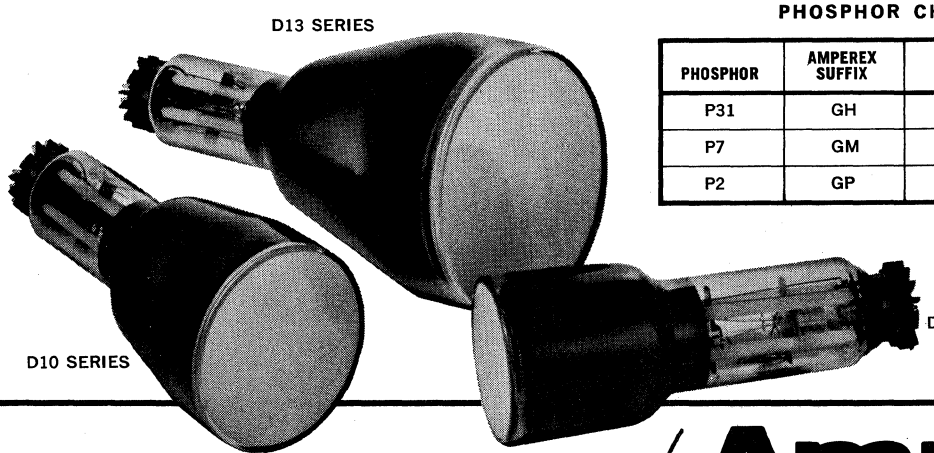
Amperex CRT's are ruggedly constructed and are designed to be mounted in any position; thus they are suitable for use in portable and mobile instruments as well as in fixed equipment. Special low-wattage heaters are available in most types to reduce power consumption of portable equipment.

These are electrostatic deflection tubes, electrostatically focussed and with symmetrical X and Y deflection plates. Orthogonality between X and Y plates is 90° ±1°. Deflection linearity from 25% to 75% of full deflection is better than 1%.

No external astigmatism control is needed for equipment in which these CRT's are used; initial adjustment at the time of manufacture is all that is required if mean X and Y plate potentials are correctly set.

Each tube is supplied with an Amperex 55566 14-pin socket.

TYPE	DIAMETER (in.)	DISPLAY AREA (cm)	PHOSPHOR	DEFLECTION COEFFICIENT (V/cm)		ACCELERATOR VOLTAGE	HEATER CURRENT (mA at 6.3V)	LENGTH (in.)	WEIGHT (oz.)
				HOR.	VERT.				
D7-190GH	2.52	5 x 6	P31	29	11.5	1000	300	8	9
D7-190GM	2.52	5 x 6	P7	29	11.5	1000	300	8	9
D7-190GP	2.52	5 x 6	P2	29	11.5	1000	300	8	9
D7-191GH	2.52	5 x 6	P31	29	11.5	1000	95	8	9
D7-191GM	2.52	5 x 6	P7	29	11.5	1000	95	8	9
D7-191GP	2.52	5 x 6	P2	29	11.5	1000	95	8	9
D10-160GH	3.35	6 x 8	P31	32	13.7	1500	300	9¼	14
D10-160GM	3.35	6 x 8	P7	32	13.7	1500	300	9¼	14
D10-160GP	3.35	6 x 8	P2	32	13.7	1500	300	9¼	14
D10-161GH	3.35	6 x 8	P31	32	13.7	1500	95	9¼	14
D10-161GM	3.35	6 x 8	P7	32	13.7	1500	95	9¼	14
D10-161GP	3.35	6 x 8	P2	32	13.7	1500	95	9¼	14
D13-480GH	4.48	8 x 10	P31	31.3	14.4	2000	300	11¼	23
D13-480GM	4.48	8 x 10	P7	31.3	14.4	2000	300	11¼	23
D13-480GP	4.48	8 x 10	P2	31.3	14.4	2000	300	11¼	23
D13-481GH	4.48	8 x 10	P31	31.3	14.4	2000	95	11¼	23
D13-481GM	4.48	8 x 10	P7	31.3	14.4	2000	95	11¼	23
D13-481GP	4.48	8 x 10	P2	31.3	14.4	2000	95	11¼	23



PHOSPHOR CHARACTERISTICS

PHOSPHOR	AMPEREX SUFFIX	COLOR	PERSISTENCE
P31	GH	green	medium short
P7	GM	yellow-green	long
P2	GP	blue-green	medium short

AMPEREX ELECTRONIC CORPORATION
Electro-Optical Devices Division
Slatersville, Rhode Island 02876
Telephone: 401-762-3800 TWX: 710-382-6332

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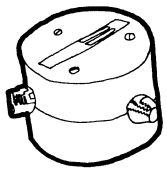
Amperex Industrial

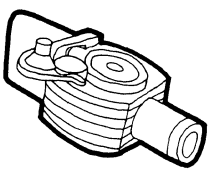
Individual catalogs for any of the six Applications Areas listed on facing page, or sets of catalogs in any combination may be obtained from Amperex Electronic Corporation, Hicksville Division, Hicksville, New York 11802

Electronic Components



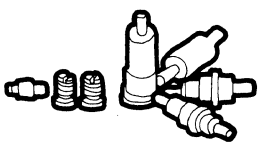
COMMUNICATION COMPONENTS

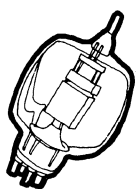
- RF POWER TRANSISTORS
- UHF RF POWER SEMICONDUCTOR MODULES
- SMALL TRANSMITTING TUBES
- LARGE TRANSMITTING TUBES
- TV TETRODE CAVITIES
- VARIABLE VACUUM CAPACITORS (See Pages 344,345)
- RF CIRCULATORS
- HIGH FREQUENCY SMA-TYPE CONNECTORS



MICROWAVE DEVICES

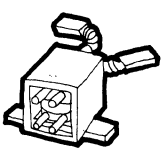
- RADAR TUBES:
  - Transmitter Magnetrons
  - Receiver Klystrons
  - Modulator Switch Tubes
- UHF TV KLYSTRONS
- MICROWAVE DIODES:
  - Gunn Effect
  - Silicon Impatt
  - Tuning Varactors
  - Schottky Barriers
- MICROWAVE IC ASSEMBLIES





INDUSTRIAL POWER COMPONENTS

- INDUSTRIAL MAGNETRONS
- RF POWER TUBES:
  - Radiation, Water, Air-Cooled Triodes
- RECTIFIERS:
  - Solid State, Gas and Vacuum Tubes
- THYRATRONS and SCR's
- IGNITRONS and IGNISTORS

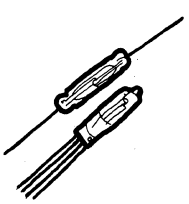


INSTRUMENTATION COMPONENTS

- TEMP-COMPENSATED CRYSTAL OSCILLATORS
- PREMIUM QUALITY TUBES

SCIENTIFIC AND RESEARCH PRODUCTS

- PHOTOMULTIPLIER TUBES
- RADIATION COUNTER TUBES
- CHANNEL ELECTRON MULTIPLIERS
- COAXIAL THERMOCOUPLE AND HEATER WIRE
- SEMICONDUCTOR RADIATION DETECTORS
- X-RAY TUBES
- X-RAY COMPONENTS



COMPUTER COMPONENTS

- REED SWITCHES
- TRIGGER TUBES

Six separate catalogs, each designed to simplify component-searches within the six Applications Areas listed above are available upon request. Each of the six market-oriented catalogs contains condensed specifications for all of the product lines available for that specific market from the Amperex Hicksville Division. You may request individual catalogs for any one of the six different applications areas or sets of catalogs in any combination, from one market to all six.

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Hicksville Division
230 Duffy Avenue, Hicksville, New York 11802
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Vol.4 COMBINES PRODUCT CATEGORIES INCLUDED IN VOLS. 1, 2, AND 3

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The 53 Product Sections categorize related electronic components, equipment, materials, instruments and systems, and fabrication services, enabling you to quickly compare and evaluate similar items.

To find a specific manufacturer's catalog pages refer to the Index of Manufacturers which appears in two places in this volume, at the beginning of the green section and at the beginning of the white section.

Product Section	Volumes 1, 2, 3 Page	1973 Volume 4 Page	Products
1100	Vol.2•308	Vol.4•309	Amplifiers, Audio, Operational, etc.
1200			Antennas & Accessories
1300	Vol.1•308	Vol.4•310	Audio Equipment & Accessories
1400	Vol.3•308	Vol.4•311	Cabinets, Chassis, Containers, Racks, Boxes, etc.
1500	Vol.3•342	Vol.4•314	Capacitors (All Types)
1600	Vol.3•516	Vol.4•324	Chemicals (Acids, Adhesives, Coatings, Lubricants, etc.)
1700	Vol.2•323		Circuit Assemblies, Circuit Boards & Breadboarding Kits
1800	Vol.3•519		Coils (Inductors, Chokes), Assemblies, Forms
1900	Vol.1•319		Communications Equipment (Facsimile, Telephone, Television)
2000	Vol.1•321	Vol.4•325	Computing, Data Handling Equipment & Accessories
2100	Vol.3•544	Vol.4•356	Connectors, Electrical (Receptacles, Sockets, Terminal Boards)
2200	Vol.2•326	Vol.4•386	Controls, Control Components & Systems
2300	Vol.2•379	Vol.4•389	Crystals & Mechanical Tuning Devices; Oscillators
2350	Vol.3•978	Vol.9•392	Delay Lines (All Types)
2400	Vol.2•456	Vol.4•397	Panel Components (Including Lighting & Readouts)
2500	Vol.3•1004	Vol.4•401	Fabricated Mechanical Parts (Bearings, Cores, Magnets, etc.)
2550	Vol.1•382		Environmental Test Equipment
2600	Vol.3•1039		Fans, Blowers & Cooling Equipment
2700	Vol.2•544	Vol.4•403	Filters
2800	Vol.3•1070		Hardware, Non-Current Carrying (Fasteners, Washers, etc.)
2900	Vol.1•386	Vol.4•404	Instruments, Measuring & Test
3000	Vol.1•536	Vol.4•430	Instruments, Graphic Recording
3100	Vol.3•1074		Insulators, Insulating Materials & Parts
3130	Vol.2•588	Vol.4•432	Integrated Circuits & Hybrid Microcircuits
3150	Vol.3•1089		Manufacturing, Subcontracting, Custom Fabrication
3200	Vol.3•1092		Materials, Raw (Metals, Plastics, Glass, Rubber, Cloth, etc.)
3400	Vol.1•544		Microwave, Laser & Radar (Systems & Subsystems)
3450	Vol.2•607	Vol.4•438	Microwave, Laser & Radar (Components/Accessories)
3500	Vol.2•630	Vol.4•442	Motors, Rotating Components & Accessories
3600			Nuclear & Radiation Equipment
3700	Vol.2•670	Vol.4•443	Photoelectric Equipment & Components
3800	Vol.2•680		Optical Equipment & Accessories
4000	Vol.1•571	Vol.4•444	Power Supplies, Converters, Inverters, Batteries, etc.
4100	Vol.1•934		Production Machinery & Automation Equipment
4200			Engineering Aids (Books, Drafting Equipment, Whiteprinters)
4300	Vol.1•935		Recording Equipment (Non-Audio Types)
4500	Vol.2•683	Vol.4•472	Relays & Solenoids
4600			Research, Development, Engineering Services
4700	Vol.3•1093	Vol.4•492	Resistors, Fixed
4750	Vol.3•1199	Vol.4•498	Resistors, Variable (Potentiometers & Rheostats)
4800	Vol.2•896	Vol.4•504	Semiconductors & Devices, Rectifiers (Non-Tube Types)
4900	Vol.2•984		Servomechanisms & Components
5100	Vol.2•993	Vol.4•541	Switches, Circuit Breakers, Fuses, Protective Devices
5200	Vol.1•936		Telemetering Equipment
5300	Vol.2•1154		Thermal Devices, Thermistors, Thermocouples, Thermostats, etc.
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5500	Vol.2•1175		Transducers & Associated Equipment
5600	Vol.3•1244	Vol.4•561	Transformers
5700	Vol.2•1181		Tubes, Tube Parts, Shields, Inserts, etc.
5800	Vol.1•938		Ultrasonic, Sonic, Subsonic Equipment
5850			Vacuum Equipment & Accessories
5900			Vibrators, Choppers, etc.
6000	Vol.3•1311	Vol.4•566	Wire, Cable, Harnesses & Accessories

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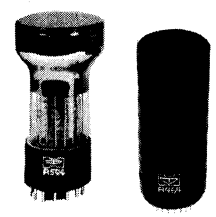
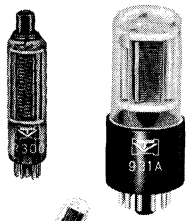
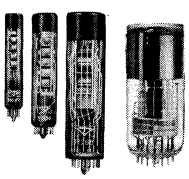
DETECTING, MEASURING, CONTROLLING, FUNCTIONING of LIGHT or by LIGHT.... HAMAMATSU supplies the tube that supplies the solution.



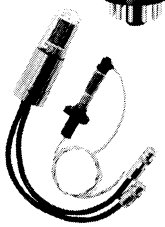
PHOTOMULTIPLIER TUBES
100 Head-On and 100 Side-On varieties in 1/2", 3/4", 1-1/8", 1-1/2", 2" and 3" in diameter size and 4, 9, 10, 11 and 12 multiplying stages—spectral response from 1600 to 12000Å—Sb-Cs, Cs-Te, Ag-O-Cs, GaAs (Cs), Bialkali and Multialkali photocathodes—UV-glass, Fused-Quartz and Borosilicate-glass window materials. Tubes cover physical, chemical and industrial applications such as spectroscopy from infrared to ultraviolet regions, mass analysis, photon counting, scintillation counting and spectrometry, chemiluminescence measurement of pollutants, and Laser field applications. Special photomultiplier tubes can be tailored to your specifications.



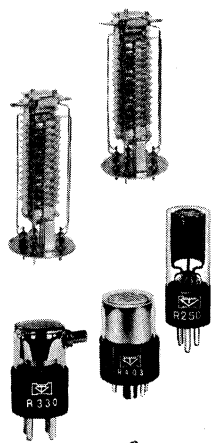
ELECTRON MULTIPLIER TUBES
5 types available, including 16 and 20 multiplying stage types. Tubes feature interchangeable first dynode, enabling easy replacement when damaged by particle bombardment. Cover fully applications for detection of electron charged particles, ultraviolet light, and soft X-rays.



PHOTOTUBES
VACUUM and GAS-FILLED types available. Selection from 50 VACUUM and 20 GAS-FILLED types. Various dimensions and spectral response to meet a wide range of precise applications. UVtron®—a solar blind gas diode, normally used as flame detector in furnace control, fire alarm systems, and fog detectors. Spectral response, 1600 to 2900Å.

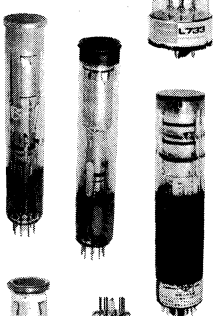


PICKUP TUBES AND MEMORY TUBES
4 IMAGE DISSECTOR TUBES for observation of high speed movement, O.C.R. sensors in computers,—2 IMAGE MEMORY TUBES for optical information storage and retrieval systems, space applications—2 MEMORY TUBES for scan convertors,—4 INFRARED VIDICONS for noctvision, observation and measurement of temperature over 200°C, observation of dislocation, laser patterns and hydrogen flame—4 X-RAY VIDICONS for observation of X-ray images, non-destructive inspection X-ray diffraction—And, ULTRA-STATIC VIDICON for TV cameras and ELECTRO-STATIC VIDICON for industrial TV cameras. VISIBLE VIDICON is a performance proven HTV unit widely used with CCTV cameras, Color TV film pickups, Data transmission, and TV telephones. 11 vidicons and 3 Si Vidicons are available in four different diameter sizes.

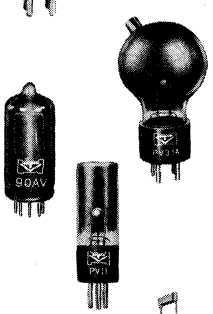


HOLLOW CATHODE LAMPS
For exact applications in atomic absorption spectrometry, available in 42 single cathode element types and 5 double cathode element types. Intensive luminosity, superior linearity, a plus long service life are a few of the proven advantages of Hamamatsu Hollow Cathode Lamps.

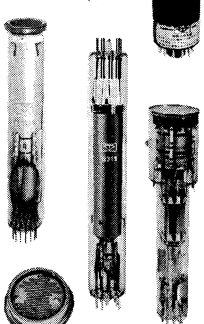
DEUTERIUM LAMPS
9 types available. Emission spectrum, 1600 to 4000Å. Features excellent stability of radiant energy and competitive life time.



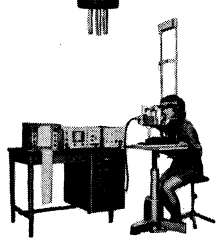
PHOTOCONDUCTIVE CELLS
Each cell represents the highest possible standard of technical know-how. Cds, Cd (S, Se), CdSe cells, Lamp-photocells, LED-photocells, LED-SPD Coupling element, and PbS cells.....these essential elements of modern machinery and equipment are recommended whenever measuring, controlling, detecting and functioning by "Light" is better.



SILICON PHOTOCELLS
Five types of diffused junction Si cells are available. All feature high quantum efficiency and low drift, and are ideally suited for use in card readers, ALC cameras, light switches and in scores of other creative applications.

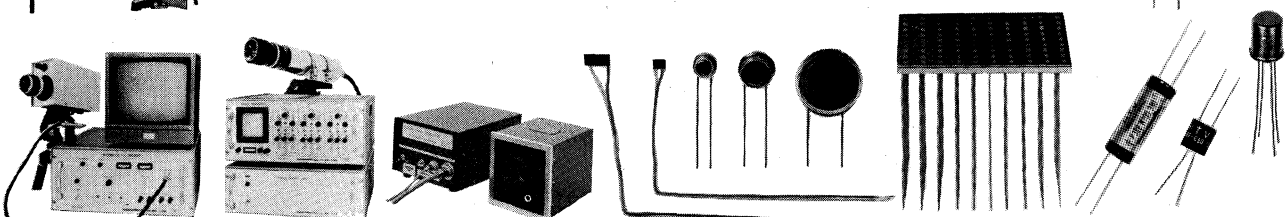


VIDEO EQUIPMENT
Where non-contact measurement of static or dynamic objects with simultaneous high speed response is a "must", Hamamatsu Video Equipment is an ideal choice. VIDEO ANALYZER, X-Y ANALYZER, HIGH SPEED X-Y TRACKER, AREA ANALYZER, IRISCORDER, INFRARED TV CAMERA and STORECT VISION.



VIDEO DATA CODER
Simultaneously recording of various data related to visual observation and synchronized with the video signal. Both data and display are perfectly recorded on a single VTR Tape. Popular type VTR's and standard Tape can be used. Unit largely facilitates complex analysis and measurement in medical and industrial research applications. With two video data coder units, can be transmitted or received over up to 16 channels simultaneously with the video signal using one coaxial cable.

WRITE FOR COMPLETE TECHNICAL INFORMATION ON INDIVIDUAL PHOTOSENSITIVE DEVICES AND OPTO-ELECTRONIC EQUIPMENTS.



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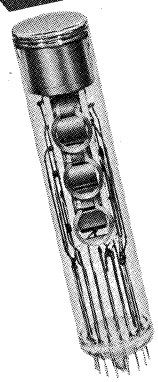
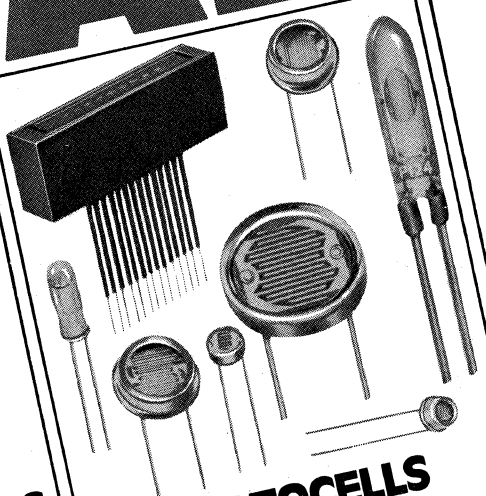


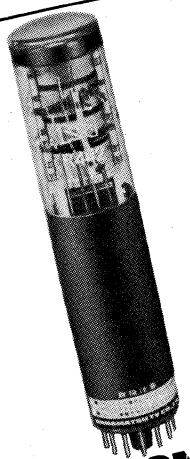
PHOTOMULTIPLIERS AND PHOTOTUBES

A complete line of side on and end on photomultipliers and phototubes including the new GaAs and RNOX cathodes. These cathodes exhibit exceptionally high quantum efficiency, low noise, low drift and wide spectral range. Ultra-miniature tubes also available.



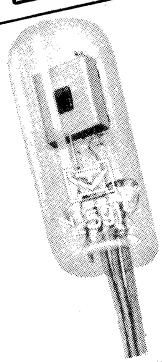
PHOTOCELLS

A complete line of CdS, PbS, LED, lamp photocells, multichannel CdS and silicon photocells. A new line of diffused junction silicon cells and blue cells are also available. These are noted for high quantum efficiency and low drift.



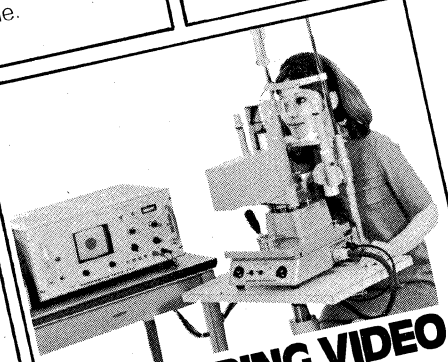
VIDICONS

A complete line from ⅔" to 1.5" for transistorized cameras, broadcast film pickup and special scanning systems. Types available include the popular 7262A, image dissector tubes, memory tubes, x-ray, ultraviolet and infrared tubes.



LIGHT SOURCES

A complete selection of hollow cathode lamps from Ag to Zr. Also a wide selection of deuterium lamps available with fused quartz or UV glass envelopes. Custom lamps, including Xenon, can be fabricated to your design requirements.



MEASURING VIDEO SYSTEMS

Hamamatsu is a leading manufacturer of special purpose measuring video systems. For area measurement, stress analysis, heat detection, tracking or any analysis that requires high-speed, real-time measurement. Call for detailed information on your requirement.

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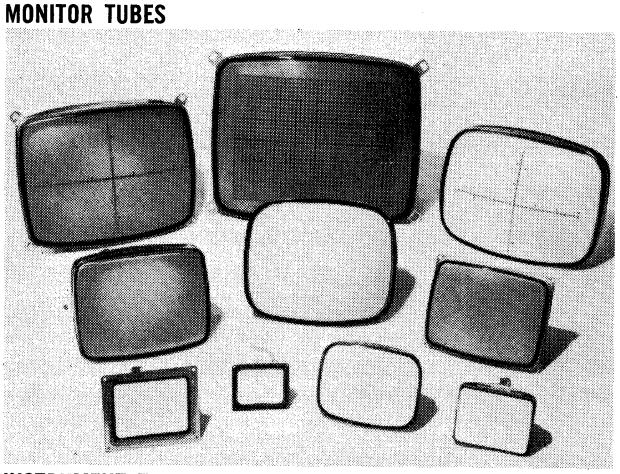
SEE OUR AD ON Vol.3•1018

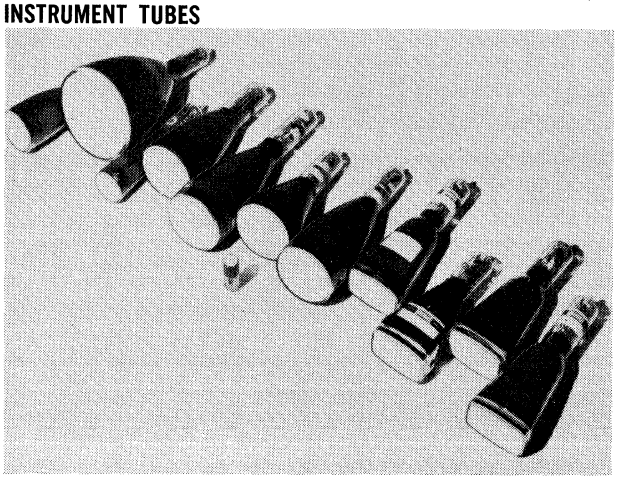
SEVENTEEN DIFFERENT PHOSPHORS / INTERNAL & EXTERNAL GRATICULES / FLASHOVER PROTECTION / IMPLOSION PROTECTION (5 Different Constructions)

Accessories offered for Brimar cathode ray tubes include sockets, connectors, yokes, focusing coils and twist coils. Substantial savings can be offered when Magnetic Shields and Tubes are purchased as assemblies.

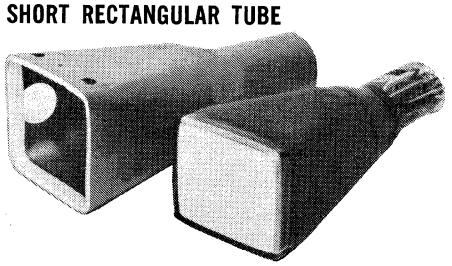
MONITOR TUBES



INSTRUMENT TUBES



D14-170 SHORT RECTANGULAR TUBE



Short overall length (12-inch) / Rectangular 3.9 x 3.15 inch display (10 x 8 cm.) / Spiral p.d.a. for bright trace / Internal graticule available / Good price / Performance specification / For general purpose oscilloscopes and electro-medical equipment / Shown above with TELFORM shield.

Substantial savings can be offered when TELCON SHIELDS and TUBES are purchased as assemblies. Also see shields described in EEM Vol.3•1018.

Thorn Radio Valves and Tubes Limited is one of Britain's largest manufacturers of industrial cathode ray tubes. Examine a BRIMAR catalog and you will find about the widest range of tubes, one of which is likely to be a perfect fit for your requirement. But if you have something unusual in mind it is probable that BRIMAR can make it.

Selected Types	Application and Description	Face Shape & Dia. (Min.)	Useful Min. Screen Area (inch)
FLYING-SPOT SCANNER TUBES			
Q8-100AA	Magnetic focus. Educational EVR video reproducers	3 ●	2.1x1.5
Q13-200GS	Electrostatic focus. Document readers or telecine EHT connection by CT8 socket	5 ●	3.5x2.7
SMALL ELECTROSTATIC DISPLAY TUBES			
D3-130	General purpose indicating device	1 ●	1.1
D7-200	Indicators. Oscilloscopes. CCTV. Alpha-numerical readout	3 ■	2x1.6
INSTRUMENT TUBES — SINGLE GUN			
D10-210	Battery oscilloscopes. Heater 11V, 68mA. Mesh p.d.a. Aluminized	4 ■	2.8x2
D13-47	Medium bandwidth. For transistor scan circuits. Spiral p.d.a.	5 ■	4x2.4
D13-51	High bandwidth. Mesh p.d.a. Transistor scan. Aluminized screen	5 ■	4x2.4
D13-600	General purpose. Short length. Large screen area.	5 ●	4x3.1
D14-170	General purpose. Short length.	5½ ■	4x3.1
D14-180	Medium bandwidth for transistor scan circuits	5½ ■	4x3.1
D14-200	High bandwidth. Mesh p.d.a. Ultra square face.	5½ ■	4x3.1
D14-210	75 MHz for very high writing speed. Aluminized mesh p.d.a.	5½ ■	4x3.1
D16-100	X-Y plotter. Square faced tube	5½ ■	4x4
RADAR TUBES			**Defl. Angle**
F17-10	Small boat radar. American type (7AB)	7 ●	50
F27-100	General marine use. American equivalent (10W)	10 ●	50
F28-130	Rimguard III 'push-through' protection. Private yacht radar	11 ■	90
F31-10	General marine use	12 ●	40
F31-14	Rimband protected. Private yacht transportable radar	12 ■	110
F41-12	Major radars for ships, port, and aircraft control	16 ●	50
DISPLAY AND PICTURE MONITOR TUBES			
M17-10	Medical waveform display. Television camera viewfinder	7 ■	70
M21-13	Medical waveform data display. Industrial monitors	8½ ■	90
M31-100	Alpha numerical or graphical, computer read-out Bonded face-plate	12 ■	70
M36-141	Television studio monitor (Sim 14 BAP)	14 ■	70
M36-142	Television studio monitor. Protected version of M36-141. Bonded face-plate (Sim 14 BDP)	14 ■	70
M38-100	Industrial monitors. Data displays. Rimguard III	15 ■	90
M38-140	Industrial monitor. Data display. High voltage electrostatic focus. Aluminized	15 ■	110
M44-120	Data displays. Ind. picture monitors. Squared-off screen. Rimguard III	17 ■	110
M61-120	Industrial monitors. Data displays. Squared up screen. Rimguard III.	24 ■	110

NEW LONG PERSISTENCE GV PHOSPHOR
FOR MEDICAL INSTRUMENTATION

Improves display qualities — Information visible 1 to 10 seconds. Initial flash and trace colors similar, eases eye fatigue. More resistant to burn damage than other long persistence screens. Reduces replacement cost where tubes must display same unmodulated base lines and other display for long intervals.

PERFECTION MICA COMPANY

MAIN OFFICE & PLANT

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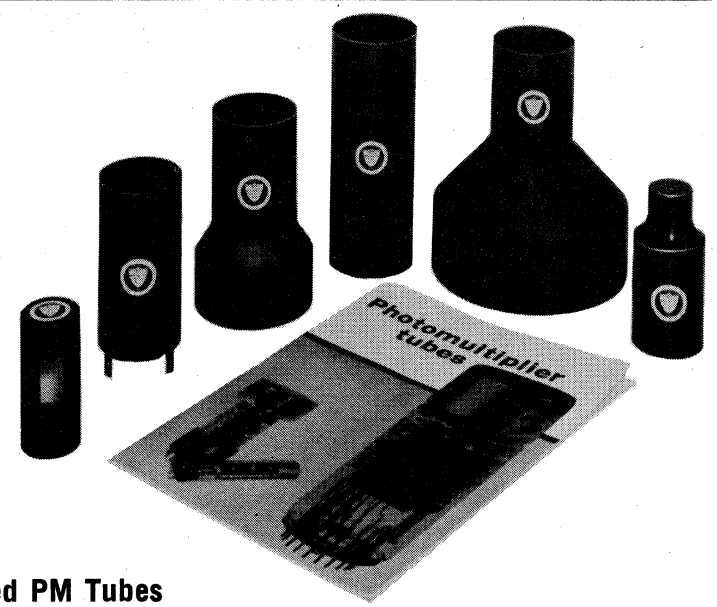
Co-Netic Precision Magnetic Shields for Photomultiplier Tubes



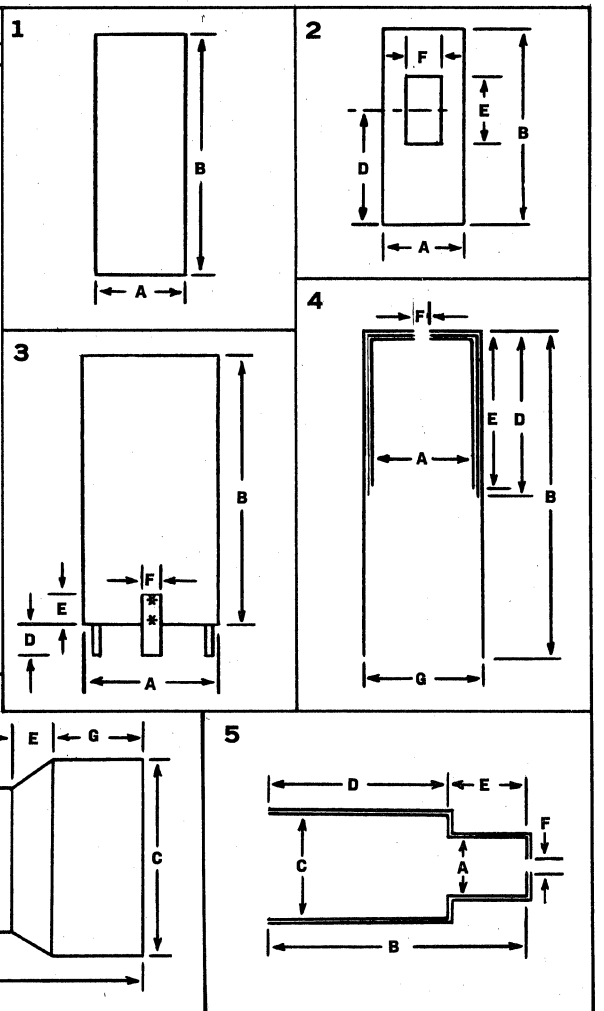
Co-Netic shields are not significantly affected by shock or vibration. They have minimal retentivity and do not require periodic reannealing. When grounded, they effectively shield from electrostatic as well as magnetic fields over a wide range of intensity.

Shields can be custom engineered to your specifications and desired quantities.

The largest line available
Covers over 90% of currently manufactured PM Tubes

SHIELDED DIMENSIONS

Part No.	Drawing	A	B	C	D	E	F	G	Notes
06P25	1	5/8	2 1/2						
07P13V1	2	3/4	1 3/8		13/16	1/2	1/4		a
10P25	1	1	2 1/2						
10P40	1	1	4						
11P42X18	5	1 1/8	4 1/4	1 7/8	2 15/16	1 5/16	1/4		d
12P31V1	2	1 1/4	3 1/8		1 1/16	1 1/8	5/8		a
12P35	1	1 1/4	3 1/2						
12P45	1	1 1/4	4 1/2						
13P23V1	2	1 3/8	2 3/8		1 1/4	1 1/8	5/8		a
13P28V1	2	1 3/8	2 13/16		1 5/16	1 1/8	5/8		a
13P32V1	2	1 3/8	3 1/4		1 15/16	1 1/8	5/8		a
13P52V1	2	1 3/8	5 1/4		3 15/16	1 1/8	5/8		a
15P27	1	1 1/2	2 3/4						
15P40	1	1 1/2	4						
15P50	1	1 1/2	5						
17P30	1	1 3/4	3						
17P33V1	2	1 3/4	3 3/8		2 1/16	7/8	3/4		a
17P45	1	1 3/4	4 1/2						
17P53V1	4	1 3/4	5 3/8		2 3/4	2 5/8	1/4	2 1/16	b
20P50	1	2	5						
21P45V1	3	2 3/16	4 1/2		1/2	1/2	1/4		c
21P55V1	3	2 3/16	5 1/2		1/2	1/2	1/4		c
22P40	1	2 1/4	4						
22P50	1	2 1/4	5						
22P60	1	2 1/4	6						
22P70	1	2 1/4	7						
23P55X32	6	2 3/8	5 5/16	3 1/2	3 3/8	1 1/16		1 1/2	
23P61X37	6	2 3/8	6 1/8	3 3/4	3 1/4	3/4		2 1/8	
23P68X57	6	2 3/8	6 7/8	5 3/4	3	1 7/8		2	
23P101X57	6	2 3/8	10 1/8	5 3/4	1/2	2 3/4		6 7/8	
25P40	1	2 1/2	4						
25P50	1	2 1/2	5						
25P60	1	2 1/2	6						
25P70	1	2 1/2	7						
27P73V1	2	2 3/4	7 3/8		3 5/8	4 3/8	3		a
30P67X57	6	3	6 3/4	5 3/4	3 1/4	1 1/2		2	
32P80	1	3 1/4	8						
32P100X55	6	3 1/4	10	5 1/2	3 1/2	1		5 1/2	
35P70	1	3 1/2	7						



NOTES:

Unless otherwise noted:

Dimensions — All ID

Material — .040" Thick Co-Netic AA

Finish — Black baked enamel; texture outside, flat inside.

a — Upper end closed.

b — Dimensions D & E are measured from the outside of the outer shell. Dimension G is the maximum OD. Material — Three layers, separable; outer .049 Netic S3-6, two inner .031 Co-Netic AA Finish — Netic S3-6, black oxide; Co-Netic AA, none.

c — Has three tabs, spaced 120° apart, to grip the metal collar of the PM tube.

d — Material — .031" Co-Netic AA.

PERFECTION MICA COMPANY

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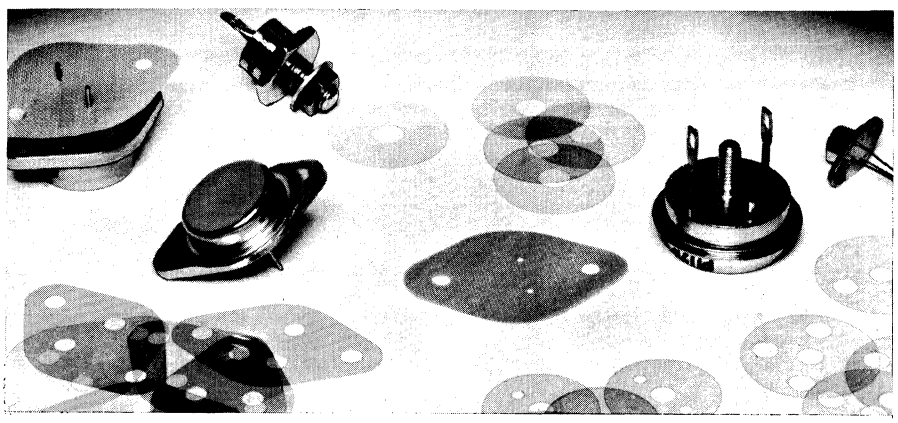
Semiconductor Mica Isolators

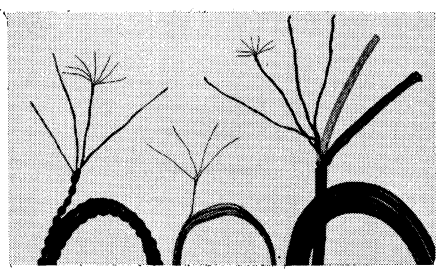


- **IMPROVED SEMICONDUCTOR EFFICIENCY from proper heat dissipation.**
- **EXTREMELY HIGH DIELECTRIC STRENGTH.**
- **THICKNESSES range from .001" to .003". Other thicknesses can be furnished.**

  MANY CONFIGURATIONS available within .002" tolerance.
- **Custom Mica insulators manufactured to your specifications.**

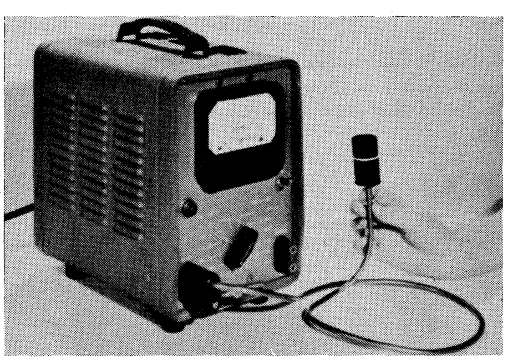
Unique Inter-8 Weave Cables reduce magnetic field pickup or radiation

Cables can be fabricated with compatible alloy wires for thermocouple applications, with plain copper wire for applications where junction EMFs are a problem, or with tinned wire. Increased magnetic or electrostatic shielding effectiveness can be realized by weaving outer shielding braids of Co-Netic or copper over the basic cable. Dielectric separation between dual layer sheaths is normally PVC but other insulating media may be used. On braided shields, a final insulating outer jacket is used. Wire sizes range from 22 to 32 AWG. Wire insulation can be PVC, Teflon or any other desired dielectric. Cables are available in continuous lengths up to 500 feet. Continuous length limitation is a function of wire size. Inter-8 cables using special wire can be fabricated in small lots for experimental and special application requirements.



Inter-8 Weave Cable — Plain, Copper Shielded, or Co-Netic Shielded.

AC Magnetic Field Evaluator Probe



The magnetic field evaluation probe Part No. EP-101, is very useful for the initial determination of fields present either in equipment or in areas where magnetic fields are generated, such as from transformers, reactors, solenoids, etc. Since it is basically an air core inductor, if oriented for maximum indication, its axis will point to the source of the field as well as give an indication of the field intensity at the plane through the color band.

The probe uses a small random wound multi-layer coil on a standard bobbin, such as is used in commercial 110 volt medium size solenoid structures. 4100 turns of No. 36 enamel covered wire are used. Coil leads are connected to a twisted pair copper shielded cable. The coil is centrally located within a brass can with flanged cover, large enough to accommodate the bobbin, with the bobbin axis concentric with that of the can.

Any laboratory type AC V.T.V.M. may be used, preferably one with a full scale sensitivity of 1 millivolt. The output at 60 Hz is 20 millivolts per gauss (RMS). The evaluator is usable up to 3 KHz, with a correction formula which appears on the plug housing of each probe:

$$B\ (\text{Gauss}) = \frac{3\ [\text{Voltage (Mv)}]}{\text{Frequency (Hz)}}$$

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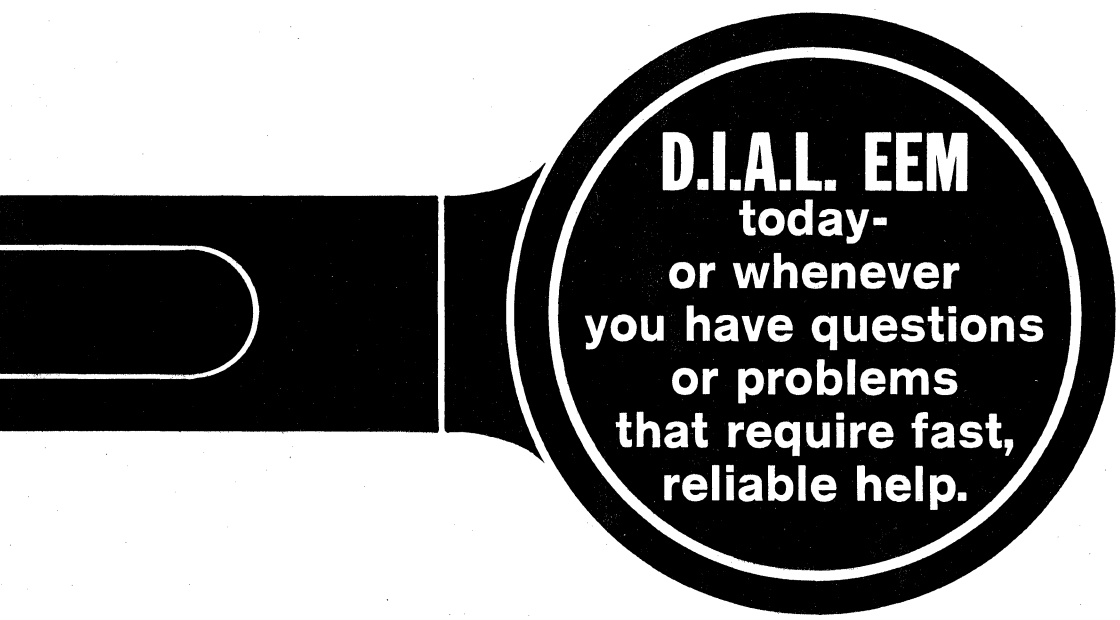

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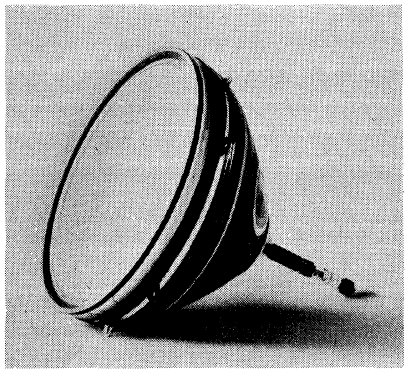
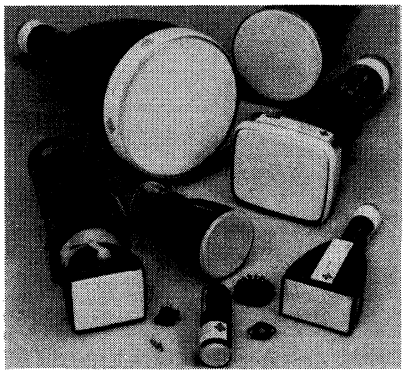
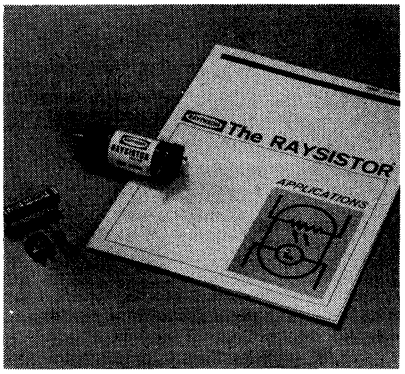
Reliable Raytheon components for data display • optoelectronics • microelectronics.



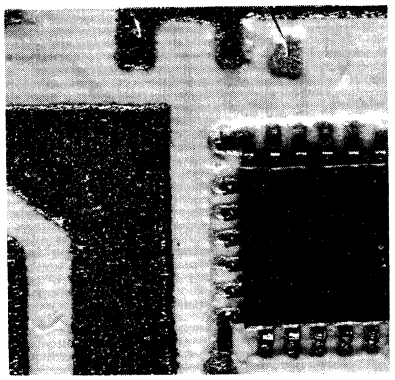
The CK1498P — is a 23" diameter, all glass, virtually flat-faced CRT for computer graphics or scan-converted radar. A precise electron gun gives a very small, well-shaped spot for great resolution at uniform high brightness over the entire screen. The tube is ideally suited where a high degree of legibility is critical. Electro-static focus and magnetic deflection are used. An aluminized screen has high brightness and contrast. The bonded safety panel and fiberglass-reinforced, steel tension-banded bulb add strength. Mounting brackets are integrally assembled, allowing for simple and low cost installation.
Write for data sheet.



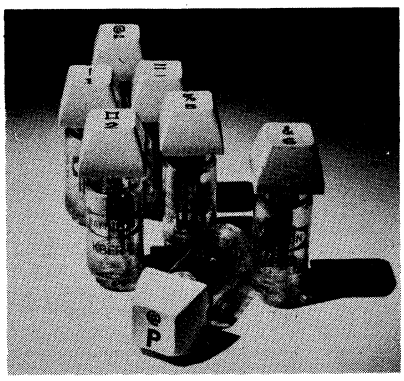
Telefunken CRT's — are now available — the entire electrostatic deflection line — from Raytheon. With the Raytheon/Telefunken combination there is no broader high-quality CRT line sold and serviced from a single source. Top performance in brightness, deflection sensitivity, post-deflection magnification, spot size and resolution are offered. Plus a full line of accessories such as shields, sockets, anode caps, special graticules and a complete range of phosphors. Samples can be delivered immediately, with rapid turn-around on production orders. **Write for data and applications assistance.**



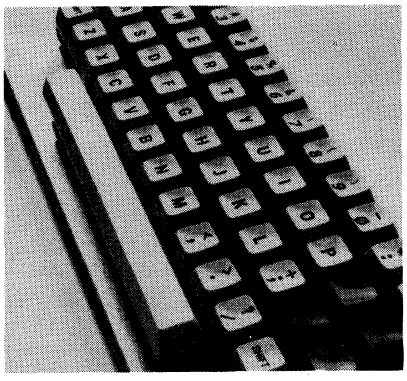
More Than 2000 Optoelectronic Devices are available from Raytheon to improve your product, cut its cost. RAYSISTORS® operate on the principle of controlled light acting on a photo-resistive element — provide a variety of control functions as variable resistors, solid-state switches, relays, voltage or signal isolators. Standard And Special Raytheon Photocells feature rugged mechanical construction, small size, light weight, low noise. They're available with cadmium sulfide or selenide sensors, TO-5 case or glass vial packaging. **Write for data and circuit applications brochure SP-1149 and SP-1150.**



RAY-PAK™ thick film hybrid circuits — available in a wide variety of package combinations — in coated, potted or hermetically sealed types. Exclusive RAY-PAK fabrications use fired-on substrate-to-package conductors for greater strength and reliability, reduced weight and size, lower cost. Internal circuit area is 25% greater than in circuits using conventional techniques. Thirteen package sizes range from ⅝" x 1" to 1½" x 2¼". Available in plug-in and planar ribbon lead versions. Beam-leaded modules are also available for minimum-connection applications. All RAY-PAK thick film hybrid modules meet MIL-Q-9858A and MIL-STD-883 specifications. **Write for Data Sheet.**



New Keyboard Switches — an original Raytheon design — are low cost yet extremely reliable. Just a feather-light (2½-oz.) touch activates the switch which is designed for switching at logic levels. Life expectancy of the dry reed type is more than 800 million cycles. Bounce is less than 250 microseconds. Costs less than $1.00 in production quantities. **Write for Bulletin MC182B.**



CAPSCAN™ **Keyboard** — has Raytheon's unique combination of capacitive coupling plus a scanning technique for encoding. With contactless, solid state keyswitches. And the entire package is sealed. Logic is DTL-TTL compatible, with odd or even parity, single through quad modes and input power at MOS and bipolar circuit levels. All key sizes and colors — including illuminated — are available. **Send for complete data.**

For data sheets, application notes, price information, call your Raytheon regional sales office. Or write: Raytheon Company, Industrial Components Operation, 465 Centre Street, Quincy, Massachusetts 02169.

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Industrial Components Operation — A reliable source for Circuit Modules / Display Devices
Filters / Hybrid Thick-Film Circuits / Industrial Tubes / Optoelectronic Devices / Panel Hardware

VICTOREEN COROTRONS

HIGH VOLTAGE REGULATING AND REFERENCE DIODES

The COROTRON* may best be described as the high voltage, gaseous equivalent of the Zener diode. At high voltage, it can perform all the functions performed by the Zener at low voltages. It may be used as a simple shunt voltage regulator, precise high voltage reference, DC coupling element or portion of a divider string.

COROTRONS operate in the Corona mode of gaseous discharge and should not be confused with the older "Glow Discharge Tubes." Unlike glow tubes but like the Zener, there is no spread between "firing" voltage and "operating" voltage. They're available at any desired nominal voltage from 350 to 30,000 volts and are not restricted to certain "natural" voltages. They exhibit a positive slope to their regulation cure rather than a negative slope and, therefore, are not subject to relaxation oscillation when used with shunt capacitance to reduce dynamic impedance; nor are they subject to "jumps" and "jitter" or noises due to "glow area shift." COROTRONS are unaffected by ambient light conditions and can operate in total darkness at exactly the same voltage as in daylight.

NOMINAL OPERATING VOLTAGE

Since the tube has a positive slope to its regulation characteristics, the nominal voltage must be measured at some predetermined test point. This test point is selected as an appropriate quiescent condition for typical circuits in which this particular tube type has been employed.

TOLERANCE

This is the value by which the voltage for the specific tube type may vary from its nominal value at the test point.

*Registered Trademark of VICTOREEN INSTRUMENT DIV.

MINIMUM CURRENT

This is that value of current below which noise may be encountered unless the COROTRON is by-passed by a small value of capacitance and above which quiet operation may be expected.

MAXIMUM CURRENT

This is the highest value of current at which the tube may safely be operated in a steady state condition without effecting the life of the tube.

PEAK CURRENT

Peak current is that value of current to which transients or other low duty cycle phenomena may cause current excursions without introducing malfunctions.

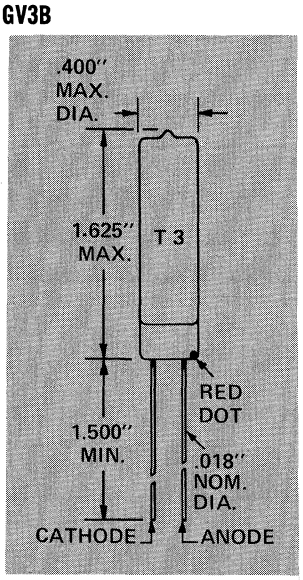
REGULATION

Regulation is assumed to be the change in operating voltage as the current through the tube is increased from its minimum value to its maximum value. Since this total excursion is rarely, if ever, encountered in a well designed circuit, the output voltage of the supply will always be held to a lower value than that listed in the column headed "REGULATION." Since the regulation curve is linear, one may readily compute the change in voltage to be anticipated for any fractional value of the previously mentioned current excursion.

WIDE SELECTION OF COROTRONS

Type	Nominal Voltage Range	Voltage Tolerance Range	Current Range In μa			Regulation (Max.)
			Min.	Max.	Peak	
GV1A	350-2000 @ 35μa	±(10-30)V	5-25	100	200-350	4-18V
GV3A, B	400-2500 @ 50μa	±(10-37)V	5-25	300-700	400-1400	20-85V
GV3S	400-3000 @ 50μa	±(10-45)V	10-25	250-650	300-1200	14-65V
GV4S	400-3500 @ 100μa	±(10-58)V	10-35	200-1000	300-1900	8-100V
GV5A, B, C	400-5000 @ 100μa	±(10-150)V	10-35	400-1000	600-1800	18-105V
GV6C	4000-6000 @ 100μa	±(100-150)V	50	500-600	900	55V
GV6A	400-3000 @ 500μa	±(10-75)V	50	750-2000	900-2900	25-120V
GV9A	450-3000 @ 1000μa	±(11-75)V	100	1500-3000	2000-6000	25-80V

TYPICAL COROTRONS
TYPES GV3A, GV3B



Current capabilities to 700μa.

Regulation of the order of 10 volts per 100 micro-amps.

Designed to regulate high voltage power supplies for portable radiation detection instruments and photo-multiplier tubes, as DC coupling elements and for other high voltage — low current applications.

Shock: 100g-11ms per MIL-STD-202C method 202B.

Vibration: 10-55cps-10g.

COMMONLY USED TYPES

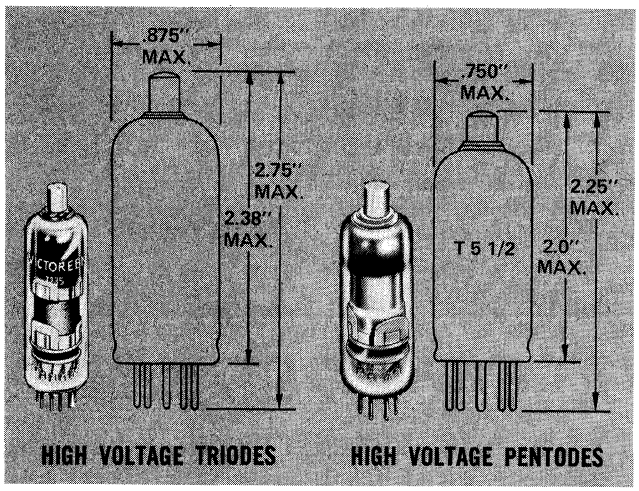
Type	Nominal Voltage @ 50μa Test Point	Tolerance	Current In Microamperes			Regulation* (Max.)	Altitude
			Min.	Max.	Peak		
GV3B-400	400V	±10V	5	300	400	20V	72,000
GV3B-500	500V	±10V	5	300	400	30V	71,000
GV3B-600	600V	±12V	5	300	400	32V	70,000
GV3B-700	700V	±14V	5	300	400	35V	69,000
GV3B-800	800V	±16V	5	400	500	35V	68,000
GV3A-900	900V	±13V	10	500	700	35V	66,000
GV3A-1000	1000V	±15V	10	500	750	40V	65,000
GV3A-1200	1200V	±18V	15	600	800	60V	63,000
GV3A-1400	1400V	±21V	15	700	850	85V	60,000
GV3A-1800	1800V	±27V	20	550	1000	85V	57,000
GV3A-2000	2000V	±30V	20	500	1100	85V	55,000
GV3A-2200	2200V	±33V	25	450	1200	85V	53,000
GV3A-2500	2500V	±37V	25	400	1400	85V	50,000

*This regulation is the change in voltage over useful range of current from Min. to Max.

VICTOREEN

FOR ADDITIONAL INFORMATION REQUEST BULLETIN 3183-7-65
FOR CURRENT SOURCE DATA CALL TOLL-FREE 800-645-9200 (IN N. Y. STATE CALL COLLECT (516) 294-0990)
VICTOREEN INSTRUMENT DIV. of VLN
10101 WOODLAND AVENUE • CLEVELAND, OHIO 44104

VICTOREEN VACUUM TUBES-MINIATURE HIGH VOLTAGE



Victoreen offers a complete line of high voltage vacuum tubes with plate voltages as high as 10 Kv and plate dissipations as high as 15 watts. The high voltage current saving capacity of these vacuum tubes suggests their use as shunt or pass tube regulators. The characteristics of these vacuum tubes suggest their use in high voltage switching applications or as high voltage amplifiers. Manufactured to meet the requirements of MIL-E-1, Victoreen can supply life test and MTBF data on many types.

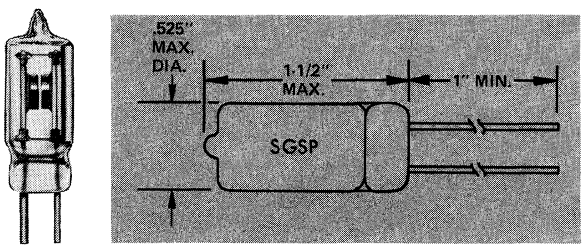
TYPES OF TUBES

Type	Plate Voltage E_b Max.	Plate Current I_b Max.	Plate Dissipation P_p Max.	Grid Voltage E_{c1} Max.
7235 High Voltage Triode	10kV	5mA avg. 100mA peak	12 watts	−200 volts
6842 High Voltage Pentode	4kV	10mA avg. 100mA peak	8 watts	−100 volts
7234 High Voltage Pentode	10kV	8mA	6 watts	−100 volts
7683 High Voltage Pentode	1kV	20mA	15 watts	−100 volts

VICTOREEN SPARK GAPS-SURGE PROTECTION & ACTIVATION

SGSP FOR PROTECTIVE APPLICATIONS

The SGSP series of spark gaps is a rugged glass encapsulated series of protective devices capable of handling as much as 10 times the energy of the familiar "button" gaps. Their construction lends them to either circuit board mounting or insertion in a suitable socket. This type spark gap is available in any firing voltage from 150 to 5000 volts. Parameters on some of the more common types are listed below.



Type	Nominal DC Firing Volt. ±10%	Firing Voltage @ 100 v/μsec. Rise	Firing Voltage @ 10 kv/μsec. Rise	Extinguishing Voltage	Energy Dissipation Capability*
SGSP-150	150	360	550	15	100 Joules
SGL	215	470	730	15	100 Joules
SGSP-350	350	680	1050	15	100 Joules
SGSP-470	470	920	1400	15	100 Joules
SGSP-600	600	1150	1750	20	100 Joules
SGSP-800	800	1530	2350	40	100 Joules

*Maximum energy capable of being dissipated in a single pulse.

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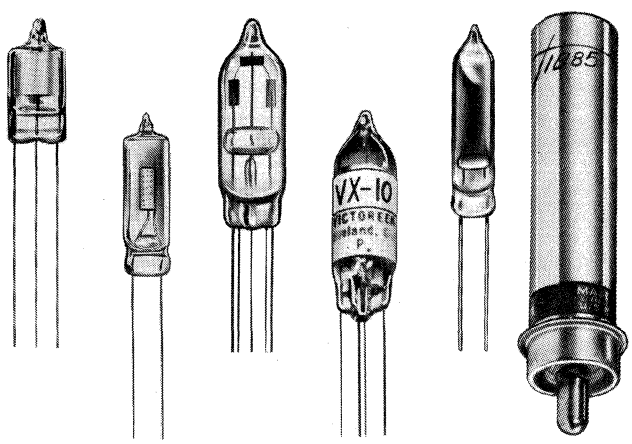

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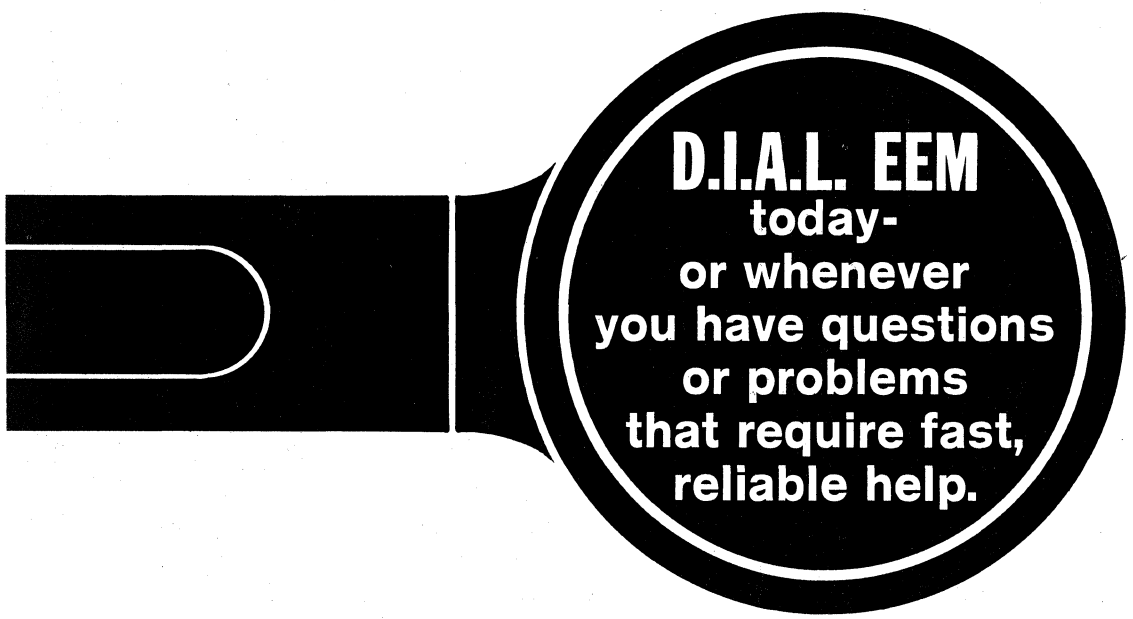

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Next page is 1421 — MANUFACTURERS AND SALES OFFICES DIRECTORY

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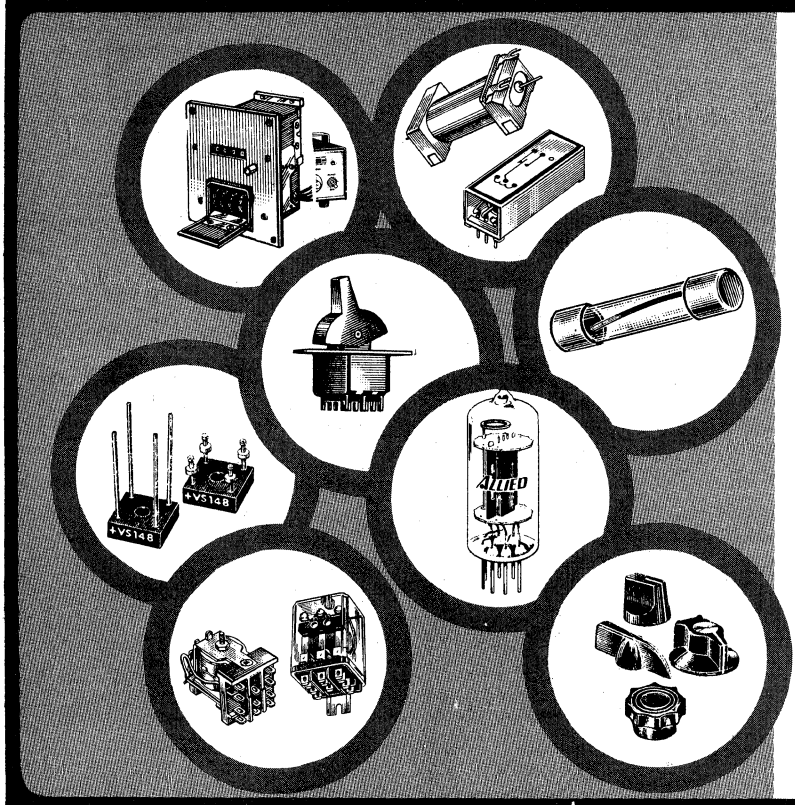

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This is an alphabetical listing of more than 3,000 manufacturers supplying electronic equipment, instrumentation, components, materials and fabrication services. Included for each company are name, address, telephone number, name of the key sales executive and TWX numbers, where available. In addition, companies have provided the name or names of individuals who may be contacted by the EEM user for additional product information. Listings may also include names of certain distributors who have paid to be included as part of the manufacturer's listing. For complete alphabetical and geographical listings of all distributors, see the Distributors Directory, on page 1594, yellow section.
Bold face listings indicate those manufacturers who have provided catalog data in the white pages. Page and volume numbers are indicated for these manufacturers. Sales office listings are provided for key electronic manufacturers.

This directory was completely revised and updated for this edition prior to publication. Thus the information is current as of Spring 1973.
This same index appears in all three volumes of EEM.

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Cal	San Diego, Rochette & Assocs.	714-282-4616
Cal	San Gabriel, Rochette & Assocs.	213-285-1251
Colo	Littleton, Cleveland Entprs.	303-771-6242
Md	Silver Spring, Rep-Tron	301-593-4844
NM	Albuquerque, Cleveland Entprs.	505-298-7671

ABA INDUSTRIES, INC., Box 517, Pinellas Pk., Fla., 33565, Tel: 813-546-3571; V.P. Eng: B. Harting; Dir. Mktg: D. Morrison

ABACUS ELCTRNS. CORP., 10 Hudson Terr., Dobbs Ferry, N.Y., 10522, Tel: 914-693-1450; Sls. Mgr: M. Meola

ABBOTT TRANSISTOR LABS., 5200 W. Jefferson Blvd., L.A., Cal., 90016, Tel: 213-936-8185; Mktg. Mgr: R. Baldarrama; Sls. Dir: A. Hilbert; Sls. Eng: W. Rodart **Vol 1•581-593; Vol 3•1246,1247**

Local Sales Offices & Reps.

NJ	Ft. Lee, Abbott Transistor Labs.	201-224-6900

ABRAMS INSTR., 606 E. Shiawassee St., Lansing, Mich., 48901, Tel: 517-484-9441, TWX: 810-251-0785; Sls. Mgr: M. Gates

ACCURATE ELCTRNS. CORP., Box 935J, Elyria, Ohio, 44035, Tel: 216-365-1211; Pres: J.F. Seybold; V.P: D.J. Seybold

ACCUTRONICS, A Hammond Corp., Co., 628 North St., Geneva, Ill., 60134, Tel: 312-232-2600, TWX: 910-237-1680; Sls. Eng: D.C. Griffin; Dir. of Sls: W.C. Benson ..... **Vol 2•380-383**

ACDC ELCTRNS., Oceanside Ind'l. Ctr., Oceanside, Cal., 92054, Tel: 714-757-1880, TWX: 910-322-1470; Nat'l. Sls. Mgr: R.E. Dietrich; Prod. Mgr: D.C. Gray; Mktg. Mgr. (Comps): F.W. Nusslock ..... **Vol 1•571-575**

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Cal	Torrance, Miltronics Inds.	213-323-7934
Cal	Van Nuys, Elctrn. Mktg. Specialists	213-787-9050
Colo	Denver, PLS Assocs.	303-771-0140
Conn	Hamden, J. & J. Assocs.	203-624-7800
Fla	Maitland, Beacon Elctrn.	305-647-3498
Fla	Palm Beach Gardens, Beacon Elctrn. Assoc.	305-622-2770
Ga	Atlanta, Beacon Elctrn.	404-351-3654
Ill	Chicago, Data Elctrns. Co.	312-283-0300
Ind	Indianapolis, Data Elctrns. Co.	317-784-6360
Kans	Shawnee Mission, EIR Co.	913-362-0919
Md	Kensington, Electronic Mktg. Assocs., Inc.	301-744-7700
Mass	Burlington, J. & J. Assocs.	617-272-2606
Mich	Detroit, WKM Assocs., Inc.	313-892-2500
Minn	St. Paul, Northport Engrg., Inc.	612-698-3841
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Albuquerque, PLS Assocs.	505-255-2330
NY	East Syracuse, Ossmann Instrs.	315-437-6666
NY	Huntington, Hansen Assocs.	212-947-0379
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
Ohio	Cleveland, WKM Assocs., Inc.	216-267-0445
Ohio	Dayton, WKM Assocs., Inc.	513-434-7500
Pa	King of Prussia, Electronic Mktg. Assocs., Inc.	215-265-1600
Pa	Pittsburgh, WKM Assocs., Inc.	412-892-2953
SC	Spartanburg, Beacon Elctrn. Assoc.	803-576-7462
Utah	Salt Lake City, PLS Assocs., Inc.	801-272-3681
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Fla	Miami, Glenn Assocs., Inc.	305-633-4606
Fla	Orlando, Glenn Assocs., Inc.	305-293-7482
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Ill	Chicago, Weinstein & White, Inc.	312-243-1155
Ind	Indianapolis, Wilder,Klein,Mayhall & Logan,	317-632-9379
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Ky	Louisville, Wilder, Klein,Mayhall & Logan,	502-935-1937
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Mich	Grand Rapids, Buschagen, Geldersma & Crotch	616-361-5335
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Miss	Jackson, R. Morrison & Assoc.	601-948-4415
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NJ	Princeton, George Dannecker	609-799-0005
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Ohio	Westerville, P. Collier	800-362-2279
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Pa	Pittsburg, M.F. Smith Assoc.	412-276-5363
SC	Columbia, E. White	803-782-6325
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Tenn	Nashville, Hopper & McCoy	615-883-7557
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ACMI IND'L. DIV., American Cystoscope Makers, 1500 Bassett Ave., Bronx, N.Y., 10461, Tel: 212-824-4600, TWX: 12-619 Cystmakers; Sls. Mgr: C.J. Hickis; Sls. Engr: V. Colton

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Mass	Chelmsford, S&S Elctrns.	617-256-8731
Mich	Farmington, Tallman Assoc.	313-477-6094
Mo	St. Louis, Data Technology	314-872-9167
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Fla	Hollywood, Reynolds & Assoc.	305-987-6720
Fla	Melbourne, Reynolds & Assoc.	305-727-3205
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Conn	Fairfield, ADC	203-366-8754
Conn	Milford, Zaslow Sls.	203-878-1094
Fla	Sanford, ADC	305-322-5422
Ill	Chicago, J. Angel	312-878-0653
Mass	Lowell, Zaslow Sls.	617-458-8452
Mass	Northboro, Zaslow Sls.	617-393-8150
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Minn	St. Paul, R. Ragon	612-488-0201
NM	Albuquerque, A. Q. Elctrns.	505-255-8701
NY	Great Neck, E.R.A.	516-482-9320
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(Refer to Amphenol Sales Div for sales office information)

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NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
NY Vestal, Federal Elctrn., Vestal Pkwy.
NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474
NC Raleigh, Schweber Elctrns. 919-832-8881
NC Winston-Salem, Cramer/EW, 938 Burke Street 919-725-8711
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Beachwood, Schweber Elctrns. 216-464-2970
Ohio Cincinnati, Schuster Elec. Co., 2410 Gilbert Ave. 513-221-5040
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
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Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
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Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Harrisburg, Pyttronic Inds. Inc., 2325 No. 7th St. 717-233-6591
Pa Montgomeryville, Pyttronic Inds. Inc., Stump Rd., Box 433 215-643-2850
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Chattanooga, Curle Elctrns., 1813-S. Market
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Beaumont, Ralph's, Inc., 1270 Broadway 713-833-9443
Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington
Tex Dallas, Sterling Elctrns., 2875 Merrell Rd. 214-357-9131
Tex Dallas, Texas Instrs. Supply, 6000 Denton Dr. 214-238-6850
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Tex Houston, Sterling Electronics, Box 1229 713-623-6600
Utah Salt Lake City, Bintz Co., W.H., 433 W. 3rd St
Utah Salt Lake City, Hamilton/Avnet Elctrns. 801-262-8451
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Bellevue, Farwest Elctrns. Co., 1240 S.E. 32nd St.
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
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Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100
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AMPHENOL SALES DIV., Component Mktg. Svc., 2875 S. 25th Ave., Broadview, Ill., 60153, Tel: 312-345-4260, TWX: 910-226-1961; Prod. Mgr: L.F. Edwards

AMPHENOL SAMS DIV., Bunker Ramo Corp., 9201 Independence Ave., Chatsworth, Cal., 91311, Tel: 213-341-0710, TWX: 910-494-1211; Mkt. Mgr. Nuclear: J. Goodsell; Cables & Conns: J. DeMille; Access Process: W. Meixner

(Refer to Amphenol Sales Div. for sales office information.)

AMPROBE INSTR., Div. SOS Consolidated Inc., 630 Merrick Rd., Lynbrook, N.Y., 11563, Tel: 516-LY-3-5600; V.P. Sls: G. Behrens

AMPROBE Local Distributors

Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
La Baton Rouge, Ralph's, Inc., 1732 Plank Rd. 504-344-3761
La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Beaumont, Ralph's, Inc., 1270 Broadway 713-833-9443
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131

AMTRON INC., 14820 S. Kedzie, Midlothian, Ill., 60445, Tel: 312-389-3955, TWX: 910-689-4494; Sls. Mgr: J.C. Fagan; Adv. Mgr: Lou Burdick

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ANADEX INSTRS., INC., 7833 Haskell Ave., Van Nuys, Calif., 91406, Tel: 213-782-9527, TWX: 910-495-1762; Sls. Mgr: K.A. Mathews

Local Sales Offices & Reps.

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Ariz	Phoenix, Hytronic Meas.	602-253-6104
Cal	Los Altos, J. Stone & Assocs.	415-948-4563
Cal	Los Angeles, Basic Systems	213-938-2833
Cal	San Diego, Mesa Electronics	714-278-8021
Colo	Denver, Hytronic Meas.	303-770-4400
Conn	Hartford, Instr. Assoc.	203-525-9367
Fla	Orlando, Currie Aerospace	305-855-0843
Ill	Chicago, Pivan Engrg.	312-539-4838
Ind	Indpls., Pivan Engrg.	317-253-1681
Kans	Mission, Pivan Engrg.	913-722-1030
Md	Wheaton, SONCO	301-942-9420
Mass	Bedford, Instr. Assocs.	617-275-0700
Mich	Farmington, Carter, McCormic & Peirce, Inc.	313-477-7700
Minn	Mpls., Pivan Engrg.	612-537-4501
Mo	Manchester, Pivan Engrg.	314-227-3501
NJ	Ft. Lee, Tech. Mktg.	201-224-6911
NM	Albuquerque, Hytronic Meas., Inc.	505-268-3941
NY	E. Syracuse, Ossmann Instrs., Inc.	315-437-6666
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
NC	Greensboro, Currie Aerospace	919-273-3040
Ohio	Cleveland, Carter, McCormic & Peirce, Inc.	216-333-5650
Ohio	Columbus, Carter, McCormic & Peirce, Inc.	614-888-4466
Ohio	Dayton, Carter, McCormic & Peirce, Inc.	513-278-5873
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Pa	King of Prussia, SONCO	215-CH-2-8460
Pa	Pittsburgh, Carter, McCormic & Peirce, Inc.	412-824-3760
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Tex	Houston, Data Mktg.	713-686-9627
Tex	San Antonio, Data Mktg.	512-828-0937
Utah	Salt Lake Cy., Hytronic Meas.	801-466-4924
Wash	Seattle, R. S. Drake Assocs.	206-763-2755
Wisc	Brookfield, Pivan Engrg.	414-786-1940
For:	Can., Burnaby, B.C., Ahearn & Soper	604-291-0214
For:	Can., Montreal, Que., Ahearn & Soper	514-487-5702
For:	Can., Ottawa, Ont., Ahearn & Soper	613-232-4518
For:	Can., Rexdale, Ont., Ahearn & Soper	416-247-7141

ANADYNE, 12741 Los Nietos Rd., Santa Fe Springs, Cal., 90607, Tel: 213-698-7991, TWX: 910-586-1881; Sls Mgr: D. Soscia

ANALOGIC, Audubon Rd., Wakefield, Mass., 01880, Tel: 617-246-0300, TWX: 710-348-0425; V.P., Marketing: Fred Molinari; Prod. Mktg. Spec: R. Rosenbaum

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Ala	Huntsville, Gentry Assocs., Inc.	205-534-9771
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Cal	Campbell, Sedillo Co. Inc.	408-374-5220
Cal	Costa Mesa, Meas. Assocs.	714-540-7160
Colo	Denver, BFA Corp. of Ariz.	303-744-3301
Conn	New Canaan, R.H. Sturdy Co., Inc.	203-966-2580
Fla	Orlando, Gentry Assocs., Inc.	305-894-4401
Ill	Chicago, Berndt Assocs., Inc.	312-283-0713
Kans	Shawnee Mission, EIR Co.	913-362-0919
Mass	Wellesley Hills, R. H. Sturdy Co., Inc.	617-235-2330
Mich	Detroit, WKM Assocs., Inc.	313-892-2500
Mo	Hazelwood, EIR Co.	314-895-4100
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Las Cruces, BFA Corp. of Ariz.	505-523-0601
NY	DeWitt, DB Assocs., Inc.	315-446-0220
NY	Huntington, Hansen Assocs.	212-947-0379
NC	Burlington, Gentry Assocs., Inc.	919-227-3639
Ohio	Cleveland, WKM Assocs.	216-267-0445
Ore	Beaverton, Arneson Assocs., Inc.	503-646-6064
Pa	Norristown, Data Engrg. Co.	215-272-1444
Tex	Houston, Data Aids Assocs.	713-785-0581
Wash	Seattle, Arneson Assocs., Inc.	206-762-7664
Wisc	Milwaukee, Berndt Assoc.	414-476-1500
Exp:	Wakefield, Analogic Corp.	617-246-0300

ANAREN MICROWAVE, INC., 185 Ainsley Drive, Syracuse, N.Y., 13205, Tel: 315-476-7901, TWX: 710-541-1507; Mgr. Mktg: R.A. Worden; Applications Engr: L.E. Buckridge ..... Vol 4•438*

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Ariz	Phoenix, The Thorson Co.	602-956-5300
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Cal	Palo Alto, Waldman Assocs.	415-961-4100
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Ga	Smyrna, Spar Tech Assocs.	404-432-3644
Ill	Park Ridge, R.F. Specialists	312-698-2044
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Md	Upper Marlboro, R.L. Engrg.	301-760-5533
Mass	Reading, Geder-Rotondi Assocs.	617-944-3105
NM	Albuquerque, The Thorson Co.	505-265-5655
NY	Greenvale, Bertram D. Aaron & Co.	516-621-0630
NY	Skaneateles, Robtron	315-685-5731
Pa	Philadelphia, Eastern Instrumentation of Phila., Inc.	215-927-7777
Tex	Houston, Kemco, Inc.	713-498-1768
Tex	Irving, Kemco, Inc.	214-255-0537
Wash	Seattle, Rush S. Drake Assocs., Inc.	206-763-2755

ANCHOR ALLOYS, INC., 968 Meeker Ave., Brooklyn, N.Y., 11222, Tel: 212-782-7090; Sls. Mgr: I. Levinthal

ANCHOR SPECIALTY MFG., 300 Hollister Rd., Teterboro, N.J., 07608, Tel: 201-288-1939; Pres: W. Zablocky

ANDERSEN LABS. INC., 1280 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-242-0761, TWX: 710-425-2390; Sls. Mgr: B. Wagner ..... Vol 3•982,983

Local Sales Offices & Reps.

Cal	Woodland Hills, Interstate Mktg. Assocs.	213-883-7606
Iowa	Cedar Rapids, H.R. Brown Sls. Co.	319-366-0635
Mass	Newton, V. J. Huntoon Assocs., Inc.	617-244-5871
Mich	Ann Arbor, H. C. Heym Assocs.	313-971-6552
Minn	Minneapolis, Hasse & Assocs.	612-588-0551
Minn	St. Paul, R. G. Ragon, Inc., Mfg.	612-488-0201
NJ	Wallington, COMP-TECH	201-935-5454
NY	New Hyde Park, COMP-TECH	516-593-2628
Pa	Berwyn, Tucker Assocs.	215-644-0142
Tex	Dallas, Gillett Inds., Co.	214-363-0107
Tex	Richardson, P. J. Scanlon Co.	214-231-4661

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Mich	Ann Arbor, H. C. Heym Assocs., 1615 Charlmers Dr.	313-971-6552
Minn	St. Paul, Ragon, 1136 W. Larpenteur St.	612-488-0201

NJ Wallington, Comp-Tech, 437 Paterson Ave. 201-935-5454
NY New Hyde Park, Comp-Tech, Box 237 516-593-2628
Pa Berwyn, Tucker Assocs., 1018 Derwydd Lane 215-644-0142
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ANDERSON, W.E., INC., 320E West 80th St., Kansas City, Mo., 64114, Tel: 816-333-9882; Sls. Mgr: E. Charles

ANDREW CORP., 10500 W. 153 St., Orland Pk., Ill., 60462, Tel: 312-349-3300, TWX: 910-651-3340; Sls. Mgr: H.L. Woodbury

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Cal Claremont, Andrew California Corp. 714-626-3505
Cal Palo Alto, Andrew California Corp. 415-323-3139
Colo Denver, Andrew Corp. 303-222-1579
Ill Orland Park, Andrew Corp. 312-349-3300
Md Rockville, Andrew Corp. 301-762-1900
NJ Hawthorne, Andrew Corp. 201-423-0715
Tex Richardson, Andrew Corp. 214-235-1279

ANDREW Local Distributors
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121

ANGELICA UNIFORM CO., 700 Rosedale Ave., St. Louis, Mo., 63112, Tel: 314-863-0500; V.P. Sls: B.H. Saunders

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Cal Los Angeles, Angelica Uniform Co. 213-381-1361
Ga Atlanta, Angelica Uniform Co. 404-355-1875
Ill Chicago, Angelica Uniform Co. 312-677-9710
NJ Cherry Hill, Angelica Uniform Co. 215-528-5455
NY Long Island City, Angelica Uniform Co. 212-937-0800
Tex Dallas, Angelica Uniform Co. 214-358-5171

ANSLEY ELCTRNS. CORP., Sub. Thomas & Betts Corp., Old Easton Rd., Doylestown, Pa., 18901, Tel: 215-345-1800, TWX: 510-665-8105; Sls. Service Dept:

ANTEX INDS., INC., 1059 E. Meadow Cir., Palo Alto, Cal., 94303, Tel: 415-326-2441; Sls. Mgr: D.A. Holst; Pres: K.T. Chow

ANZAC ELCTRNS., 39 Green St., Waltham, Mass., 02154, Tel: 617-899-1900, TWX: 710-324-6484; Sls. Mgr: A. L. LeMay

A. P. CIRCUIT CORP., 865 West End Ave., New York, N.Y., 10025, Tel: 212-222-0876; Sls. Mgr: D. Ellern Vol 2•551

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Va Fairfax, Schibley 703-591-3008
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APAHOUSER CORP. OF N.E., 1312 Boylston St., Boston, Mass., 02215, Tel: 617-KE-6-1223; Sls. Mgr: J.F. Gately

APM-HEXSEAL, 44 Honeck St., Englewood, N.J., 07631, Tel: 201-LO-9-5700; Mktg. Mgr: C. Czapinski

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Ariz Phoenix, Elctrn. Coms. Sls. 602-267-1348
Cal Encino, Porter Co. 213-788-2350
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Fla Orlando, Buchanan & Abrams 305-423-8995
Ill Hinsdale, Hill & Gray, Inc. 312-325-4810
Ind Ft. Wayne, Val-Skol Sls., Inc. 219-742-9122
Kans Overland Park, Penzner Assocs., Inc. 913-381-0004
Md Silver Spring, N. Kronstadt Assocs. 301-585-6141
Mass E. Long Meadow, Gerber Sales Co. 413-525-3059
Mass New Haven, Gerber Sls. Co. 203-777-6279
Mich Troy, C. B. Jensen & Assocs. 313-645-0240
Minn St. Paul, Northport Engrg. 612-698-3841
Mo Hazelwood, Penzner Assocs., Inc. 314-731-4334
NM Albuquerque, Elctrn. Components Sls. 505-256-9831
NY Great Neck, F. Tylinski Co., Inc. 516-466-9070
NY Syracuse, Rep Tech, Inc. 315-437-2845
Ohio Cleveland Hgts., Val-Skol Sls., Inc. 216-462-2822
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Pa Pittsburgh, G. S. Root & Co. 412-561-4125
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Utah Salt Lake City, Elctrn. Components Sls. 801-486-2317
Wash Seattle, Blum & Assocs. 206-782-1600

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Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541

APOLLO CORP., 5-1, Togoshi 6-Chome, Shinagawa-Ku, Tokyo, Japan, Tel: 786-2001; Mgr: M. Kohmoto; Mgr: M. Kishita

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APPLIED MATERIALS TECH., 2999 San Ysidro Way, Santa Clara, Cal., 95051, Tel: 408-738-0600; Sls. Mgr: T. Rafalovich

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Cal Partola Valley, Kipp Assocs. 415-851-0123
Colo Denver, Walter Engr. 303-777-5585
Fla Fort Lauderdale, Modems Plus 305-587-3849
Ill Highland Park, Feller Assoc. 312-433-3651
Mass Stoneham, REPCO 617-438-3113
Mo St. Louis, G Fixman Engr. 314-725-5219
NJ Ridgewood, Damon/Engel 201-444-1400
NY New York, DB Assocs. 315-446-0220
Okla Tulsa, Carey-Wolf Co. 918-622-9233
Tex Fort Worth, Carey-Wolf Co. 817-738-1996
Tex Houston, Carey-Wolf Co. 716-643-2114
Va Annandale, J Hopkins 703-280-2086
Wash Seattle, Showalter-Judd 206-762-2310
Exp: Hallandale, Fla., Emec, Inc. 305-925-5366
For: Can., Montreal, Componetics 514-342-4117

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NJ Westfield, Gray & Reed Assocs. Inc. 201-233-6116
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NY Syracuse, Lightstone Corp. 315-454-3209
Pa Newtown Sq, SWR Assocs. 215-356-8550
Tex Dallas, Texas Avionics 214-368-3566
Va Fairfax, Schibley Assocs. 703-591-3008

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Ohio Dayton 513-435-1301
Ohio Fairview Pk. 216-333-4120
Tex Dallas 214-328-6211
Tex Houston 713-667-3420
Wash Kirkland 206-822-4191

ARCIDY ASSOCS., 370 Commercial St., Manchester, N. H., 03101, Tel: 603-668-2111; M/M: Louis J. Arcidy

ARCO ELCTRNS., INC., PFC Mfg. Div., Community Dr., Great Neck, N.Y., 11022, Tel: 516-487-0500, TWX: 510-223-0804; Sls. Mgr. PFC Only: M. Samuels; G. Mgr: A. Rosenblum; Prod. Mgr: C. Feinsot .... Vol 3•357-361

Local Sales Offices & Reps.
Ariz Phoenix, Shefler-Kahn 602-258-7893
Cal Redwood City, Sinai-Johnson, Inc. 415-365-6263
Cal Torrance, Arco Elctrns. 213-775-8916
Cal Van Nuys, Obie Mktg. Co. Dealer Only 213-997-1124
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Ga Jonesboro, Wallace Elctrn. Sls. 404-471-6297
Haw Honolulu, Pegart International 808-538-7818
Ill Chicago, G. McL. Cole Co. 312-774-3535
Ind Indianapolis, C. Scheffler Co. 317-253-6337
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Md Kensington, Forti-Austin Assoc. 301-949-1706
Mass Brookline, Technology Prods. (PFC Prods.) 617-731-0858
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NJ Trenton, Kriegner Sls. Co. 609-882-6330
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Cal No. Hollywood, Distro Inc., 12517 Burbank Blvd. 213-980-8888
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
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Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621

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Cal Torrance, Cal. Tech. Svcs. 213-320-1310
Fla Tequesta, J. Alexander 305-746-4129
Ill Highland Park, Teller Assocs. 312-433-3651
Kans Mission, Inland Assocs. 913-362-2366
Tex Dallas, S. Hamilton 214-350-4344

A.R.F. PRODUCTS, INC., Box 3226, Boulder, Colo., 80303, Tel: 303-443-4844, TWX: 910-940-3446; Sls. Mgr: J.D. Ellington

ARGOS PRODS. CO., INC., 600 S. Sycamore St., Genoa, Ill., 60135, Tel: 815-784-5118; Sls. Mgr: A. Hoyne

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Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

ARI INDS., INC., 9000 King St., Franklin Pk., Ill., 60131, Tel: 312-671-0511, TWX: 910-227-0052; Prod. Mgr: G. Schauner; Prod. Mgr: S. Steinberg; Prod. Mgr: D. MacKenzie

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Ala Huntsville, Col-Ins-Co., Inc. 205-539-1771

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Cal Redwood City, Marchi Assocs. 415-364-3411
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Conn North Haven, Forsberg Sls. 203-239-5111
Fla Orlando, Col-Ins Co., Inc. 305-423-7615
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Ind Indianapolis, Electro Engrg. & Sls., Inc. 317-547-5273
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Mass Newton Centre, Daner-Hayes 617-969-4650
Mich Clawson, Instr. Specialties 313-435-3311
Minn Minneapolis, Industra 612-929-6224
Mo St. Louis, Maise Equip. Co. 314-241-4351
NJ Fair Lawn, Par Assocs. 201-447-3722
NM Albuquerque, Rustco Entprs. 505-296-6474
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Pa Blue Bell, W. Gregory & Co. 215-643-4702
Tex Houston, Instrs. 713-225-6626
Wash Seattle, Branom Instr. 206-762-6050

ARK-LES SWITCH CORP., 51 Water St., Watertown, Mass., 02172, Tel: 617-924-2330; Gen. Sls. Mgr: R.W. Swift

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Ala Mountain Brook, Applebee-Church Co. 205-870-4417
Ark Little Rock, Industrial Sls. Co. 501-562-5852
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Fla Clearwater, J.J. Galleher Co. 813-446-7706
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Ill Chicago, Stevens Engrg. Co. 312-775-8410
Ind Indianapolis, Neal Engrg. Co. 317-849-4201
Ky Louisville, Neal Engrg. Co. 502-459-7330
Mass Topsfield, The Representatives Corp. 617-426-0541
Mich Detroit, R. C. Dakin Co. 313-647-2262
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NY Rye, C. Avery Assoc. Ltd. 914-967-7610
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Pa Glenside, Shelmar Elctrns. Co. 215-885-0800
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Tex Dallas, D. Shuhart Co. 214-239-0185
Va Lynchburg, Royelec 703-846-7117
Wisc Milwaukee, G. Hatch Co. 414-671-6550

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ARMSTRONG CORK CO., W. Liberty St., Lancaster, Pa., 17604, Tel: 717-397-0611, TWX: 717-560-4405; Prod. Info: R.H. McKowen; Prod. Info: J.P. Heinrich

ARMSTRONG PRODS. CO., Box 657, Warsaw, Ind., 46580, Tel: 219-267-3226, TWX: 810-298-0790; Sls. Mgr: M.V. Rothschild

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Cal Fullerton, Arnold Engrg. Co. 714-871-1560
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Ill Chicago, Arnold Engrg. Co. 312-AN-3-6300
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Mass Lexington, Arnold Engrg. Co. 617-862-2804
Mich Jackson, Arnold Engrg. Co. 517-784-5663
Minn Minneapolis, Arnold Engrg. Co. 612-545-1494
Mo Hazelwood, Centech Sls. 314-731-4220
Mo Raytown, CenTech Sls. 816-358-8100
NJ Leonia, Arnold Engrg. Co. 201-461-8150
NY E. Syracuse, Young & Co. 315-437-7733
NC Raleigh, Arnold Engrg. Co. 919-828-3270
Ohio Shaker Heights, Arnold Engrg. Co. 216-283-7580
Pa Pittsburgh, Arnold Engrg. Co. 412-366-5443
Tex Dallas, Arnold Engrg. Co. 214-821-4654
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Mass Lexington, Kitchen & Kutchin 617-862-8230
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Ohio Dayton, Sculley & Ingling Assoc. 513-298-9575
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Va Annandale, Nine Assocs. 703-256-9105
Wisc Milwaukee, Larsen Assoc. 414-258-0529
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Cal Los Angeles, Thorson Co. 213-937-0790
Cal Palo Alto, Thorson Co. 415-321-2414
Cal San Diego, Thorson Co. 714-298-8385
Cal Tustin, Thorson Co. 714-544-5121
Colo Broomfield, R. A. Mayes Co. 303-466-6311
Fla Lighthouse Point, Saber Assoc. 305-943-3076
Ill Highland Pk., Feller 312-433-3646
Ind Rochester, Feller Assocs. 219-223-2377
Kans Merriam, Tech. Reps. 913-432-4110
Md Ellicott City, Doss Elctrns. 301-465-1336
Mass Cochituate, Micronic Assocs. 617-872-6561
Mo Hazelwood, Tech. Reps. 314-524-6900
NM Albuquerque, R. A. Mayes 505-265-7989
NY Great Neck, EAC 516-466-9798
NY Syracuse, Tesco Assocs. 315-463-4566
Pa Newton Sq., SWR Assocs. Corp. 215-356-8550
Wash Seattle, Thorson Co. 206-ME-2-0710
Exp: Fla., Hallandale 305-925-6366
For: Can., Montreal 252, Quebec, Componetics Ltd.

ARROW-HART, INC., 103 Hawthorn St., Hartford, Conn., 06106, Tel: 203-249-8471; Mgr. Mktg. Svcs: G. Heiden; Promotions Mgr: H.O. Weunberg

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Cal Cerritos, Arrow-Hart, Inc. 213-773-1736
Cal El Cajon, Arrow-Hart, Inc. 714-442-9608
Cal San Francisco 415-824-4620
Ga Atlanta, Arrow-Hart, Inc. 404-355-8862
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Ind Indianapolis, Arrow-Hart, Inc. 317-632-6456
Mass Norwood, Arrow-Hart, Inc. 617-762-3660
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Tex Garland, Arrow-Hart, Inc. 214-270-5441
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La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
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NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
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Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131

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Kans Kansas City, L. Bruns 913-AT-9-5242
Minn St. Paul, R. Bittrick 612-226-6178
Tex Dallas, P. Scanlon 214-AD-1-4661

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Mass Northboro, Zaslow Sls. 617-393-8150
Minn Minneapolis, Delta Assoc. 612-560-6240
NJ E. Orange, Masin-Esco 201-674-6505
NY Chappaqua, Masin-Esco 914-CE-8-8337
NY Syosset, Masin-Esco 516-364-0310
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Ohio Grove City, G & H Sls. Co. 614-878-1128
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ARVIN FREQUENCY DEVICES, Elctrn. Sys. Div., Arvin Inds., 15th St. Plant, Columbus, Ind., 47201, Tel: 812-379-3842, TWX: 810-352-1272; Sls. Mgr: L. Bower Vol 2•379

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NY Great Neck, EAC Assocs., Inc. 516-466-9798
Exp: Chicago, Ill., E.D. Magnus Assocs. 312-334-1502

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NM Albuquerque, W. J. Purdy Co. 505-266-7959
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NY Rochester, Elcom Sls. 716-385-1400
NY Utica, Elcom Sls. 315-732-6445
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Pa Pittsburgh, Augnat Assocs. 412-281-8283
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For: Can., Montreal West, Hooker Elec. Canada 514-487-5151

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Tex Houston, Lenert Co., Box 2184 713-225-1465

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Ark	Little Rock, Electra-Tech Hidsouth	501-562-4090
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Cal	Palo Alto, Priz Co.	415-326-9333
Colo	Denver, BFA Corp.	303-744-3301
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Fla	Orlando, Datarep, Inc.	305-843-5224, 5225
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Mass	Sudbury, Digital Mktg.	617-890-7148
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Mo	St. Louis, Engrg. Svcs. Co.	314-726-2233
NJ	Ridgewood, Damon Engel, Inc.	201-444-1400
NM	Albuquerque, BFA Corp.	505-296-8303
NM	Las Cruces, BFA Corp.	505-523-0601
NY	Cazenovia, P. Decew, Inc.	315-655-8602
Ohio	Dayton, LI/Corp.	513-278-0788
Okla	Tulsa, Kemp Eng. Co.	918-628-0309
Pa	Hatboro, Damon Engel Inc.	215-922-3270
SC	Greenville, Greentron, Inc.	803-277-3537
Tex	Addison, Kemp Engrg.	214-661-0400
Tex	Houston, Kemp Engrg. Co.	713-688-1431
Wash	Seattle, Hayes Technical	206-763-2210
For:	Can., Montreal, Radionics	514-735-4565

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Colo	Arvada, Arrowhead Sls. Corp.	303-423-5556
Fla	Orlando, Gra-Mar, Inc.	305-894-3351
Ill	Itasca, English Sls. Co.	312-773-9449
Md	Baltimore, D.K. Jones & Assocs.	301-752-0577
Mass	Marlboro, Ken Parker Assocs.	617-485-7096
Mich	Detroit, Electro Enterprises, Inc.	313-521-1500
Minn	Minneapolis, Dick Swanson Co.	612-789-5636
NJ	Haddonfield, Mills Equip. Co.	609-429-1005
NY	Floral Park, Elm Assocs., Inc.	516-352-2798
NY	Skaneateles, Spar-Kleen Prods., Inc.	315-685-5711
Ohio	Cleveland, Electro Enterprises, Inc.	216-261-7670
Wash	Bellevue, Bill Waddell Co.	206-822-0211
Exp:	Burbank, Cal., Tech-Ser, Inc.	213-846-9631
Exp:	Paris, France, Anglade S.A.	

ATLANTIC OPTICAL MOULDING CO., Ellis St., Dudley, Mass., 01570, Tel: 617-943-1746; G.M: J.F. Krysiak

ATLAS ELECTRIC DEVICES, 4114 N. Ravenswood Ave., Chicago, Ill., 60613, Tel: 312-327-4520; Sls. Mgr: R. Metzinger

ATLAS SOUND DIV., American Trading & Production Corp., 10 Pomeroy Rd., Parsippany, N.J., 07054, Tel: 201-887-7800; Gen. Sls. Mgr: H.M. Jaffe

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Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

ATLEE CORP., 8 Gill Street, Woburn, Mass., 01801, Tel: 617-729-5800, TWX: 710-393-0176; Elctrn. Hardware Sls. Engr: W.J. Carroll; Elctrn. Hardware Sls. Engr: N. Bougas; Busbars Sls. Mgr: W. Scott

Local Sales Offices & Reps.

Cal	Burlingame, J. Logan Assoc.	415-697-6100
Cal	Los Angeles, El-Com.	213-223-1351
Colo	Denver, I.W. Strong Assoc., Inc.	303-292-6900
Conn	Milford, Conti-Younger Assoc., Inc.	203-929-3294
Fla	Largo, Massey Assocs.	813-595-8950
Ill	Chicago, Ellinger Sls. Corp.	315-763-1570
Iowa	Clarion, Ellinger Sls. Corp.	515-532-3218
Mass	Waltham, Conte & Younger Assoc.	617-890-4852
Mo	St. Louis, Ellinger Sls. Corp.	314-352-2027
NJ	Madison, A. L. Livera & Assocs.	201-377-3220
NY	Roslyn Heights, A. L. Livera & Assoc., Inc.	516-484-1276
Ohio	Toledo, Deo Volente Assocs.	419-882-2830
Pa	Newtown Square, Kaufholz Assocs.	215-356-5000
Tex	Irving, Lee Sls. Co.	214-255-5043
For:	Can., Malton, Ont.,, Hooker Canada, Ltd.	416-677-3554
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Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346

ATR ELCTRNS., INC., 300 E. 4th St., St. Paul, Minn., 55101, Tel: 612-222-3791; Sls. Mgr: A.A. Goffstein **Vol 1•580**

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AUBIN, A.E. CO., P.O. Box 29, Glastonbury, Conn., 06033, Tel: 203-525-7747; Sls. Mgr: A.E. Aubin

AUDIO DEVICES, INC., A Capitol Inds., Co., 100 Research Dr., Glenbrook, Conn., 06906, Tel: 203-327-6500, TWX: 710-474-2045; Sls. Mgr: W. Goldstein

AUDIO Local Distributors

NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121

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AUDIOTRONICS, 7428 Bellaire Ave., N. Hollywood, Cal., 91605, Tel: 213-877-1308; Video AM: L. Aron; Mktg. Svcs. Mgr: J. Steorts

AUGAT INC., 33 Perry Ave., Attleboro, Mass., 02703, Tel: 617-222-2202, TWX: 710-391-0644; Sls. Mgr: E. Redgate

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Colo	Littleton, Simpson	303-798-8439
Conn	New Canaan, S. Pierce	203-966-4630
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Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Chicago, R. Krueger	312-282-8444
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Kans	Overland Park, Lowell-Kangas & Assocs., Inc.	913-888-3200
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NJ	Cherry Hill, Trinkle Sls., Inc.	609-667-3500
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NY	N. Syracuse, L. D. Allen, Inc.	315-458-7470
NC	Charlotte, Cartwright & Bean Inc.	704-333-6457
NC	Raleigh, Cartwright & Bean, Inc.	919-832-7128
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Ohio	Dayton, A. Nace Co., Inc.	513-836-7548
Ore	Portland, C.K. Shanks	503-292-5656
Pa	Pittsburgh, A. Nace Co.	412-922-7225
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Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
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Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000
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Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
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Ohio Cleveland, Milgray/Cleveland, 1821 E. 40th ST. 216-881-8800
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Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
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AUSTIN ELCTRNS., 450 W. First Ave., Roselle, N.J., 07023, Tel: 201-241-3300, TWX: 710-996-5981; Asst./Dv. Mgr: K.F. O'Connor

AUSTRON, INC., 1915 Kramer Lane, Austin, Tex., 78758, Tel: 512-836-3523, TWX: 910-874-1356; Sls. Mgr: R. Malone; Cust. Svcs: V. Bode .... Vol 1•391; Vol 2•385

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Mass Waltham, Technical Entprs. 617-890-5300
NJ Haddonfield, Brisco 215-923-1075
NC Winston-Salem, W.A. Brown Instrs. Co. 919-768-3600
Ohio Dayton, L.D. Bruno Co. 513-434-1847
Tex Austin, Austron, Inc. 512-836-3523
Tex Houston, Pan-Tech Engrg. Co. 713-623-0640

AUTOCON INDS., INC., Sub. Control Data, 2300 Berkshire La. N., Minneapolis, Minn., 55441, Tel: 612-545-2851; Mktg. Mgr: J.S. Tart

AUTOMATED MEAS., Div. E.H. Research Labs, Box 1289, Oakland, Calif., 94604, Tel: 415-834-3030, Ext. 319, TWX: 910-366-7258; Sls. Mgr: R.L. Aston

(Refer to E-H Resch. Labs. for sales office information)

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Tex Dallas, Data Marketing Assoc. 214-358-4643

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Ohio Cleveland, Anderson-Bolds, Inc. 216-229-4700
Ohio Worthington, Anderson-Bolds, Inc. 614-885-3933
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AUTOMATION DYNAMICS, Div. Resalab, Inc., 35 Industrial Pkwy., Northvale, N.J., 07647, Tel: 201-768-9200; Sls. Mgr: C.E. Barlow

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Wash Renton, Automation Industries, Inc., Sperry Div. 206-228-3170
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Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971

AUTRONICS CORP., 180 N. Vinedo Ave., Pasadena, Calif., 91107, Tel: 213-681-3545, TWX: 213-449-2854; Sls. Mgr: J.F. Hayward; Tech. Dir: C.B. Barnes
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Cal Tustin, Thorson Co. 714-554-5121
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Tex Houston, Thorson Co. 713-771-3504
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NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700

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Cal Palo Alto, The Thorson Co. 415-321-2414
Cal San Diego, The Thorson Co. 714-298-8385
Cal Tustin, The Thorson Co. 714-544-5121
Colo Denver, The Thorson Co. 303-355-3521
DC Washington, Applied Engrg. Conslts. 202-783-7319
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Ind Indianapolis, Cozzens/Cudahy, Inc. 317-244-2456
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Kans Shawnee Mission, E.I.R. Co. 913-362-0919
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Mass	Holbrook, McLellan	617-963-8812
Mich	Detroit, WKM Assocs.	313-892-2500
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NM	Albuquerque, Zeus, Inc.	505-268-3941
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Pa	Ambler, W.M. Assocs.	215-643-4119
Pa	Pittsburgh, Frame Elec.	412-322-1500
Tex	Dallas, Data Aids Assocs.	214-620-1551
Tex	Houston, Data Aids Assocs.	713-785-0581
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Mich	Southfield, Carrier & Gable	313-444-8980
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Tex	Houston, Ammon & Rizos	713-729-1233
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For:	Can., Downsview, Ont., Kaytronics Ltd.	416-638-5511
For:	Can., Montreal, Que., Kaytronics Ltd.	514-487-3434

AVX Local Distributors

Cal	Irvine, Cramer/L. A., 17201 Daimler St.	714-979-3000
Cal	San Diego, Cramer/San Diego, 8975 Complex Drive	714-565-1881
Fla	Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214	305-894-1511
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
Md	Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive	301-948-0110
Mass	Newton, Cramer Elctrn. Inc., 85 Wells Avenue	617-969-7700
Mass	Newton, Cramer/International, 85 Wells Ave.	617-969-7700
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121

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Local Sales Offices & Reps.

NY	Rochester, B & B Motor & Control Corp.	716-473-6640

B & F INSTRS., INC., Cornwells Hgts., Pa., 19020, Tel: 215-639-7100, TWX: 510-667-1516; Sls. Mgr: B. Pogach

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs., Inc.	205-837-4304
Cal	North Hollywood, B. J. Wolfe Entprs.	213-877-5518
Cal	Walnut Creek, D. Dahl Assocs.	415-933-9595
Colo	Arvada, Cleveland Entprs., Inc.	303-423-3707
Ill	Evanston, Mauer Co.	312-869-1644
Iowa	Cedar Rapids, Palatine Engrg. Sls.	319-365-8071
Kans	Andover, Palatine Engrg. Sls.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls.	913-262-5643
Mass	Natick, Andruss-Peskin Corp.	617-653-3919
Mich	Plymouth, Measurement Instrs.	313-352-2144
Mo	St. Louis, Palatine Engrg. Sls.	314-426-7055
NM	Albuquerque, Cleveland Entprs., Inc.	505-298-7671
NY	Melville, Astrorep Incorp.	516-423-2266
NC	Charlotte, Systems Svc. Corp.	704-377-3407
Ohio	Cincinnati, Measurement Instrs.	513-531-2729
Ohio	Columbus, Measurement Instrs.	614-488-9753
Pa	Jenkintown, PDC Corp.	215-887-9610
Pa	Monroeville, Measurement Instrs.	412-366-1906
Tex	Houston, Palatine Engrg. Sls.	713-777-4477
Tex	Richardson, Palatine Engrg. Sls.	214-231-9489
Wash	Seattle, Brett Assocs., Inc.	206-935-8054

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Ala	Huntsville, Lee Associates, Inc.	205-883-2530
Ariz	Scottsdale, Barnhill Three, Inc.	602-947-7841
Cal	Anaheim, B & K Instrs., Inc.	714-778-2450
Cal	San Mateo, B & K Instrs., Inc.	415-948-9519
Colo	Denver, Barnhill Three, Inc.	303-934-5505
Conn	Hamden, Equipment Sls. Co.	203-248-5581
Fla	Orlando, Lee Assocs., Inc.	305-241-4445
Ga	Chamblee, Lee Assocs., Inc.	404-457-7117
Ill	Chicago, Carter Elctrns., Inc.	312-585-5485
Ind	Indianapolis, Carter Elctrns., Inc.	317-293-0696
Md	Rockville, Farrell Assocs.	301-424-9460
Mass	Chelmsford, Equipment Sls. Co.	617-256-8547
Mich	Detroit, Electro Sls. Assocs.	313-526-8800
Minn	Minneapolis, Carter Elctrns., Inc.	612-544-9393
Mo	Hazelwood, Carter Elctrns., Inc.	314-731-2237
NM	Albuquerque, Barnhill Three, Inc.	505-299-7658
NY	DeWitt, DB Assocs.	315-446-0220
NY	Great Neck, Measurement Tech., Inc.	212-895-7177
NC	Raleigh, Lee Assocs., Inc.	919-787-5818
Ohio	Cleveland, Electro Sls. Assocs.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs.	513-426-5551
Pa	King of Prussia, LeTronix Inc.	215-242-6223
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Tex	Houston, Barnhill Two, Inc.	713-621-0040
Tex	Richardson, Barnhill Two, Inc.	214-231-2573
Wash	Seattle, H. Levinson Co.	206-323-5100
Wisc	Milwaukee, Carter Elctrns., Inc.	414-464-5555

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Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	

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Local Sales Offices & Reps.

Cal	L A, E. Landa Co.	213-879-0770
Cal	Los Altos, E. Landa	415-948-0788
Colo	Denver, Checkmate Sls.	303-771-4920
Conn	Haven, Kitchen & Kutchin	203-239-0212
Fla	Ft. Lauderdale, G. Bohman	305-564-3081
Fla	Orlando, G. Bohman	305-855-0274
Ill	Chicago, Carlson Elctrn.	312-774-4812
Ind	Greenwood, Valentine/Schillinger & Assoc.	317-888-2260
Ind	South Bend, Valentine/Schillinger & Assoc.	219-291-6258
Kans	Overland Park, Ensco Rep. Inc.	913-381-7557
Md	Bethesda, W. Mount	301-657-9312
Mass	Lexington, Kitchen & Kutchin	617-862-8230
Minn	Minneapolis, J-EX Electra Sls.	612-566-5340
NJ	Teaneck, R. T. Reid	201-692-0200
NM	Albuquerque, Data Handling	505-268-0928
NY	Cicero, Advanced Comps.	
NY	Endicott, Advanced Comps.	607-785-3191
NY	No. Syracuse, Advanced Comps.	315-699-2671
NY	Poughkeepsie, Advanced Comps.	914-471-1623
NY	Scottsville, Advanced Comps.	716-889-1429
NC	Winston Salem, Ensco Rep. Inc.	314-567-3935
Ohio	Cincinnati, Giesting Assocs.	513-931-0812
Ohio	Dayton, Giesting Assocs.	513-293-4044
Ore	Beaverton, Arneson	503-646-3416
Pa	Glenside, Precision Elctrns.	215-646-8383
Pa	Jenkintown, W. Mount	215-886-0383
SC	Greenville, Elctrn. Mktg. Assocs.	803-268-1125
Tex	Houston, Aid Elctrns.	713-777-3882
Tex	Irving, Aid Elec.	214-259-4761
Wash	Seattle, Arneson	206-762-7664
Wisc	Milwaukee, Carlson Electronic Sales	414-476-2790

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Ariz	Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave.	602-269-1391
Cal	Hollywood, Hamilton/Avnet Elctrncs.	305-925-5401
Cal	Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd.	415-961-7000
Cal	Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr.	415-964-0820
Cal	San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd.	714-279-1550, 279-2421
Colo	Denver, Hamilton/Avnet Electronics	303-534-1212
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Ga	Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd.	404-448-0800
Ill	Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.	
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Kans	Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St.	913-362-3250
Md	Baltimore, Arrow Elctrns., 5207 E. Drive	301-247-5200
Md	Beltsville, Powell Elctrns/Washington, 10728 Hanna St.	301-937-4030
Md	Hanover, Hamilton/Avnet Elctrns.	301-796-5000
Mass	Burlington, Arrow Elctrns., 15 A Street	617-273-0100
Mass	Burlington, Hamilton/Avnet Elctrns.	617-273-2120
Mich	Livonia, Hamilton/Avnet Elctrns.	313-522-4700
Minn	Minneapolis, Hamilton/Avnet Elctrns.	612-854-8400
Mo	Hazelwood, Hamilton/Avnet Electronics	314-731-1144
NJ	Cedar Grove, Hamilton/Avnet Elctrns.	201-239-0800
NJ	Cherry Hill, Hamilton/Avnet Elctrns.	609-662-9337
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
NY	Syracuse, Hamilton/Avnet Elctrns.	315-437-2642
NY	Westbury, Hamilton-Avnet Electrns., 70 State St.	
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
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Utah	Salt Lake City, Hamilton/Avnet Elctrns.	801-262-8451
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BAFCO, INC., 717 Mearns Rd., Warminster, Pa., 18974, Tel: 215-674-1700, TWX: 510-665-6860; Pres: J.C. Boonshaft; V.P: A.M. Fuchs ..... Vol 1*393

Local Sales Offices & Reps.

Cal	Carson, ABCO Co.	213-537-5152
Cal	Palo Alto, Mauldin	415-326-5291
Conn	Newtown, Daner-Hayes Inc.	203-426-9094
Fla	Orlando, Truex	305-859-2160
Mass	Newton Centre, Daner-Hayes Inc.	617-969-4650
NY	Rochester, Daner-Hayes Inc.	716-467-5100
Ohio	Dayton, P. Glavinos	513-433-1010
Pa	Melrose Park, R. Meyers Assoc.	215-224-1663

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BAILEY METER CO., Sub. Babcock & Wilcox, Wickliffe, Ohio, 44092, Tel: 216-943-5500, TWX: 216-944-4160; Sls. Mgr: C.E. Bergman

BAKER CO., INC., Drawer E - Sanford Airport, Sanford, Me., 04073, Tel: 207-324-8773

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Ariz	Scottsdale, F. Schoeffler Assocs.	
Cal	Culver City , Sodaro Co.	213-478-7733
Conn	Meriden, Abbitt-Allison	203-237-9232
Ill	Northbrook, R.T. Howlett & Assocs.	312-498-5444
Kans	Overland Park, Bob Rush Assocs.	913-831-4259
Md	Gaithersburg, Wright Co.	301-948-5588
NJ	Harrington Pk., Metro Tech. Sls.	201-768-8495
NJ	Moorestown, A.A. Foley Assoc.	609-663-4545
NY	Jericho, Metro Tech. Sls.	516-935-3330
Ohio	Columbus, McFadden Sls.	614-221-3363
Wash	Seattle, J.B. Jolly	206-938-4166
Wisc	Milwaukee, Gentron Corp.	414-543-8110
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For:	Can., Montreal, Electro Design	514-389-5914
For:	Can., Ottowa, Electro Design	613-745-0541
For:	Can., Toronto, Ont., Electrodesign Ltd.	416-787-0991
For:	Can., Ville Lasalle, Que., Electrodesign Ltd.	514-363-5120

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Ark	Little Rock, Baldwin Elctrns., Inc.	501-375-7351
Cal	Granada Hills, Baldwin Elctrns., Inc.	213-368-1716
Cal	Palo Alto, Baldwin Elctrns., Inc.	415-321-7840
Fla	Oviedo, Conley Associates	305-365-3283
Ill	Chicago, Carlson Elctrns. Sls. Co.	312-774-0277
Md	Arnold, S. Jordan, Reg. Sls. Mgr.	301-757-5904
Mass	Needham Heights, Northeast Representatives, Inc.	617-449-3034
Minn	Minneapolis, J-Ex Elctrn. Sls. Co.	612-566-5340
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NM	Albuquerque, R.A. Mayes Co.	505-265-7989
NY	Rochester, H.C. Johnson Agencies	716-482-3000
Ohio	Cincinnati, Baldwin Elctrns., Inc.	513-231-1786
Ore	Portland, Brett Associates, Inc.	503-232-4184
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Wash	Seattle, Brett Associates, Inc.	206-935-8054

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Ala	Huntsville, Gentry Assoc. Inc.	205-536-5306
Ariz	Scottsdale, Williams Assoc.	602-947-4297
Cal	Irvine, Moxon Elctrns.	714-833-2000
Cal	San Diego, Moxon Elctrns.	714-292-4820
Cal	Sunnyvale, Moxon Elctrns.	408-734-4352
Colo	Denver, Williams Assocs.	303-343-2911
Fla	Melbourne, Gentry Assocs.	305-773-3411
Fla	Orlando, Gentry Assocs.	305-894-4401
Fla	St. Petersburg, Gentry Assocs.	813-867-7820
Ill	Chicago, Scientific Sls.	312-775-7594
Ind	Indianapolis, Scientific Sls.	317-253-4606
Kans	Shawnee Mission, Eir Co.	913-362-0919
Mass	Newtonville, H. J. Schuft	617-527-5304
Mich	Royal Oak, Satullo Co.	313-549-3910
Minn	Bloomington, Scientific Sls.	612-881-3300
Mo	Hazelwood, Eir Co.	314-895-4100
NJ	Bordentown, Dyna Rep Co.	609-298-6700
NM	Albuquerque, Williams Assocs.	505-255-1638
NY	Mt. Vernon, Q.E.D. Elctrns.	914-664-0080
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NY	Schenectady, NACO Elctrns.	518-244-4720
NY	Utica, NACO Elctrns.	315-732-1801
NC	Burlington, Gentry Assocs.	919-227-3639
Ohio	Cleveland, Satullo Co.	216-486-2800
Ohio	Dayton, Satullo Co.	513-293-7061
Okla	Norman, Data Mktg. Assoc. Inc.	405-364-8320
Tex	Dallas, Data Mktg. Assocs.	214-358-4643
Tex	Houston, Data Mktg. Assocs.	713-686-9627
Tex	San Antonio, Data Mktg. Assoc. Inc.	512-828-0937
Va	Springfield, Dyna Rep Co.	703-321-8630

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Local Sales Offices & Reps.

Ala	Huntsville, Candor Co.	205-539-6575
Cal	Menlo Park, Long & Assocs., Inc.	415-327-1300
Cal	Sherman Oaks, R. Meussdorffer & Assoc.	213-788-0771
Colo	Denver, Todd & Assocs., Inc.	303-744-2313
Conn	Berlin, White Sls. Co.	203-224-0423
Ill	Chicago, Newman-Krause Co.	312-736-6800
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Mass	Needham, White Sls. Co.	617-444-3676
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	Hazelwood, Penzner-Mankus Assocs.	314-731-4334
NJ	Mt. Laurel, Naudain Assocs.	609-235-1801
NJ	Springfield, P. H. Werner, Inc.	201-376-9440
NY	East Aurora, Harries & Hershaw	716-652-1221
NC	Winston-Salem, Candor Co.	919-924-1480
SC	Myrtle Beach, Candor Co.	803-448-5213
Tex	Ft. Worth, Barber-Colman Co.	817-732-2818
Va	Lynchburg, Candor Co.	703-239-5265
Wisc	Milwaukee, Barber-Colman Co.	414-464-5900
Exp:	Milwaukee, Wis., Dummann World Trade Co.	414-464-0100

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Cal	Redwood City, CB Controls	415-364-2313
Cal	San Diego, R. Brainard Co.	714-274-1333
Colo	Denver, Technical Engrg. Sls.-Svc. (TESSCO)	303-744-1119
Conn	Hamden, Barber-Colman Co., Industrial Instrs. Div.	203-288-2644
Fla	Miami, G. Brophy Assoc.	305-444-6253
Fla	Winter Park, Control Equip. Co.	305-647-4496
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Ill	Lincolnwood, Barber-Colman Co., Industrial Instrs. Div.	312-673-4550
Ill	Loves Park, Barber-Colman Co., Industrial Instrs. Div.	815-633-9585
Ill	Rock Island, Barber-Colman Co., Industrial Instrs. Div.	309-786-3351
Ind	Indianapolis, Barber-Colman Co., Industrial Instrs. Div.	317-293-4700
Ind	Lanesville, Barber-Colman Co., Industrial Instrs. Div.	502-585-4027
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La	Shreveport, JDJ Sls. Co.	318-865-2393
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Ohio	Highland Hgts., Barber-Colman Co., Industrial Instrs. Div.	216-461-2480
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Pa	Pittsburgh, Barber-Colman Co., Industrial Instrs. Div.	412-885-2200
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Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Schweber Elctrns. 312-593-2740
Md Rockville, Schweber Elctrns. 301-881-2970
Mass Waltham, Schweber Elctrns. 617-890-8484
Mich Detroit, Schweber Elctrns. 313-583-9242
NJ Somerset, Schweber Elctrns. 201-469-6008
NY Rochester, Schweber Elctrns. 716-328-4180
NC Raleigh, Schweber Elctrns. 919-832-8881
Ohio Beachwood, Schweber Elctrns. 216-464-2970

BARNES ENGRG. CO., 30 Commerce Rd., Stamford, Conn., 06902, Tel: 203-348-5381, TWX: 710-474-3367; Adv. Mgr: N. Buitenkant; Mktg. Mgr: S. Haffner

BARNES & REINECKE, INC., 351 E. Ohio St., Chicago, Ill., 60611, Tel: 312-321-0350; Sls. Mgr: J.E. Smart; Staff Engr: G. Landes; Admin. Engr: J.G. Ferkan

BARON-BLAKESLEE, DIV. PUREX CORP., 1620 S. Laramie Ave., Chicago, Ill., 60650, Tel: 312-656-7300; Prod. Mgr: P.W. Johnson

BARTH ELCTRNS., INC., 7777 Wall St., Cleveland, Ohio, 44125, Tel: 216-524-5136; Pres: J.E. Barth

BASIC CERAMICS INC., Sub. Basic Inc., 221 Seventh Ave., Hawthorne, N.J., 07507, Tel: 201-427-4211, TWX: 710-988-4133

Local Sales Offices & Reps.
Cal Van Nuys, Wesk Assocs. 213-989-3070
Ill Northfield, Basic Ceramics 312-446-6004
Pa Wayne, R. Williams 215-688-2807
RI Warwick, Schumacher-Yarrington 401-884-5671

BASLER ELEC. CO., Box 269, Rte. 143, Highland, Ill., 62249, Tel: 618-654-2341, TWX: 910-996-2522; Sls. Mgr: D.L. Ginther

BAUSCH & LOMB, 87973 Bausch St., Rochester, N.Y., 14602, Tel: 716-232-6000, TWX: 716-97-8231; Mgr.-Mktg. Comm: H. Lettau

BAY LABS., INC., 20160 Center Ridge Rd., Cleveland, Ohio, 44116, Tel: 216-333-3898; Pres: G.J. Prusha; V.P: D. Richards

Local Sales Offices & Reps.
Cal Los Angeles, SABER Entprs., Inc. 213-534-2876
Cal San Diego, SABER Entprs., Inc. 714-272-5743
Mich Detroit, WKM Assoc., Inc. 313-892-2500
NY Northport, Lindgren Assoc., Inc. 516-261-7937
Ohio Cleveland, WKM, Assoc., Inc. 216-267-0445
Ohio Dayton, WKM, Assoc., Inc. 513-434-7500
Pa Pittsburgh, WKM, Assoc., Inc. 412-892-2953

BAY PRODS., Div. American Metal Works, Somerset & Gurney Sts., Phila., Pa., 19134, Tel: 215-426-6050; Mktg. Dir: H.S. Gardner; V.P.-Sls: G. Somes; Ass't. Sls. Mgr: T. Ford

BEAD ELCTRNS., Div. Bead Chain Mfg. Co., 110 Mountain Grove St., Bridgeport, Conn., 06605, Tel: 203-334-4124; Mgr. Off. Sls: B.M. Krafcik

Local Sales Offices & Reps.
Cal Los Angeles, Yarbrough Sls. Co. 213-254-5101
Conn Vernon, Manu-Rep
Fla Volcrening/Southeast, Voickening/Southeast 305-584-9390
Ill Chicago, Gene F. Sls. Co. 312-545-5562
Ind Indianapolis, Hoster & Sieloff Assocs., Inc. 317-547-5230
Mass Needham, Mr. A. G. Anderson 617-449-1418
Mich Orchard Lake, Fox Industries, Inc. 313-363-3105
Minn St. Paul, Ed Melius & Assocs., Inc. 612-854-4270
Mo Kirkwood, Mr. Tim W. Miller 314-821-5500
NJ Cherry Hill, Dyneers, Inc. 609-667-4484
NJ Princeton, Krone & Rubin Assocs., Inc. 609-924-0200
NJ Union City, The Alton Co., Inc. 201-865-4080
NY Webster, Krone & Rubin Assocs., Inc. 716-671-6709
Va Williamsburg, Dyneers, Inc. 703-229-3612
Wash Seattle, F.W. Aurich & Co. 206-284-5561

BEARING INSPECTION, 10041 Shoemaker Ave., Santa Fe Springs, Cal., 90670, Tel: 213-944-6251; V.P. D.L. Hutton

BECKMAN INSTRS., (AISSD), 2500 Harbor Blvd., Fullerton, Cal., 92634, Tel: 714-871-4848, TWX: 910-592-1260; Sls. Mgr: H. Peper

BECKMAN INSTRS., Cedar Grove Opers., 89 Commerce Rd., Cedar Grove, N.J., 07009, Tel: 201-239-6200, TWX: 710-994-5781; Adv. Mgr: N. Uptegrove

Local Sales Offices & Reps.
Cal Fullerton, Kendall Co. 714-870-4110
Cal Palo Alto, Kendall Co. 415-322-6338
Colo Denver, Williams-Assocs. 303-388-4391
Fla Miami, Brinkley-Pallatz 305-238-0864
Ill Chicago, Megatek, Inc. 312-889-1277
Kans Mission, Mid-America Elctrns. 913-432-8678
Md Silver Spring, Gawler-Knoop 301-589-4406
Mass Newtonville, H. Schuft 617-527-5304
NJ Roseland, Gawler-Knoop 201-226-4545
NY Cortland, RJC Assocs. 607-753-3909
Ore Portland, R. Legg 503-292-8824
Pa Doylestown, Gawler-Knoope 215-348-4646
Pa Pittsburgh, K. J. Lesker 412-892-2996
Tex Dallas, Crockett Engrg. Co. 214-637-6120

BECKMAN INSTRS., Ectrn. Instrs. Div. Ectrn. Instrumentation, 3900 N. River Rd., Schiller Park, Ill., 60176, Tel: 312-671-3300, TWX: 910-253-1820; Prod. Line Mgr: D. Levingston

BECKMAN INSTRS., Helipot Div., 2500 Harbor Blvd., Fullerton, Cal., 92634, Tel: 714-871-4848, TWX: 910-592-1260; Adv. Mgr: H.D. Frazier
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Local Sales Offices & Reps.
Ala Huntsville, Murphy & Cota 205-539-8476
Ariz Scottsdale, Barnhill Five 602-947-7841
Cal El Monte, G.S. Marshall 213-686-0141
Cal Palo Alto, Beckman Instrs. 415-326-1970
Cal San Diego, G.S. Marshall 714-278-6350
Cal Sunnyvale, G.S. Marshall 408-732-1100
Colo Denver, Barnhill Five 303-934-5505
Conn Hamden, Compar New Eng. 203-288-9276
Fla St. Petersburg, Lynch-Gentry Assocs. 813-347-5131
Fla Winter Park, Lynch-Gentry Assocs. 305-671-7649
Ga Atlanta, Murphy & Cota 404-875-2525
Ill Mt. Prospect, Magnuson 312-956-0700
Md Beltsville, Angus 301-792-4743
Md Silver Spring, Beckman 301-622-2500
Mass Newton Highlands, Compar New Eng. 617-969-7140
Mass Newton Highlands, Helipot 617-969-7357
Mich Farmington, Sheridan Assocs. 313-477-3800
Minn St. Paul, Magnuson 612-227-8495
NJ Clifton, Beckman 201-778-8888
NJ Moorestown, Angus 609-235-1900
NJ Moorestown, Helipot 609-235-3314
NJ Rutherford, Kierulff/Schley 201 935-2120
NM Albuquerque, Barnhill Five 505-299-7658
NY Kingston, Ossmann Comp. 914-338-5505
NY Rochester, Ossmann 716-442-3290
NY Syracuse, Ossmann 315-454-4477
NY Vestal, Ossmann 607-785-9949
NC Winston-Salem, Murphy & Cota 919-723-1001
Ohio Cincinnati, Sheridan Assocs. 513-761-5432
Ohio Cleveland, Sheridan Assocs. 216-524-8120
Ohio Dayton, Sheridan Assocs., Inc. 513-277-8911
Ohio Florissant, Sheridan 314-837-5200
Ore Portland, Almac/Stroum 503-292-3534
Pa Monroeville, Sheridan 412-373-1070
Tex Dallas, Norvell 214-350-6771
Tex Houston, Norvell 713-774-2568
Wash Seattle, Almac/Stroum 206-763-2300
For: Can., Toronto, Ont., Beckman 416-251-5251

BECKMAN Local Distributors
Ala Huntsville, M & C Sales, Inc., 904 Bob Wallace Ave. 205-539-8476
Ariz Scottsdale, Barnhill Five, Inc., 7329 E. Stetson Dr. 602-947-7841
Cal El Monte, Marshall Co., G.S., 9674 Telstar Ave 213-686-0141
Cal San Diego, Marshall Co., G.S., 7990 Engineer Rd 714-278-6350
Cal Sunnyvale, Marshall Co., G.S., 732 N. Pastoria Ave 408-732-1100
Colo Denver, Barnhill Five, Inc., 1107 S. Sheridan Blvd. 303-934-5505
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Conn Hamden, Compar New England, 2531 Whitney Ave. 203-288-9276
Fla St. Petersburg, Lynch-Gentry Assocs., 6731 First Ave. 813-347-5131
Fla Winter Park, Lynch-Gentry Assocs., 3470 Bowman Dr. 303-671-7649
Ga Atlanta, M & C Sales, Inc., 500 Plasamour Dr. NE 404-875-2525
Ill Mt. Prospect, Magnuson Elctrns., 2420 Oakden St. 312-956-0700
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Newton Highlands, Compar New England, 88 Needham St. 617-696-7140
Minn St. Paul, Magnuson Elctrns, 1246 W. 7th St. 612-227-8495
Mo Florissant, Sheridan Sales Co., 110 South Hwy 140 314-837-5200
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Rutherford, Kierulff-N.J., 5 Industrial Dr. 201-935-2120
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NM Albuquerque, Barnhill Five Inc., 1410-D Wyoming, N.E. 505-299-7658
NY Buffalo, Ossmann Comp. Sls., 395 Cleveland Dr. 716-832-4271
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Hicksville, Kierulff - Hicksville, 49 Bethpage Rd. 516-433-5530
NY Kingston, Ossmann Comp. Sls., 411 Washington Ave. 914-338-5505
NY Rochester, Ossmann Comp. Sls., 280 Metro Park 716-442-3290
NY Syracuse, Ossmann Comp. Sls., 132 Pickard Bldg. 315-454-4477
NY Vestal, Ossmann Comp. Sls., 1911 Vestal Pkwy E. 607-785-9949
NC Winston-Salem, M & C Sales, Inc., 1106 Burke St. 919-723-1001
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Okla Tulsa, Norvell Elctrns. Inc., 3340 So. Memorial Dr. 918-663-1247
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Tex Dallas, Norvell Elctrns. Inc., 10210 Monroe 214-350-6771
Tex Houston, Norvell Elctrns. Inc., 5440 Hillcroft 713-774-2568
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300

BECO, INC., 740 Kesler Mill Rd., Salem, Va., 24153, Tel: 703-389-3053; Sls. Mgr: A.T. Ball

BEECHWOOD MFG., 360 S. Downey Ave., Indpls., Ind., 46219, Tel: 317-356-2493; G.M: R.E. Cox

BEEDE ELECTRICAL INSTR. CO., INC., S. Main St., Penacook, N.H., 03301, Tel: 603-753-6362, TWX: 710-364-6977; Mkt. Mgr: L.H. Issel ..... Vol 1•394,395

Local Sales Offices & Reps.
Ala Huntsville, Components Sls. 205-883-7794
Ariz Phoenix, M. Richardson Assoc. Inc. 602-278-6296
Cal LA, Universal Comp. 213-474-1537
Cal San Carlos, Elctrn. Engrg. 415-593-2189
Colo Denver, Electronic Sls. Inc. 303-771-6300
Conn Farmington, R. Perron 203-673-4825
Conn Trumbull, R. Perron 203-268-9631
Fla Indialantic, Comps. Sls. Corp. 305-727-2681
Fla Terra Ceia, Components Sls. Corp. 813-722-6376
Ill Skokie, Saffro & Assoc. 312-588-0905
Iowa Marion, Thomas & Modrcin 319-377-6261
Kans Shawnee Mission, Thomas & Modrcin Assoc., Inc. 913-HE-2-2131
Mass Norwood, R. Perron 617-762-8114
Mich Detroit, Burcaw 313-533-7700
Minn Mpls, Wenco Sls. 612-866-3639
Mo Hazelwood, Thomas & Modrcin 314-838-6446
NH Dover, R. Perron & Co., Inc. 603-742-2321
NJ Ridgewood, Ballou Inc. 201-444-6990
NY Buffalo, Ossmann Comp. Sls. Corp. 716-832-4271
NY Kingston, Ossmann Component Sls. 914-338-5505
NY Rochester, Osmann Comp. 716-442-3290
NY Syracuse, Ossmann Comp. 315-454-4477
NY Vestal, Ossman Comp. 607-785-9949
NC Raleigh, Comp. 919-832-1897
Ohio Cleveland, D. Steffen & Assoc. 216-461-8333
Ohio Dayton, D. Steffen & Assoc. 513-293-3146
Pa Devon, B & A Assoc. 215-688-5173
Tex Dallas, Southwest Elctrn. Inds. 214-233-9816
Tex Houston, Southwest Elctrn. Inds. 713-621-3760
Wash Mercer Island, J.H. Andersen, Assoc. 206-232-0484
Exp: Brampton, Ont., Can., Mod Tronic Instrus. Ltd. 416-457-6322

BEHLMAN DIV., CALIFORNIA INSTRS., Div. Aiken Ind., 5150 Convoy St., San Diego, Cal, 92111, Tel: 714-279-8620; Product Appl. Eng: W.W. Hanford

Local Sales Offices & Reps.
Ala Huntsville, Currie Aerospace 205-536-5650
Ariz Scottsdale, Williams Assocs. Inc. 602-947-4297
Cal Cupertino, T. L. Snitzer Co. 408-257-8333
Cal Los Angeles, T. L. Snitzer Co. 213-836-6170
Colo Denver, Williams Assocs. Inc. 303-343-2911
Fla Orlando, Currie Aerospace 305-855-0843
Haw Honolulu, Aloha Assocs. 808-941-1574
Ill Chicago, Megatek, Inc. 312-889-1277
Iowa Cedar Rapids, Palatine Engrg. Sls. Co. 319-365-8071
Kans Andover, Palatine Engrg. Sls. Co. 316-683-7512
Kans Overland Pk., Palatine Engrg. Sls. Co. 913-262-5643
La Baton Rouge, SESCO 504-927-7574
Mass Needham, Addelco Corp. 617-444-4754
Mich Detroit, Hocker Assocs. 313-531-1403
Minn Minneapolis, Megatek, Inc. 612-925-4242
Mo St. Louis, Palatine Engrg. Sls. 314-426-7055
NJ Fairfield, KLS Assocs. 201-227-2900
NJ Hazlet, Mer Mon (2M) Elctrn. Instru. 201-264-1851
NM Albuquerque, Williams Assocs. Inc. 505-255-1638

NY Depew, Labtronics, Inc. 716-685-4111
NY Endicott, Labtronics, Inc. 607-748-0509
NY Syracuse, Labtronics 315-454-9314
NY Ulster Pk., Labtronics, Inc. 914-883-6279
NC Greensboro, Currie Aerospace Assocs. 919-273-3040
Ohio Cleveland, Hocker Assocs. 216-734-4433
Ohio Dayton, Hocker Assocs. 513-298-8638
Pa Mt. Penn, Mer-Mon (2M) Elctrn. Instr. 215-779-1640
Tex Houston, Sesco 713-668-7840
Tex Richardson, Sesco 214-231-9364
Va Annandale, Nine Assocs. 703-256-9105
Wash Seattle, Datacom Assocs. 206-329-2989

BEHLMAN ENGRG. CORP., Box 4518, 427 N. Nopal St., Santa Barbara, Cal., 93103, Tel: 805-963-9019; Sls. Mgr: J. Behlman ..... Vol 1•616,617

Local Sales Offices & Reps.
Ariz Phoenix, R. L. Davis Co. 602-955-2266
Cal Glendale, Instrument Specialists Inc. 213-245-9404
Fla Melbourne, Reynolds & Assocs., Inc. 305-727-3205
Ga Atlanta, Reynolds & Assocs., Inc. 404-252-5360
Md Rockville, Farrell Assocs. 301-424-9460
NJ Hackensack, SJS Assocs. 201-488-2444
Pa King of Prussia, Letronix 215-265-1020
For: Canada, West Hill, Ont., Electromechanical Prods. 416-282-3870

BEL FUSE, INC., 203 Van Vorst St., Jersey City, N.J., 07302, Tel: 201-432-0463, TWX: 710-730-5301; Sls. Mgr: A.L. Sutta; V.P: H. Bernstein; Engr: R. King Vol 3•986-991

Local Sales Offices & Reps.
Cal Burlingame, Leddy 415-347-5247
Cal Escondido, Andrew Elctrn. Sls. 714-743-3015
Cal Los Angeles, Universal Comp. Co. 213-641-4255
Colo Littleton, Alden Sls. 303-794-1531
Colo Littleton, Leddy Assoc. 303-795-1973
Conn Norwalk, Eastern Tech. Sls. 203-853-8350
Fla Clearwater, Southeastern Compt. Sls. 813-531-8324
Ill Chicago, Memac Sls. 312-545-1033
Mass Newton, QRC Co. 617-332-9600
Minn Hopkins, Beta Engrg. 612-925-4422
NY Hempstead, Kahgan Sls. 516-538-2300
NY Pompey, S. Foster 315-677-3333
Pa Bala Cynwyd, M. Friedman 215-839-3450
Tex Addison, Parvin Sls. Co. 214-239-9148
Utah Salt Lake City, Leddy Assoc. 801-299-4382

BELDEN CORP. ELCTRN. DIV., Box 1100, Richmond, Ind., 47374, Tel: 317-966-6681, TWX: 810-345-1393; Gen. Mgr: J.F. Wohlhueter; Sls. Svc. Mgr: G.T. Novak

BELDEN Local Distributors
Ala Birmingham, J.W. Clary Co., 1713 Second Ave. S. 205-322-2488
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal Goleta, Radio Prods. Sls., 350 S. Kellogg Ave 805-964-6823
Cal Los Angeles, Radio Prods. Sls., 1501 S. Hill St. 213-748-1271
Cal Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave. 415-961-1500
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd. 714-292-5611
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Colo Denver, Burstein-Applebee 303-244-3336
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Kansas City, Burstein-Applebee 816-561-5460
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
La Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094 318-423-6131
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd 314-428-8522
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NY Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave. 212-492-9590
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY Buffalo, Radio Equip. Corp., 196 Vulcan St 716-874-2690
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Elmsford, Melville Radio, 1 Nepperham Ave. 914-592-7100
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Farr Elctrns, 5403 Prospect Ave. 216-881-7403
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Chattanooga, Curie Elctrns., 1813-S. Market
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Tex Houston, Lenert Co., Box 2184 713-225-1465
Tex Lubbock, R & R Elctrn Supply Co, 1607 Ave. G, Box 1860 806-765-7727
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

BELL CO., INC., 106 Morrow Ave., Trussville, Ala., 35173, Tel: 205-655-2135; V.P: N.H. Bell; V.P: H.C. Bell; Pres: R.C. Bell

BELL & HOWELL, 706 Bostwick Ave., Bridgeport, Conn., 06605, Tel: 203-368-6751, TWX: (710) 453-2997; Prod. Sls. Mgr: I. Isdale; Prod. Sls. Mgr: T. Tomasko

BELL & HOWELL CO., Elctrns. & Instr. Grp., 360 Sierra Madre Villa, Pasadena, Calif., 91109, Tel: 213-796-9381, TWX: 213-577-0067

BELL INDUSTRIES, ELECTRONIC COMPONENTS DIV., 150 W. Cypress Ave., Burbank, Cal., 91502, Tel: 213-846-9302, TWX: 910-498-2207; Sls. Mgr: J. Cammiso

BELL INDUSTRIES, J.W. Miller Div., 19070 Reyes Ave., Compton, Cal., 90221, Tel: 213-537-5200, TWX: 910-346-6740; Sls Mgr: G.E. Hall; Indul Sls Mgr: J. Johnson; Distr. Sls. Mgr: A. Bufford .... Vol 3•528-532

Local Sales Offices & Reps.
Ariz Phoenix, H.A. Moore 602-274-0060
Ark El Dorado, D. Bellew 501-863-8325
Cal Gardena, Bidwell Sls. 213-770-0300
Cal Redwood City, Logan 415-369-6726
Colo Denver, R. Bowen 303-722-4641
Fla Maitland, Hutto-Hawkins-Peregoy 305-831-2474
Fla Pompano Bch., Hutto-Hawkins-Peregoy 305-943-9593
Ga Atlanta, Millar Elctrns. 404-261-6160
Ill Chicago, Markal 312-282-5800
Ind Indianapolis, J. Merritt 317-291-9674
Iowa Cedar Rapids, Palatine Sls. Inc. 319-365-8071
Kans Andover, Palatine Sls., Inc. 316-683-7512
Kans Overland Park, Palatine Sls. Inc. 913-262-5643
La Kenner, D. Bellew 504-729-4550
Md Baltimore, Par-Nell Sls. 301-655-2944
Mass N. Scituate, W. Hendrickson 617-545-0652
Mich Detroit, Markal Sls. Corp. 313-341-1000
Minn Minneapolis, C.R. Gibb 612-377-1200
Mo St. Louis, Palatine Sls. Inc. 314-426-7055
NJ Englewood, J.J. Bressler 201-569-7600
NM Albuquerque, C. Carlberg 505-265-1579
NC Raleigh, Millar Elctrns., Inc. 919-787-9564
Ohio St. Marys, T. Shelby 419-394-3377
Ore Portland, Earl & Brown 503-292-9145
Pa Holland, Par-Nell Sls. Co. 215-355-9330
Tex Addison, Campion Sls. 214-239-9196
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Ga Atlanta, Hollingsworth & Still Inc. 404-394-3270
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La New Orleans, The Texport Co. 504-486-6073
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Tex Dallas, The Texport Co. 214-358-3435
Tex Houston, The Texport Co. 713-464-2828
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Exp: New York, N.Y., Genex Corp. 212-524-2557

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Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Va Roanoke, Peoples Radio & Tv Supply Co., 1015 Moorman Rd

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Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
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Colo Denver, Hytronic Meas. 303-388-4081
Conn Hamden, Scientific Devices 203-248-9361
Fla Orlando, J. Highsmith 305-293-5202
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Ind Indpls., K.W. Meyers 317-243-6681
Kans Prairie Vlg., Engrg. Svcs. 913-649-4000

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Mo St. Louis, Engrg. Svcs. 314-726-2233
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NY Rochester, Scientific Devices 716-334-2445
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Ohio Dayton, Scientific Devices 513-298-9904
Pa Melrose Pk., Meyers 215-224-1663
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Va Richmond, J.L. Highsmith 703-272-5888
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Ind Indianapolis, K. Meyers 317-243-6681
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Cal Sun Valley, Weightman & Assocs. 213-768-5750
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NJ Stirling, NBS Assocs. 201-647-0330
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Fla Pompano Beach, Dyne-A-Mark 305-942-5850
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Fla	Winter Park, Brand-Rex	305-671-5500
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Mich	Grand Rapids, Elko Sales Corp.	616-949-1451
Mich	Grosse Pointe Woods, Elko Sales Corp.	313-884-7893
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	Kansas City, KSW Assocs.	816-363-5651
Mo	St. Louis, KSW Assocs.	314-781-6111
NJ	Peninsauken, J.A. Maguire & Co.	609-665-5136
NJ	Plainfield, J.A. Maguire & Co.	201-754-6400
NY	Camillus, Brand-Rex	315-474-8281
NY	Island Park, Brand-Rex	212-661-0944
NY	Rhinebeck, Brand-Rex	914-297-6296
Ohio	Aurora, Clark Sls. Co.	216-543-5656

BRANSON CORP., Box W, Denville, N.J., 07834, Tel: 201-625-0600, TWX: 710-987-8466; Sls: J.A. Witzler

Local Sales Offices & Reps.

Fla	Orlando, Perrott Assoc. Inc.	305-275-1132
Ohio	Columbus, T. Mulligan & Assoc.	614-457-2242

BRANSON INSTRUMENTS CO., 76 Progress Dr., Stamford, Conn., 06904, Tel: 203-324-6721, TWX: 710-474-0893; Sls. Mgr: G.P. Shaw

BRELONIX, INC., 106 North 36th St., Seattle, Wash, 98103, Tel: 206-ME-3-1964; V.P: T.A. Rommel

BREW RICHARD D. & CO., INC., 90 Airport Rd., Concord, N.H., 03301, Tel: 603-225-6605; Sls. Mgr: D.E. Hemingway

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Cal	Menlo Park, Long & Assocs., Inc.	415-327-1300
Cal	Newport Beach, Fieldtec Inc.	213-860-4000
Wash	Seattle, Eustis Co.	206-623-7060

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BRISTOL SAYBROOK CO., Div. Pratt Read, Coulter St., Old Saybrook, Conn., 06475, Tel: 203-388-3414; Sls. Eng: C. Gill

BROOKS INSTR. DIV., Emerson Elec. Co., Hatfield, Pa., 19440, Tel: 215-368-2000; Sls. Mgr: R. Edsall

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Ariz	Scottsdale, Brooks Instr. Div. Emerson Elec. Co.	602-947-8073
Cal	Stanton, Brooks Instr. Div. Emerson Elec. Co.	213-860-4460
Del	Wilmington, Brooks Instr. Div. Emerson Elec. Co.	215-724-7373
Ill	Westchester, Brooks Instr. Div. Emerson Elec. Co.	312-345-2740
NJ	Teaneck, Brooks Instr. Div. Emerson Elec. Co.	212-753-4628
Ohio	Cleveland, Brooks Instr. Div. Emerson Elec. Co.	216-884-7036
Pa	Hatfield, Brooks Instr. Div. Emerson Elec. Co.	
Tex	Houston, Brooks Instr. Div. Emerson Elec. Co.	713-526-8366

BROWN ELECTRO-MEAS. CORP., 11060 118th Pl., Kirkland, Wash., 98033, Tel: 206-822-6092; S/M: W. Pennington ..... Vol 1•398

BUCHANAN ELEC. PRODS., Sub. Amerace Esna, 1065 Floral Ave., Union, N.J., 07083, Tel: 201-289-8200; V.P. Mktg: E. Kane ..... Vol 3•558

Local Sales Offices & Reps. (Terminal Blocks)

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Ariz	Scottsdale, N.F. Ross	602-945-7262
Cal	Concord, P.W. Jasin Co.	415-686-0905
Cal	La Mirada, H. Van Ysseldyk	213-921-7953
Colo	Denver, Paul A. Douden	303-744-1497
Conn	Prospect, P. Yoder	203-758-4221
Fla	Coral Springs, O.C. Puckett Co.	305-974-3722
Fla	Jacksonville, O.C. Puckett Co.	904-733-0505
Fla	Orlando, O.C. Puckett Co.	305-422-7197
Fla	Temple Terrace, O.C. Puckett Co.	813-988-7077
Haw	Honolulu, D. Schwab	808-537-1658
Ill	Glen Ellyn, Andersen Elec. Sls.	312-469-7805
Ill	Wheaton, Andersen Elec. Sls.	312-688-5056
Ind	Indianapolis, Ralph A. Wendel	317-846-5833
Iowa	Cedar Rapids, Bertsch Elec. Sls. Co.	319-366-7719
Ky	Jeffersontown, A. Pickens Co.	502-267-8213
Ky	Louisville, Fultz & Co.	502-897-9605
La	Metairie, Strickland	504-833-2543
Md	Pikesville, A.D. Wilson Assoc.	301-SA-7-1424
Mass	Dedham, R. Carll	617-326-8686
Mich	Flint, Linder Assoc.	313-789-1275
Mich	Lansing, Linder	517-489-0292
Mich	Southfield, Linder	313-353-4334
Minn	Mpls., Lee-Noonan Co.	612-920-7851
Miss	Jackson, Strickland	601-366-6195
Mo	Kirkwood, Martin Elec.	314-966-8659
Mo	Raytown, Arehart-Barnds Sls.	816-356-3488
Neb	Lincoln, E. Taber & Sons	402-423-4420
NJ	Berkeley Hgts.	201-464-0334
NM	Albuquerque, T. Deskin	505-242-3581
NY	Buffalo, A.C. Schultz Co.	716-839-1010
NY	Manhasset, G. Gavalakis	516-869-8113
NC	Matthews, C.C. Niedringhaus	704-847-9288
Ohio	Cincinnati, Goldschmidt Electric Sales	513-641-1708
Ohio	Cleveland, V. O'Neill	216-331-4273
Okla	Moore, J. Morton & Assocs.	405-794-2157
Ore	Portland, M. Gerrard	503-224-0864
Pa	Oreland, W. Cusick Elec. Sls.	215-TU-6-2100
Pa	Pittsburgh, M.F. Smith & Assocs.	412-276-5363
Tenn	Memphis, H. Beard	901-274-1744
Tex	Dallas, J.E. Morton	214-341-1414
Tex	Houston, McIver & Slavin Co.	713-861-3888
Utah	Salt Lake City, B.E. Blomquist	801-359-7074
Wash	Seattle, Tal Agencies, Inc.	206-624-3355
Wisc	Milwaukee, Andersen Elec. Sls.	414-332-2948

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Cal	Los Angeles, W. Green	213-268-1824
NJ	Union, Larry Bourdeau	201-289-8200

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Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541

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Cal	Los Angeles, Buckbee Mears Co. Sls. Office	213-889-9962
Cal	San Jose, Buckbee Mears Co. Sls. Office	408-248-2750
Colo	Lakewood, Buckbee Mears Co. Sls. Office	303-534-7858
Ill	Elk Grove Village, Buckbee Mears Co. Sls. Office	312-439-6433
Ind	Indianapolis, Buckbee Mears Co. Sls. Office	317-255-5501
NH	Nashua, Buckbee Mears Co. Sls. Office	603-883-0316
NJ	East Windsor, Buckbee Mears Co. Sls. Office	609-443-3340
NY	Manlius, Buckbee Mears Co. Sls. Office	315-469-7394
Ohio	Sylvania, Buckbee Mears Co. Sls. Office	419-882-6918
Pa	Huntington Valley, Buckbee Mears Co. Sls. Office	215-525-3000
Tex	Richardson, Buckbee Mears Co. Sls. Office	214-231-7401

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Cal	Pasadena, P. Nurches Co.	213-MU-1-8957
Colo	Greeley, G. Moss Elctrns., Inc.	303-353-1452
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ill	Chicago, W.J. Doyle Co.	312-BR-4-6685
Mass	Belmont, Elctrn. Comps. & Svc.	617-484-8680
Mich	Lathrup Village, R.C. Nordstrom Co.	313-444-4417
Minn	Minneapolis, A.J. Warner Co.	612-729-7371
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NY	New York, P. Saftler Assoc.	212-CI-7-3855
Ohio	Columbus, Elctrns. Mktg.	614-299-4161
Pa	Paoli, T. Griffin Co.	215-647-1550
Tex	Houston, Southland Engrg. & Sls.	713-782-4575
Tex	Houston, Southland Engrg. & Sls.	713-782-4575
Wash	Seattle, Underwood & Underwood	206-243-2133

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Local Sales Offices & Reps.

Ariz	Tempe, Jack Berman Co., Inc.	602-966-5440
Cal	Inglewood, Jack Berman Co., Inc.	213-678-1281
Cal	San Carlos, David H. Ross Co.	415-591-4411
Colo	Denver, Lindberg Co.	303-758-9033
Fla	Orlando, Cartwright & Bean Co.	
Ga	Atlanta, Cartwright & Bean Co.	404-237-2273
Ill	Chicago, GNB Assocs., Inc.	312-673-4050
Ind	Angola, Southern Sls. Co.	219-665-3691
Ind	Indianapolis, Southern Sls. Co.	317-257-7575
Iowa	Cedar Rapids, Palatine Engrg. Sls. Inc.	319-465-8071
Kans	Andover, Palatine Engrg. Sls. Inc.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls. Inc.	913-262-5643
Ky	Louisville, Southern Sls. Co.	502-582-6902
La	Chalmette, Cartwright & Bean Co.	504-279-4598
Mass	Needham, Mullin Technical Sls. Co., Inc.	617-444-4700

Mich St. Clair Shores, Jack M. Thorpe Co. 313-779-6363
Minn Minneapolis, The Clark R. Gibb Co. 612-377-1200
Mo St. Louis, Palatine Engrg. Sls. Inc. 314-426-7055
NJ Cherry Hill, Trinkle Sales, Inc. 609-667-3500
NM Albuquerque, Lindberg Co. 505-345-2489
NY Rochester, Marsey Sls., Inc. 716-442-9700
NY Rockville Centre, Willgold Elctrn. Sls. Corp. 516-764-4022
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NC Raleigh, Cartwright & Bean Co. 919-832-7128
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Tenn Memphis, Cartwright & Bean Co. 901-276-4442
Tex Dallas, Lund & Co. 214-358-4335
Utah Salt Lake City, Lindberg Co. 801-364-6409
Wash Seattle, Earl & Brown Co., Inc. 206-284-1121

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Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
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Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
Mo Kansas City, Burstein Applebee 816-561-5460
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Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
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NY Buffalo, Radio Equip. Corp., 196 Vulcan St 716-874-2690
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
NY White Plains, Westchester Elctrns., 602 Mamaroneck Ave. 914-949-2400
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
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Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
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Cal Menlo Park, Straube 415-323-2476
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Colo Boulder, Straube Assocs-Mountain States, Inc. 303-443-8600
Conn Suffield, T. P. Dunn Co. 203-688-0446
Fla Orlando, Perrott Assocs. 305-275-1132
Ill Chicago, Techrep 312-761-0548
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Kans Prairie Village, Engineering Svcs. 913-649-4000
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Minn Mpls., Torkelson Associates, Inc. 612-920-1046
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NY New York, E. Glass Assoc. 212-586-8440
NY Rochester, H.C. Johnson Agencies, Inc. 716-482-3000
Ohio Akron, Augnat Assoc. 216-725-6087
Pa Philadelphia, Eastern Comps., Inc. 215-927-6262
Tex Dallas, United Comps. 214-324-1448
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Cal Palo Alto, WESCO Elctns.-Palo Alto, 3973 E. Bayshore Rd. 415-968-3475
Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112
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Cal San Diego, Electronic Mktg. Specialists 714-273-3773
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Fla Orlando, BCS Assocs. 305-896-4881
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Md Silver Spring, QED Elctrns. Inc. 301-588-8134
Mass Wakefield, Measurement Equip. Co. 617-245-4870
Mich Farmington, Sheridan Assocs. Inc. 313-477-3800
Minn Minneapolis, ECR Inc. 612-927-4547
Mo Florissant, Sheridan Assocs. Inc. 314-837-5200
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NY Clinton, Advanced Comps. Corp. 315-853-6438
NY Endicott, Advanced Comps. Corp. 607-785-3191
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Okla Tulsa, Norvell Assocs. Inc. 918-663-1247
Pa Monroeville, Sheridan Assocs. Inc. 412-373-1070
Tex Dallas, Norvell Assocs. Inc. 214-350-6771
Tex Houston, Norvell Assocs. Inc. 713-774-2568
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Minn	Hopkins, Beta Engrg.	612-928-2551
Mo	St. Louis, Engrg. Svc.	314-726-2233
NY	Huntington Station, K/R Marketing	516-549-4301
Ohio	Cleveland, Del Steffen	216-486-7078
Pa	Glenside, Elcom Inc.	215-885-1325
Tex	Dallas, Hillman Entprs.	214-521-9907
Exp:	Cal., Santa Monica, Trans World Trade	213-472-0444
Exp:	N.Y., N.Y., Multiparts	212-WH-4-4370

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Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg.	602-955-3193
Cal	Santa Monica, Cal-R	213-451-9761
Colo	Boulder, Mile High Elctrns.	303-444-5615
Ill	Northbrook, Raines-Brin Assoc.	312-498-0890
Ind	Greenwood, Valentine Schillinger	317-881-3547
Kans	Prairie Vlg., Engrg. Svc.	913-649-4000
Mass	Winchester, Blake Assocs.	617-729-7890
Minn	Hopkins, Beta Engrg.	612-928-2551
Mo	St. Louis, Engrg. Svc.	314-726-2233
NY	Huntington Station, K/R Marketing	516-549-4301
Ohio	Cleveland, Del Steffen	216-486-7078
Pa	Glenside, Elcom	215-885-1325
Tex	Dallas, United Comps.	214-321-1222
Exp:	L.A., Trans World Trade	213-472-0444
Exp:	N.Y., N.Y., Multiparts	212-WH4-4370

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CAL-R, INC., Thermonetics Div., 1601 Olympic Blvd., Santa Monica, Cal., 90404, Tel: 213-451-9761, TWX: 910-343-6966; V.P.Sls: J.C. Waldal

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Cal	Santa Monica, Cal-R	213-451-9761
Colo	Boulder, Mile High Elctrns.	303-444-5615
Conn	West Haven, Elctrn. Mktg. Reps Inc.	203-934-0261
Fla	No. Miami, L. Haas Co. Inc.	305-949-9143
Ill	Northbrook, Raines-Brin Assoc.	312-498-0890
Ind	Greenwood, Valentine Schillinger	317-881-3547
Md	Baltimore, Wafer Assocs.	301-744-1133
Minn	Hopkins, Beta Engrg.	612-928-2551
NY	Huntington Station, K/R Marketing	516-549-4301
Ohio	Cleveland, Del Steffen	216-486-7078
Pa	Glenside, Elcom	215-885-1325
Wash	Bellevue, Ruggles Tech. Sls.	206-455-2778
Exp:	Cal., L.A., Trans World Trade	213-472-0444
Exp:	N.Y., N.Y., Multiparts	212-WH4-4370

CAL-TEX SEMICONDUCTOR, 3090 Alfred St., Santa Clara, Cal., 95050, Tel: 408-247-7660, TWX: 357424; Dir. Mktg: C.M. Christoff

CALABRO UNITRACK, Div. Calabro Plastics, Inc., 8738 W. Chester Pike, Upper Darby, Pa., 19082, Tel: 215-789-3820; Sls. Mgr: A.D. Calabro

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Cal	Mountain View, Gado Instr. Sls.	415-961-2222
Cal	Torrance, Saber Entrps.	213-534-2876
Conn	Middletown, Mancib	203-347-5629
Mass	Burlington, Mancib	617-272-9450
Minn	Wayzata, Wm. A. Sternad	612-473-4700
NY	Utica, B. Hummel Co.	315-736-7821
Ohio	Cleveland, Teplitz	216-371-2044
Ohio	Dayton, H. Teplitz & Co.	513-277-6531
Wash	Bellevue, Topp Engr. Sls. Co.	206-747-5401

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Cal	San Diego, Mesa Elctrns.	714-278-8021
Cal	Santa Clara, Rodgers Assocs.	408-984-8110
Colo	Denver, Williams-Assocs., Inc.	303-343-2911
Fla	Orlando, Currie Aerospace Assocs., Inc.	305-855-0843
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Megatek, Inc.	312-889-1277
La	Baton Rouge, Systems Engrg. Sls. Co., Inc.	504-927-7574
Mass	Needham, Addelco Corp.	617-444-1931
Mich	Detroit, Hocker Assocs.	313-531-1403
Minn	Minneapolis, Megatek, Inc.	612-925-4242
Mo	St. Louis, Arentsen Elctrns.	314-434-3605
NJ	Fairfield, KLS Assocs., Inc.	201-227-2900
NJ	Hazlet, Mer Mon Elctrn. Instr.	201-264-1851
NM	Albuquerque, Williams-Assocs., Inc.	505-255-1638
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	914-471-2808
NC	Greensboro, Currie Aerospace, Inc.	919-273-3040
Ohio	Cleveland, Hocker Assocs., Inc.	216-734-4433
Ohio	Dayton, Hocker Assocs., Inc.	513-298-8638
Pa	Mt. Penn, Mer Mon Elctrn. Instr.	215-779-1640
Tex	Houston, Systems Engrg. Sls. Co., Inc.	713-668-7840
Tex	Richardson, Systems Engrg. Sls. Co., Inc.	214-231-9364
Va	Annandale, Nine Assocs., Inc.	703-256-9105
Wash	Seattle, Datacom Assocs.	206-285-2525

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Cal	Sunnyvale, California Computer Prods., Inc. (CalComp)	408-732-8421
Colo	Denver, California Computer Prods., Inc. (CalComp)	303-433-7136
Conn	Rocky Hill, California Computer Prods., Inc. (CalComp)	203-563-1481
Fla	Orlando, California Computer Prods., Inc. (CalComp)	305-851-1580
Ga	Atlanta, California Computer Prods., Inc. (CalComp)	404-458-0168
Ill	Rosemont, California Computer Prods., Inc. (CalComp)	312-696-0620, 825-2125
Kans	Shawnee Mission, California Computer Prods., Inc. (CalComp)	913-362-0707
Md	Rockville, California Computer Prods., Inc. (CalComp)	301-948-6870, 948-1580
Mass	Waltham, California Computer Prods., Inc. (CalComp)	617-890-6626, 890-0484
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Minn	Minneapolis, California Computer Prods., Inc. (CalComp)	612-835-5644
Mo	St. Louis, California Computer Prods., Inc. (CalComp)	314-567-5215
NJ	Union, California Computer Prods., Inc. (CalComp)	201-686-7100
NY	Hicksville, California Computer Prods., Inc. (CalComp)	516-938-7255
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Pa	Wayne, California Computer Prods., Inc. (CalComp)	215-687-2910
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Exp:	Anaheim, Cal., California Computer Prods., Inc. (CalComp) International Mktg.	714-821-2686

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Cal	Los Angeles, T. Louis Snitzer Co.	213-836-6170
Colo	Denver, Williams-Assocs., Inc.	303-343-2911
Fla	Orlando, Currie Aerospace Assocs., Inc.	305-855-0843
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, Megatek, Inc.	312-889-1277
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Kans	Andover, Palatine Engrg. Sls. Co.	316-683-7512
Kans	Overland Park, Palatine Engrg. Sls. Co.	913-262-5643
La	Baton Rouge, Systems Engrg. Sls. Co., Inc.	504-927-7574
Mass	Needham, Addelco Corp.	617-444-1931
Mich	Detroit, Hocker Assocs., Inc.	313-531-1403
Minn	Minneapolis, Megatek, Inc.	612-925-4242
Mo	St. Louis, Arentsen Elctrns.	314-434-3605
Mo	St. Louis, Palatine Engrg. Sls. Co.	314-426-7055
NJ	Fairfield, KLS Assocs., Inc.	201-227-2900
NJ	Hazlet, Mer Mon Elctrn. Instr.	201-264-1851
NM	Albuquerque, Williams-Assocs., Inc.	505-255-1638
NY	Binghamton, Labtronics, Inc.	607-748-0509
NY	Depew, Labtronics, Inc.	716-685-4111
NY	Syracuse, Labtronics, Inc.	315-454-9314
NY	Ulster Park, Labtronics, Inc.	914-471-2808
NC	Greensboro, Currie Aerospace Assocs., Inc.	919-273-3040
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Tex	Houston, Systems Engrg. Sls. Co., Inc.	713-668-7840
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Cal	Los Altos, Casey Assocs.	415-941-6892
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Fla	Orlando, Technical Assocs.	305-894-7531
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Mo	Florissant, Inland Assocs.	314-355-1851
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NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Vestal, Ossmann Instrs.	607-785-9947
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Ohio	Dayton, Dietrich & Assocs.	513-233-6042
Pa	King of Prussia, J.E. Cuesta & Co., Inc.	215-242-0150
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Pa	Valley Forge, J.E. Cuesta & Co. Inc.	215-265-5800

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Wash Bellevue, L.B. Robbins 206-455-1246

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Mass Cambridge, Cambridge Thermionic Corp. 617-491-5400
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Utah Salt Lake City, Elcom, Div. of Zeus Inc. 801-486-2317
Wash Seattle, J. J. Backer Co. 206-285-1300

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Tex Dallas, Texaswitch Inc., 2942 Congressman La. 214-357-1768
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Wash Seattle, Bergford 206-936-6664

CHATHAM CONTROLS CORP., 33 River Rd., Chatham, N.J., 07928, Tel: 201-635-8892; Sls. Mgr: D.C. Perst

Local Sales Offices & Reps.
Cal Pasadena, Components Corp. 213-681-7448
NJ Fairlawn, PAR Assocs., Inc. 201-447-3722

CHATILLON JOHN & SONS, 83-30 Kew Gardens Rd., Kew Gardens, N.Y., 11415, Tel: 212-847-5000; V.P. Sls: N. Lavenda; Sls. Engr: R. Eklund

CHEM AERO, INC., 231 E. Lomita Blvd., Wilmington, Cal., 90744, Tel: 213-775-2581, TWX: 910-345-6267; Mktg. Mgr: E. Swanson

CHEMCUT CORP., 500 Science Pk., State College, Pa., 16801, Tel: 814-238-0514; Dist. Mgr. East: L. Moyer; Dist. Mgr. Central: B. Reish; Sls. Mgr., West Coast Off: W. Mullins

Local Sales Offices & Reps.
Cal Anaheim, Chemcut Corp., Western Dist. Office 714-630-1700

CHEMETRON CORP., Welding Prods., 111 E. Wacker St., Chicago, Ill., 60601, Tel: 312-565-5000; V.P. Sls: C.L. Reinecke; Mktg. Mgr. Gas Equip: D. Kelker

CHEMICAL ETCHING EQUIP. & SUPPLY, 7629 Crawford Ct., Alexandria, Va., 22310, Tel: 703-971-2646; Sls. Mgr: R.E. Hunt

CHEMICAL PRODS. CORP., King Philip Rd., E. Providence, R.I., 02914, Tel: 401-434-1770, TWX: 401-438-2607; Pres: H.B. Allison; V.P. Sls: J.S. Hawes; Sls. Office Mgr: H.B. Davenport

CHEMPLAST, INC., 31-150 Dey Rd., Wayne, N.J., 07470, Tel: 201-696-4700, TWX: 710-988-5834; Exec. V.P: M. Powell, Jr.

CHEMPLAST, Local Distributors
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621

CHEMTRONICS, INC., 1260 Ralph Ave., Brooklyn, N.Y., 11236, Tel: 212-NA-9-1300; Sls. Mgr: J. Ebert

Local Sales Offices & Reps.
Cal Los Angeles, Erlanger Sls. Co. 213-RE-1-2238
Colo Englewood, Electronix Spec. Co. 303-781-4409
Fla Ft. Lauderdale, Jack Sproch Sls. Corp. 305-886-0927
Ga Norcross, B. Cooper Co. 404-448-5460
Ill Chicago, Markal Sls. Corp. 312-282-5800
Ind Indianapolis, New/Era Sls. 317-257-7333
Mass N. Scituate, W.A. Hendrickson 617-545-0652
Minn St. Paul, Carl-M Co. 612-699-8004
Mo Raytown, Taraski Sls. Corp. 816-358-4590
NY Grand Island, L.J. McTaggart Assoc. 716-773-9222
Ohio St. Mary's, Repp Co. 419-394-4724
Pa Pittsburgh, R. Tanner Co. 412-561-4687
Tex Richardson, Willoughby-Fouler Co. 214-235-3664
Wash Seattle, Fleehart & Sullivan 206-LA-2-1533

CHEMTRONICS, Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

CHERRY ELECTRICAL PRODS., 3623 Sunset Ave., Waukegan, Ill, 60085, Tel: 312-689-7702, TWX: 910-235-1572; Sls. Prom. Mgr: F. Amendola Vol 2•1029-1036

Local Sales Offices & Reps.
Ala Huntsville, Powertronics 205-852-6347
Ariz Scottsdale, Intermountain Engrg. Co. 602-947-7379
Cal Palo Alto, Abbott Engrg. 415-327-0830
Cal Torrance, O'Donnell 213-323-9243
Colo Arvada, Arrowhead Sls. 303-423-5556
Conn Meriden, Electro-Products Sls. 203-235-4040
Fla Pompano Beach, CBC Elctrns., Inc. 305-782-0804
Ind Ft. Wayne, Menze Sls. 219-747-5616
Mass Waltham, Electro-Products Sls. 617-899-1570
Mich Novi, Miltimore Sls. 313-349-5820
Mich Troy, McPhail 313-689-6444
Minn St. Paul, Cahill 612-739-8445
Mo Prairie Village, Thro Industrial Sls. 913-362-2533
NJ Ft. Lee, S. Justin 201-947-4371
NJ Pitman, Colrud Co. 609-589-5866
NM Albuquerque, Inter-Mountain Engrg. Co. 505-344-2212
NY Rochester, Andres Sls. 716-244-2445
NC Thomasville, Powertronics 919-476-4257
Ore Portland, J.J. Backer Co. 503-297-3776
Tex Dallas, Reese Assoc. 214-638-6575
Tex Houston, Reese Assoc. 713-621-3134
Wash Seattle, Jas. J. Backer Co. 206-285-1300
Wisc Pewaukee, D. Herrick 414-691-2770

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CHERRY RIVET & BOOTS NUT DIVS., Townsend Co., P.O. Box 2157, Santa Ana, Calif., 92707, Tel: 714-545-5511, TWX: 910-595-1500; Sls. Mgr: D.J. Sauser

CHESAPEAKE INSTR. CORP., Shadyside, Md., 20867, Tel: 301-867-2151; Mktg. Mgr: J.F. Luckey

CHESTERFIELD PRODS. INC., 511A Victor St., Saddle Brook, N. J., 07662, Tel: 201-845-6886; Pres: M. Silver; Chf. Elec. Engr: A. Spencer .....Vol 2•555

Local Sales Offices & Reps.

Colo	Golden, Comm-well Sls. & Engrg.	303-277-0807
Ill	Chicago, K. W. Meyers Co.	312-774-6440
Ind	Indianapolis, K. W. Meyers Co.	317-243-6681
Md	Edgewater, Commart, Inc.	301-798-0607
Mass	Acton, E.E. Specialists, Inc.	617-259-9200
Minn	Minneapolis, K. W. Meyers Co.	612-920-7080
NJ	Saddle Brook, L&M Assocs.	201-843-8700
NY	Brentwood, L & M Assocs.	516-231-8363
NY	New York City, L & M Assocs.	212-675-7486
Pa	Andalusia, L & M Assocs.	215-639-3100
Tex	Dallas, Bradenco	214-358-3278
Tex	Houston, Bradenco	713-529-9881
Wisc	Milwaukee, K. W. Meyers Co.	414-482-1313

CHICAGO CONDENSER CORP., 3255 W. Armitage Ave., Chicago, Ill., 60647, Tel: 312-227-7070; Sls. Mgr: P. Philips

CHICAGO DYNAMIC INDS., Precision Prods. Div., 1725 W. Diversey Blvd., Chicago, Ill., 60614, Tel: 312-935-4600; Sls Mgr: J.M. Early .....Vol 2•1028

Local Sales Offices & Reps.

Ala	Huntsville, Craft Assocs.	205-837-0221
Cal	Menlo Pk., West Engrg. Sls.	415-325-2885
Cal	Sun Valley, Weightman	213-768-5750
Colo	Denver, TESSCO	303-744-1119
Conn	Waterbury, Coakley, Boyd & Abbett	203-756-8766
Fla	Maitland, Craft Assoc.	305-645-2242
Ga	Atlanta, Craft Assoc.	404-237-2282
Ill	Rolling Meadows, Sumer	312-394-4900
Ind	Ft. Wayne, Temple Eng.	219-744-4331
Md	Glen Arm, Billis Sls. Co.	301-592-7047
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Deroit, L. Dickelman	313-255-3300
Minn	Edina, M. Foster	612-941-7600
Mo	Kansas City, Harris-Hanson Co	816-HI-4-9494
Mo	St. Louis, Harris-Hanson	314-962-0111
NJ	Cherry Hill, J. Billis Sls.	609-HA-8-3651
NM	Albuquerque, TESSCO	505-298-0024
NY	Albany, Compar-Albany	518-489-4777
NY	Jamaica, S.A.M. Assocs.	212-OL-8-8881
NC	Greensboro, L & D, Inc.	919-292-3201
Ohio	Cleveland, L. Dickelman	216-831-1039
Tex	Dallas, Glidden Electro Equip.	214-EM-3-6539
Tex	Houston, Glidden Electro Equip.	713-681-1415
Exp:	N.Y., Westbury, Minthorne Int'l. Co.	212-895-3120
For:	Ville Lasalle 650, Que., Electrodesign, Ltd.	514-363-5120

CHICAGO LOCK CO., 4275 W. Belmont Ave., Chicago, Ill., 60641, Tel: 312-282-7177; Pres: L.B. Shinn, Jr.; Dir. Tech. Engrg: W.S. Christopher .....Vol 2•1037

Local Sales Offices & Reps.

NY	New Rochelle	914-636-1311

CHICAGO MINIATURE LAMP WORKS, 4433 N. Ravenswood Ave., Chicago, Ill., 60640, Tel: 312-784-1020, TWX: 910-221-5445; Sls. Mgr: R. Galarneau .....Vol 2•464-475

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe Sls.	602-264-7971
Cal	Freemont, CMLC	415-391-1098
Cal	No. Hollywood, CMLC	213-877-0158
Colo	Denver, Lindberg Co.	303-758-9033
Conn	New Haven, Gerber Sls.	203-777-6279
Fla	N. Miami Bch., Cartwright & Bean	305-945-2962
Fla	Orlando, Cartwright & Bean	305-896-2031
Ga	Atlanta, Cartwright & Bean	404-237-3108
Ill	Chicago, CMLW	312-784-1020
Ind	Indianapolis, L. M. DeVoe Co.	317-257-1227
Iowa	Cedar Rapids, J. G. Twist Co.	319-365-1401
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
La	Chalmette, Cartwright & Bean	504-279-4598
Mass	E. Longmeadow, Gerber Sls.	413-525-3059
Mass	Waltham, Gerber Sls.	617-890-8040
Mich	Detroit, R.C. Merchant	313-535-6000
Mich	St. Joseph, R.C. Merchant	616-983-7378
Minn	Edina, M. Foster Co.	612-835-2252
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NJ	Cherry Hill, Trinkle Sls.	609-667-3500
NY	Pt. Washington, T.M.A., Inc.	516-883-2432
NY	Syracuse, L. D. Allen, Inc.	315-458-7470
NC	Charlotte, Cartwright & Bean	704-333-6457
Ohio	St. Marys	419-394-3377
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, Techno	214-357-9213
Utah	Salt Lake City, Lindberg Co.	801-364-6409
Wash	Seattle, J.J. Backer Co.	206-285-1300
Exp:	Ill., Chicago, E.D. Magnus & Assoc. Inc.	312-334-1503
For:	Can., Toronto, Ont., General Instr. Can.	416-763-4133

CHICAGO MINIATURE Local Distributors

Ala	Birmingham, J.W. Clary Co., 1713 Second Ave. S.	205-322-2488
Ariz	Phoenix, Liberty Electrns., 3612 N. 16th St.	602-264-4438
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Diego, Shanks and Wright Inc., 2045 Kettner Blvd.	714-239-0176
Colo	Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave.	303-287-9611
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Iowa	Cedar Rapids, Iowa Radio Supply Co. Inc., 719 Center Point Rd. NE	319-364-6154
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	Baton Rouge, Ralph's, Inc., 1732 Plank Rd.	504-344-3761
La	Lafayette, Ralph's Inc., 3004 Cameron St.	318-234-4507
La	New Orleans, Ralph's, Inc., 4334 Stemway Dr.	504-242-2731
La	Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094	318-423-6131
Md	Baltimore, Arrow Elctrns., 5207 E. Drive	301-247-5200
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Burlington, Arrow Elctrns., 15 A Street	617-273-0100
Mass	Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy.	617-491-3300
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Mich	Muskegon, Western Elctrn Supply, 1781 5th St	616-722-7628
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Lincoln, Scott Elctrn Supply Corp., 4040 Adams St	403-434-8308
Neb	Omaha, J-B Distributing Co., 1616 Cass St	402-341-5525
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys.	609-662-4000
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza	607-797-1236
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
NY	Farmingdale, Harrison Elctnc., 20 Smith St.	516-293-7990
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Cleveland, Farr Elctrns, 5403 Prospect Ave.	216-881-7403
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Ohio	Solon, REPCO, 6835 Cochran Rd.	216-248-8900
Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541
Ore	Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd	503-292-3534
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA-9-1880
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tenn	Chattanooga, Curle Elctrns., 1813-S. Market	
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971
Tex	Beaumont, Ralph's, Inc., 1270 Broadway	713-833-9443
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
Wash	Seattle, Liberty Elctrns., 5303 2nd Ave. S.	206-763-8200
Wisc	Madison, Satterfield Elctrn., 1900 S.Park St.	608-257-4801
Wisc	Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave.	414-228-8100
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CHICAGO SWITCH, 2035 W. Wabansia Ave., Chicago, Ill., 60647, Tel: 312-489-5500; Sls. Mgr: M. Podgorski Vol 2•476,477,1038-1045

Local Sales Offices & Reps.

Cal	San Marino, Van Gott & Assoc.	213-282-1125
Fla	Indian Rocks Bch., Tech-Rep.	813-595-2834
Fla	Melbourne, Tech-Rep.	305-723-9140
Ga	Atlanta, Tech Rep.	404-963-8651
Mass	Newton Upper Falls, Brookdale/Richter Engrg.	617-244-6969
Mich	Southfield, J. Montgomery	313-358-2616
NJ	River Edge, MEG Elctrn. Sls.	201-265-9887
NY	Syracuse, Nycom	315-437-8343
Ohio	Chagrin Falls, Elctrn. Salesmasters	216-247-8201
Ore	Beaverton, N. R. Schultz Co.	503-646-1345
Tex	Addison, Campion Sls.	214-239-9196
Wash	Bellevue, N. Schultz	206-GL-4-5224

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CHOMERICS, INC., 77 Dragon Ct., Woburn, Mass., 01801, Tel: 617-935-4850, TWX: 710-393-0173; Sls. Mgr: K. Dunne; Sls. Engr: A. Benoit; Sls. Engr: R. Stahl

CHRISTIANSEN RADIO INC., 3034 Nestall, Laguna Beach, Cal., 92651, Tel: 714-497-1506 .....Vol 2•323

CHRISTIE ELEC., 3404A W. 67th St., Los Angeles, Cal., 90060, Tel: 213-750-1151, TWX: 910-321-3867; V.P: F. Benjamin; Applications Engr: Herm Rudman Vol 1•648,649

Local Sales Offices & Reps.

Ala	Huntsville, Ridge Instr.	205-837-3211
Ariz	Phoenix, R.A. Mayes	602-279-5243
Cal	Los Angeles, Halbar Assocs.	213-387-8283
Cal	Santa Clara, Thomas-Hartman Assoc.	408-247-1252
Colo	Broomfield, R.A. Mayes Co.	303-466-6311
Fla	Winter Park, Ridge Instr. Co.	305-239-4711
Ga	Tucker, Ridge Instr.	404-939-1554
Haw	Honolulu, Victor Kim Elctrns.	507-132
Kans	Prairie Vlg., Engrg. Svcs.	913-649-4000
Md	Silver Spg., L. White	301-585-3141
Mass	Burlington, W.M. Hague Co.	617-273-2450
Mich	Farmington, Carter, McCormic & Pierce	313-477-7700
Mo	Dayton, Carter, McCormic & Pierce	513-278-5873
Mo	St. Louis, Engrg. Svcs.	314-726-2233
NJ	Ridgewood, Instr. Sls. Co.	201-445-5210
NM	Albuquerque, R. Mayes	505-265-7989
NY	Syracuse, Rep. Tech., Inc.	315-437-2845
NC	Winston-Salem, L. White & Co.	919-725-3612
Ohio	Cleveland, Carter, McCormic & Pierce	216-333-5650
Ohio	Worthington, Carter, McCormic & Pierce, Inc.	614-888-4466
Pa	King of Prussia, L. White-Keystone	215-265-1817

Pa Pittsburgh, Carter, McCormic & Pierce 412-824-3760
Tenn Oak Ridge, Ridge Instr. 615-483-1311
Tex Richardson, C. Tinch 214-231-1322
Wash Bellevue, A. Smith Co. 206-746-6770
Exp: Cal., L.A., Trans-World Trade 213-472-0444

CHROMALLOY-ALCON INC., 1750 N Kimball Ave., Chicago, Ill., 60647, Tel: 312-BE-5-5030 .....Vol 3•552

Local Sales Offices & Reps.
Cal Reseda, M. J. Cozzi 213-DI-2-7383
Fla St. Petersburg, Comps. Sls. 813-360-7460
Ill Chicago, Alcon Metal Prods. 312-BE-5-5030
Ill Rolling Meadows, Sumer, Inc. 312-394-4900
Ind Indianapolis, Marquart & Assocs. 317-253-3997
Mass Acton, G Dick Assocs. 617-899-2364
Minn Minneapolis, Siedare Assocs. 612-533-2294
NJ Englewood Cliffs, Sprung-Nussbaum 201-947-6767
NY Brockport, G. J. Gay, Inc. 716-637-2846
Pa Philadelphia, Paragon Sls. Co. 215-LO-3-7060
Tex Richardson, Corwin Assocs. 214-424-8333
Va Lynchburg, J. A. Griffin 703-384-5236

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CHRONETICS, INC., 500 Nuber Ave., Mt. Vernon, N.Y., 10550, Tel: 914-699-4400, TWX: 710-560-0014; Sls. Mgr: S. Gordon .....Vol 1•410

Local Sales Offices & Reps.
Cal Sherman Oaks, Windsor Dynamics 213-989-3631
Cal Woodside, Windsor Dynamics 415-854-4870
Colo Arvado, Technology Mktg. Assoc. 303-322-6844
Fla Clearwater, Brennan Assocs., Inc. 813-446-5006
Ill Chicago, L.F. Green & Assocs. 312-286-6824
Ill Mt. Prospect, Contemporary Science 312-255-3793
Ind Indianapolis, L.F. Green & Assocs. 317-253-2087
Md Bethesda, Powell-Pendergraph, Inc. 301-656-4535
Mass Waltham, McBar Assocs. 617-890-0233
Minn Minneapolis, L.F. Green & Assocs. 612-781-1611
NM Albuquerque, Technology Mktg. Assoc. 505-298-4321
NY Dewitt, DB Assocs. 315-446-0220
NY Mt. Vernon, Q.E.D. Elctrns., Inc. 914-664-0080
Ohio Dayton, Rixan Assocs. 513-278-4216
Pa King of Prussia, Letronix 215-265-1020
Tenn Knoxville, Pulcir, Inc. 615-693-3641
Tex Dallas, R. Martin Assocs, Inc. 214-358-3704
Tex Houston, R. Martin Assocs., Inc. 713-462-4077
Va Richmond, Powell-Pendergraph, Inc. 703-264-2341
Wash Seattle, H. Levinson Co. 206-EA-3-5100

CHRONO-LOG CORP., 2583 W. Chester Pike, Broomall, Pa., 19008, Tel: 215-EL-6-6771; Sls. Mgr: D. Biberman Vol 1•333

Local Sales Offices & Reps.
Cal Los Angeles, Thorson Co. 213-WE-7-0790
Cal Palo Alto, Thorson Co. 415-DA-1-2414
Cal San Diego, Thorson Co. 714-CY-8-8385
Cal Tustin, Thorson Co. 714-544-5121
Colo Broomfield, R. A. Mayes Co. 303-466-6311
Mass Needham, Wild & Assocs. 617-HI-4-2366
NJ Mendham, J. J. Wild, Inc. 201-543-4782
NM Albuquerque, R.A. Mayes Co. 505-265-7989
NY Hastings on Hudson, Wild & Assocs. 914-963-3803
NY Jericho, J. J. Wild, Inc. 516-963-6600
Ohio Worthington, Ohio Instr. Co. 614-885-0743
Pa Southampton, Wild & Assocs. 215-EL-7-6645
Tex Houston, R. A. Mayes Co. 713-466-8325
Tex Richardson, R. A. Mayes Co. 214-235-3043
Va Arlington, H.J. Heffernan Co. 703-JA-2-6666
Wash Seattle, Thorson Co. 206-ME-2-0710
For: Can., Don Mills, Ont., York Instrs. 416-445-1255

CIMCO WIRE & CABLE, 250 W. Crescent Ave., Allendale, N.J., 07401, Tel: 201-327-2522; Sls. Mgr: J.B. Monaghan; Asst. Sls. Mgr: J. Ryan .....Vol 3•1347

Local Sales Offices & Reps.
Ariz Phoenix, Electrical Specialty 602-275-5736
Cal Chatsworth, Cal-Ward Sls. Co. 213-885-1771
Cal Palo Alto, Lockwood Assocs/No. 415-328-3999
Colo Denver, Electrical Specialty 303-321-0226
Fla Orlando, Royce Elctrn. Sls., Inc. 305-843-6030
Ill Chicago, Kennedy Engrg. 312-631-8283
Ind Ft. Wayne, Component/Insulation Corp. 219-485-7114
Mass Weston, F.C. Talbot Co. 617-893-6877
Mich Birmingham, Comp./Insulation 313-644-0087
Mo Springfield, Del-Tech Assocs. 417-881-3667
NY Mineola, R.A. Colucci Co. 516-746-0397
NY Rochester, Simcona Elctrns. 716-328-3230
Ohio Cleveland, Component/Insulation Corp. 216-521-3570
Pa Bala Cynwyd, Vantage Sls. Co. 215-667-0990
Pa Pittsburgh, J.W. Kight Co. 412-781-8303
Tex Dallas, R.E. Nesbitt Co. 214-357-4601
Va McLean, Paragram Sls. Co. 703-356-0808
For: Can., Montreal, Que., Allied Elctrn. Sls. 514-488-5547

CIMCO Local Distributors
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230

CINCH CONNECTORS, OPER OF TRW ELCTRN. COMPS., 1501 Morse Ave., Elk Grove Village, Ill., 60007, Tel: 312-439-8800, TWX: 910-222-1796; Sls. Mgr: K.E. Meyers .....Vol 3•854-924

Local Sales Offices & Reps.
Ala Huntsville 205-772-9656
Cal Cerritos 213-924-5711
Cal Mountain View 415-969-2252
Fla Orlando 305-894-6881
Ill Elk Grove Village 312-437-5110
Ind Indianapolis 317-547-9411
Mass Reading 617-944-3020
Mich Detroit 313-873-1150
Minn Minneapolis 612-835-5454
Mo St. Louis 314-727-7370
NJ Clifton 201-545-0990
NY Melville 516-293-9000
NY Rochester 716-461-3070
Ohio Dayton 513-298-9862
Pa Glenside 215-887-7520
Tex Dallas 214-637-6650
Wash Seattle 206-633-3160

CINCH Local Distributors
Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way 213-685-5511
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd. 415-968-6292
Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal Woodland Hill, Rampart Components, 21201 Oxnard St. 213-887-7260
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Colo Denver, Burstein-Applebee 303-244-3336
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ill Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave. 312-282-5400
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Kansas City, Burstein-Applebee 816-561-5460
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
La Baton Rouge, Ralph's, Inc., 1732 Plank Rd. 504-344-3761
La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
La Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094 318-423-6131
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd 314-428-8522
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Clifton, Eastern Radio, 312 Clifton Ave. 201-471-6600
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Hauppauge, Rampart Components, Engineers Rd. 516-273-1111
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Beaumont, Ralph's, Inc., 1270 Broadway 713-833-9443
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Tex Lubbock, R & R Elctrn Supply Co, 1607 Ave. G, Box 1860 806-765-7727
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Va Roanoke, Peoples Radio & Tv Supply Co., 1015 Moorman Rd
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CINCH-GRAPHIK, OPER. OF TRW ELCTRN. COMPS., Div. TRW INC., 200 S. Turnbull Canyon Rd., City of Industry, Cal., 91744, Tel: 213-333-1201, TWX: 910-584-1861; Sls. Mgr: G. Holmes .....Vol 2•325

(Refer to Cinch Connectors for Sales Office Information)

CINCH-MONADNOCK, OPER. OF TRW ELCTRN. COMPS., Div. TRW INC., 18300 E. Valley Blvd., Box 1222, City of Industry, Cal., 91747, Tel: 213-964-6581, TWX: 910-584-1303; Sls. Mgr: G. Holmes

CINCINNATI DEV. & MFG. CO., 5614 Wooster Pike, Cincinnati, Ohio, 45227, Tel: 513-271-7280; Sls. Mgr: E. Mooney

CINCINNATI ELCTRNS. CORP., 2630 Glendale Milford Rd., Cincinnati, Ohio, 45241, Tel: 513-563-6000, TWX: 810 464-8151; Mktg. Mgr. - Commun: F.G. Biscardi; Mktg. Mgr. - EW: J.H. Newman; Mktg. Mgr. - IR: D.F. Coates

CINCINNATI MILACRON, Process Controls Div., Lebanon, Ohio, 45036, Tel: 513-494-5444, TWX: (810) 460-8761; Sls. Mgr: M. Radeke

Local Sales Offices & Reps.

Cal	Los Angeles, Cincinnati Milacron	213-582-8361
Cal	San Francisco, Cincinnati Milacron	408-735-0701
Ga	Atlanta, Cincinnati Milacron	404-634-6312
Ill	Chicago, Cincinnati Milacron	312-439-5726
Mich	Detroit, Cincinnati Milacron	313-557-2700
NY	New York, Cincinnati Milacron	201-687-4500
Tex	Houston, Cincinnati Milacron	713-622-4620

CINCINNATI SUB-ZERO PRODS., 2612 Gilbert Ave., Cincinnati, Ohio, 45206, Tel: 513-751-8810; Chief Engr: T.J. Frederick .....Vol 1•383

CINEFOT INTERNATIONAL CORP., One Park Ave., New York, N.Y., 10016, Tel: 212-532-2323; Sls. Mgr: W.S. Victor

CIR-Q-TEL, 10504 Wheatley St., Kensington, Md., 20795, Tel: 301-946-1800; Sls. Mgr: R. Wainwright Vol 2•556,557

CIRCON CORP., 749 Ward Drive, Santa Barbara, Ca., 93111, Tel: 805-967-0404

Local Sales Offices & Reps.

Ariz	Phoenix, Jensen Tools & Alloys	
Cal	Alta Loma, Metro-Line Western	714-987-4112
Cal	Palo Alto, Andot Tech. Sls.	415-325-0058
Fla	Miami, Elctrn. Equip.	
Mass	Boston, Ind'l. Equip. & Sls.	617-227-8112
NJ	Saddle River, B. Most Assocs.	201-825-0033
NY	Binghamton, Stack Ind'l. Elctrns.	607-723-6326
NY	Hempstead, Davis Elctrns.	516-483-9200
NY	New York, Terminal-Hudson Elctrns.	212-243-5200
Pa	Cornwells Heights, H. Mann	215-639-6200
Pa	Phila., Techni-Tool	212-569-4457
Tex	Dallas, Metron Central	214-234-1411

CIRCUIT ASSEMBLY CORP., 3025 S. Kilson Dr., Santa Ana, Cal., 92707, Tel: 714-540-5490

CIRCUIT POWER, INC., 227 Main St., Portland, Conn., 06480, Tel: 203-342-2520; Sls. Mgr: P.C. Hooper

Local Sales Offices & Reps.

Cal	Los Altos, Cain & Co.	415-948-6533
Cal	Los Angeles, Cain & Co.	213-476-2251
Conn	Milford, Westwood Assocs.	203-878-8528
Ill	Mt. Prospect, Cain	312-253-3578
Mass	Reading, Geder	617-944-3105
NJ	Montville, G & A Sls.	201-227-3926
NY	Cortland, RJC Assocs.	607-753-3909
Ohio	Reynoldsburg, Cain	614-861-2119
Pa	Lafryette Hill, M. Lader	215-825-3177
Tex	Dallas, Cain	214-369-2897
Va	Woodbridge, M. Lader	202-296-2497

CIRCUIT-STIK, INC., 24015 Garnier St., Torrance, Cal., 90510, Tel: 213-530-5530; Sls. Mgr: D. Harper; Pres: N.R. Levesque; Operations Mgr: G.L. McCray

Local Sales Offices & Reps.

Ariz	Scottsdale, F. Board Assocs.	602-949-9561
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Los Angeles, W. B. Knight, Inc.	213-678-4711
Colo	Littleton, W.J. Purdy Co.	303-794-4225
Fla	Miami, Cartwright & Bean, Inc.	305-945-2962
Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Hinsdale, Hill-Gray Assoc.	312-325-4810
Kans	Overland Pk., T.L. Dowell	913-649-6069
Mass	Babson Park, P.R. Sturgeon Co.	617-237-3506
Mich	Detroit, R.C. Merchant Co.	313-535-6000
NJ	Teaneck, Steve Fisher Sls. Corp.	201-836-6661
NM	Albuquerque, C.T. Carlberg & Assocs.	505-265-1579
NY	Syracuse, Mar-Com Assocs.	415-437-2843
Ohio	St. Marys, Thomas Shelby & Co.	419-394-3377
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, J.Y. Schoonmaker Co.	214-357-8481
Wash	Seattle, Earl & Brown Co.	206-284-1121

CIRCUIT-STIK, Local Distributors

Ariz	Phoenix, Liberty Electrns., 3612 N. 16th St.	602-264-4438
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ore	Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd	503-292-3534
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
Wash	Seattle, Liberty Elctrns., 5303 2nd Ave. S.	206-763-8200

CIRCUIT STRUCTURES LAB., Div. Lincoln Instr. Co., Inc., 3200 N. San Fernando Blvd., Burbank, Calif., 91504, Tel: 213-849-6341; Pres: E.L. Deatrick; V.P: F.V. Criswell; Sales: G. Vogel

CIRCUIT TECHNOLOGY, 160 Smith St., Farmingdale, N.Y., 11735, Tel: 516-293-8686, TWX: 510 224 6555; Mkt. Mgr: M. Spitz

Local Sales Offices & Reps.

Cal	Manhattan Beach, Circuit Technology Inc.	213-374-7446

CIRCUITS, INC., 59 Deming Rd., Berlin, Conn., 06037, Tel: 203-828-3526; Sls. Mgr: R.E. Johnson; Pres: G.A. Johnson

CIRTECH CORP., 3802 W. 95th St., Leawood, Kans., 66206, Tel: 913-649-2800, TWX: 910-749-6806; Pres: M. Viamis .....Vol 2•402

Local Sales Offices & Reps.

Ariz	Phoenix, Runyon Co.	602-959-6060
Cal	Los Angeles, Westaironics, Inc.	213-466-6201
Fla	Clearwater, WMM Assoc., Inc.	813-446-0075
Mass	Braintree, Bordewieck Eng. Sales	617-843-0845
NY	Buffalo, Telesco Assoc., Inc.	716-834-1026
NY	New York, F & F Assoc.	516-ED-4-1160
Ohio	Dayton, Berberich & Assoc.	513-252-9981
Tex	Dallas, Tinch Sls. Co.	214-231-1322

CITIES SVC. CO., Chester Cable Opers., Oakland Ave., Chester, N.Y., 10918, Tel: 914-469-2141, TWX: 510-249-4813; Sls. Mgr: H.J. Coffey; Mktg. Mgr: G.L. Jacobson; Engrg. Mgr: B. Levinson

Local Sales Offices & Reps.

Ariz	Scottsdale, Inter-Mountain Engrg.	602-947-7379
Cal	Chatsworth, Cal-Ward Sls. Co.	213-885-1771
Fla	Orlando, Fausett of Florida	305-894-6071
Ill	Elk Grove Vill., Knoblock & Assocs.	312-593-5940
Ind	So. Whitley, Warner, Kesler & Assocs.	219-723-5353
Kans	Shawnee Mission, Kathrinus, Kelly, & Co.	913-722-0000
Ky	Ft. Mitchell, G. W. Thelen	606-341-8181
Mo	St. Louis, Kathrinus, Kelly & Co.	314-968-3800
NJ	Haddonfield, Keefe Elctrn.	609-429-4650
NM	Albuquerque, Inter-Mountain Engrg.	505-344-2212
NY	Brooklyn, J. D. Coury	212-836-7387
NY	Great Neck, Cooper-Simon	516-487-1142
NY	Rochester, B. H. Tollefson Assocs.	716-271-4141
NY	Woodmere, I. G. Strauss	516-374-5273
NC	Charlotte, B. Jackson	704-366-6678
Pa	Delmont, T. F. Laslo & Assocs.	412-468-5045
Tenn	Memphis, W. L. Porter Co.	901-386-7714
Tex	Dallas, R. E. Nesbitt	214-357-4601
Tex	Houston, R. E. Nesbitt Co.	713-224-3633
Wisc	Milwaukee, Gentron Co.	414-351-1660
For:	Can., Montreal 307, Que., Space Elctrns. Corp.	514-735-1108

CLAIREX ELCTRNS., 560 S. Third Ave., Mt. Vernon, N.Y., 10550, Tel: 914-664-6602; Sls. Mgr: G.A. Smith Vol 2•672,673

Local Sales Offices & Reps.

Ariz	Scottsdale, E.V. Roberts & Ass.	602-945-2531
Cal	Culver Cy., E. Roberts	213-870-9561
Cal	Palo Alto, E. Roberts	415-324-1671
Cal	San Diego, E.V. Roberts & Assoc.	714-282-7691
Colo	Eastlake, Jensen Rep.	303-466-6061
Conn	Bethel, A.L. Livera	203-748-4639
Fla	North Miami Beach, Irby & Connolly Inc.	305-948-5197
Fla	Orlando, Irby & Connolly Inc.	305-894-8471
Ill	Chicago, L-Tec, Inc.	312-286-1500
Kans	Overland Park, Ensco-Rep	913-381-7557
Md	Phoenix, Cunningham Assoc.	301-823-4220
Mass	S. Braintree, Bordewieck Sls. Engrg.	617-843-0845
Mich	Detroit, Hilltronics	313-342-3243
Minn	Mpls., H.M.R. Inc.	612-920-8200
Mo	St. Louis, Ensco-Rep	314-542-3935
NJ	Fort Lee, Tecnimet	201-461-8686
NY	Cato, Clairex Electronics	315-626-6426
NY	Mt. Vernon	914-664-6602
NY	Roslyn Heights, A.L. Livera & Assoc.	516-484-1276
NC	Charlotte, Electro Rep Inc.	704-333-0451
Ohio	Chardon, Clairex Elctrns.	216-285-3415
Pa	Media, Reeves	215-LO-6-6709
Tex	Dallas, J.B. Guenther Inc.	214-528-6286
Tex	Houston, J.B. Guenther Inc.	713-468-0232
Wash	Seattle, H. Levinson Co.	206-323-5100

CLAIREX Local Distributors

Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971

CLARE, C.P. & CO., 3101 Pratt Blvd., Chicago, Ill., 60645, Tel: 312-262-7700; V.P. Sls: F.H. Bihler Vol 2•702-716; Vol 4•474-478*

Local Sales Offices & Reps.

Ala	Huntsville, C.P. Clare	205-534-5438
Ariz	Phoenix, Spectrum Assocs.	602-277-8168
Ark	Fort Smith, J. R. Masterson	501-646-7756
Cal	Mountain View, C.P. Clare	415-968-2831
Cal	Santa Ana, Spectrum Assocs.	714-835-4114
Colo	Denver, Walker Assocs.	303-623-8713
Fla	Ft. Lauderdale, R.I. Smith Assocs.	305-772-5100
Ga	Atlanta, A. Brown Assocs.	404-457-6381
Ill	Chicago, C.P. Clare & Co.	312-262-7700
Ind	Ft. Wayne, Baehr, Greenleaf	219-483-6864
Iowa	Des Moines, C.P. Clare	515-276-4147
Kans	Overland Park, Lowell-Kangas & Assocs.	913-888-3200
Md	Ellicott City, Doss Electronics	301-465-1336
Mass	Needham, C.P. Clare & Co.	617-449-4780
Mich	Mt. Clemens, C.P. Clare	313-468-1784
Minn	St. Paul, REPOR, Inc.	612-645-8618
Mo	St. Louis, Lowell-Kangas & Assocs.	314-821-4050
NY	Fayetteville, C.P. Clare	315-637-3939
NY	Great Neck, C.P. Clare	516-466-2100
NC	Charlotte, R.W. Chapman	704-525-2421
NC	Raleigh, R.W. Chapman & Co.	919-782-2624
Ohio	Cincinnati, Baehr, Greenleaf	513-891-3826
Ohio	Cleveland, Baehr, Greenleaf	216-221-9030
Ohio	Columbus, Baehr, Greenleaf	614-486-4046
Pa	Erie, Foster-Mc Clinton	814-455-9111
Pa	Ft. Wash., C.P. Clare & Co.	215-643-5321
Pa	Pittsburgh, Foster-McClinton	412-561-4803
SC	Greenville, R.W. Chapman & Co.	803-233-0053
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, Getty-Eads-Adair	713-781-3005
Va	Richmond, Advance Control Equip	703-288-0124
Wash	Bellevue, C.P. Clare	206-747-5600
WVa	Huntington, Foster-Mc Clinton	304-736-5161
Wisc	Wauwatosa, Larsen Assocs.	414-258-0529
For:	Can., Montreal, Que., C.P. Clare Can. Div.	514-482-9750
For:	Can, Toronto, Ont., C.P. Clare Canada, Div.	416-762-8154

CLARE, C.P. Local Distributors

Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Mass	Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy.	617-491-3300
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
Neb	Lincoln, Scott Elctrn Supply Corp., 4040 Adams St	403-434-8308
NJ	Clifton, Eastern Radio, 312 Clifton Ave.	201-471-6600
NY	Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza	607-797-1236
NY	Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave.	716-873-9661
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971
Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CLARE-PENDAR CO., Box 785, Post Falls, Idaho, 83854, Tel: 208-773-4541; Mktg. Mgr: S.F. Meyer

Local Sales Offices & Reps.

Ala	Huntsville, C. P. Clare & Co.	205-534-5438
Ark	Ft. Smith, J.R.Masterson	501-646-7756
Cal	Mountain View, C. P. Clare & Co.	415-968-2831
Cal	Santa Ana, C. P. Clare & Co.	714-835-4114
Cal	Sun Valley, Richey Elctdns.	213-983-0222
Colo	Denver, Omega Ltd.	303-758-1508
Fla	Ft. Lauderdale, C.P. Clare & Co.	305-772-5100
Ga	Atlanta, Hooker Reid Co.	404-237-9385
Ill	Chicago, C. P. Clare & Co.	312-262-7700
Ill	Palatine, OHM/Elctrns.	312-359-5500

Ind Ft. Wayne, Baehr, Greenleaf & Assoc. 219-483-6864
Iowa Des Moines, C. P. Clare & Co. 515-276-4147
Kans Overland Park, Lowell-Kangas & Assoc. 913-888-3200
Mass Needham, C.P. Clare & Co. 617-449-4780
Mich Mt. Clemens, C. P. Clare & Co. 313-468-1784
Minn St. Paul, Repor Inc. 612-645-8618
Mo St. Louis, Lowell-Kangas & Assoc. 314-821-4050
NJ Moorestown, Angus Inc. 609-235-1900
NY Buffalo, Genesee Radio & Parts 716-873-9661
NY Fayetteville, C. P. Clare & Co. 315-637-3939
NY Great Neck, C. P. Clare & Co. 516-466-2100
NY Huntington, Caravan Sls. 516-692-2839
NY Syosset, Milo Elctrns. 516-364-1400
NC Charlotte, R.W. Chapman & Co. 704-525-2421
Ohio Cincinnati, Baehr, Greenleaf & Assoc., Inc. 513-891-3826
Ohio Cleveland, Baehr, Greenleaf & Assoc., Inc. 216-221-9030
Ohio Columbus, Baehr, Greenleaf & Assoc., Inc. 614-486-4046
Pa Erie, Foster-McClinton 814-455-9111
Pa Ft. Washington, C.P. Clare & Co. 215-643-5321
Pa Pittsburgh, Foster-McClinton 412-561-4803
Tex Dallas, R. E. Nesbitt Co. 214-357-4601
Tex Houston, Gettys-Eads-Adair Inc. 713-781-3005
Wash Bellevue, C. P. Clare & Co. 206-747-5600
WVa Huntington, Foster-McClinton 304-736-5161
Wisc Wauwatosa, Larsen Assoc. 414-258-0529
For: Can., Toronto, Ont., C. P. Clare Can., Ltd. 416-762-8154

CLARKE - HESS, Comm. Resch. Corp., 43 W. 16th St., New York, N.Y., 10011, Tel: 212-255-2940; Sls. Mgr: K.K. Clarke ..... Vol 1•411

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Kans Leawood, Leemark Engrs. 913-NI-8-0124
Mich Royal Oak, Satullo 313-549-3910
Minn Circle Pines, P. Lind Elctrns. 612-786-5770
NJ Hazlet, Mer Mon 201-264-1851
NY N.Y., Clarke-Hess Comm. Resch. 212-255-2940
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Ohio Cleveland, Satullo 216-486-2800
Ohio Dayton, Satullo 513-293-7061
Pa Mt. Penn, Mer Mon 215-779-1640

CLAROSTAT MFG. CO., INC., Washington St., Dover, N.H., 03820, Tel: 603-742-1120, TWX: 510-297-4455; Sls. Mgr: H. Taylor ..... Vol 3•1218,1219

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Cal Inglewood, J Berman Co. 213-678-1281
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Fla Tampa, Hutto-Hawkins-Peregoy 813-837-2512
Ga Atlanta, Millar Elctrns. 404-261-6160-61
Haw Honolulu, Pegart Int'l. Hawaii
Ill Chicago, Clarostat Mfg. Co., Inc. 312-792-3898-99
Ind Ft. Wayne, Needler Sales Co. 219-447-2123
Ind Indianapolis, New/Era Sales, Inc. 317-257-7333
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Kans Overland Park, Palatine Engrg. Sls. 913-262-5643
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Mich Ferndale, Hilltronics 313-342-3242
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NC Raleigh, Millar Elctrns. 919-787-9564
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Ohio Dayton, K.W. Elctrns. Sls. 513-890-2150
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Cal San Carlos, Sterling Electronics, 1061 Industrial Rd. 415-592-2353
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Md Rockville, Pioneer/Washington, 1037 Taft St. 301-427-3300
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Tex Houston, Lenert Co., Box 2184 713-225-1465
Tex Houston, Sterling Electronics, Box 1229 713-623-6600
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Va Charlottesville, Virginia Radio Supply, 717 Henry Ave. 703-296-4184
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Wash Seattle, Sterling Electronics, 5608 6th Ave., S. 206-762-9100
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Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100

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Pa Camp Hill, A. L. Slade & Co. 717-761-1311
Utah Bountiful, P. E. Anderson 801-295-2842
Wash Seattle, J. J. Backer Co. 206-285-1300
Wisc Milwaukee, D. Deering Co. 414-421-0857
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Ohio Dayton, H. Teplitz & Co. 513-277-6531
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DC Wash, Eastern Instr. 301-839-3800
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Mass Waltham, Meas. Consits. 617-890-4400
Mich Detroit, Micro Sls. 313-482-1229
NM Albuquerque, Hytronic Meas. 505-268-3941
NY E. Syracuse, Ossmann Instr. 315-437-6666
NY Great Neck, Eastern Instr. 516-466-9505
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Pa Phila., Eastern Instr. 215-927-7777
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Cal Palo Alto, The Thorson Co. 415-321-2414
Cal San Diego, The Thorson Co. 714-298-8385
Cal Santa Anna, The Thorson Co. 714-544-5121
Colo Denver, The Thorson Co. 303-355-3521
Fla North Palm Beach, Col-Ins-Co., Inc. 305-423-7615
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NC Raleigh, Col-Ins-Co., Inc. 919-834-6591
Tex Dallas, The Thorson Co. 214-233-5744
Tex Houston, The Thorson Co. 713-771-3506
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Cal	Los Angeles, Collins Radio Co.	213-647-5611
Cal	San Carlos, Collins Radio Co.	415-343-3224
Colo	Colorado Springs, Collins Radio Co.	303-471-0282
Fla	Madeira Beach, Collins Radio Co.	813-391-8065
Fla	Miami, Collins Radio Co.	305-888-0611
Ga	Atlanta, Collins Radio Co.	404-761-0607
Kans	Wichita, Collins Radio Co.	316-942-4201
La	Pineville, Collins Radio Co.	318-443-1228
Md	Baltimore, Collins Radio Co.	301-675-5438
Mass	Boston, Collins Radio Co.	617-272-7930
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Cal	San Diego, Perspective Meas.	714-278-8931
Colo	Littleton, Cropley, Inc.	303-794-4231
Fla	Orlando, BCS Assocs., Inc.	305-843-1510
NJ	Clifton, Doron Assoc.	201-661-0440
NC	Greensboro, BCS Assocs. Inc.	919-273-1918
Pa	Exton, Scientific Mktg.	215-363-7377
Tex	Dallas, Perception Sys.	214-233-5497

COLT INDUSTRIES, Crucible Magnetics Div., Box 100, Elizabethtown, Ky., 42701, Tel: 502-769-1333; V.P. Mktg: R.E. Budde

COLUMBIA COMPONENTS, Div. Computer Instrs., 60 Madison Ave., Hempstead, N.Y., 11550, Tel: 516-483-8200, TWX: 510-222-4189; Delay Line Sls. Mgr: L. Eagle; Hybrid Microcircuit S.M: A. Goldstein Vol 2•593; Vol 3•1221

Local Sales Offices & Reps.

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Delay Line Div.

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Cal	Menlo Park, Frauman	415-322-8461
Cal	San Diego, B. Tauber & Assoc. Inc.	714-274-7242
Fla	Orlando, F. Baetzman	305-295-4817
Ill	Chicago, Lightner Assoc.	312-SP-4-1500
Md	Pimonium, Barn Hill & Assoc.	301-252-5610
Mo	Kansas City, Automatic General Elec.	816-333-8206
NY	Huntington, Andrews & Andrews	516-692-8686
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Cal	Gardena, Bidwell Sls. Assocs.	213-770-0300
Cal	San Francisco, Technical Sls. Assocs.	415-467-1434
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Kans	Overland Park, Lowell-Kangas & Assoc.	913-888-3200
La	Metaire, J. F. McKinney Sls.	504-887-1723
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Mich	St. Joseph, R. C. Merchant & Co.	616-983-7378
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Mo	St. Louis, Lowell-Kangas & Assoc.	314-821-4050
NY	Port Washington, T.M.A., Inc.	516-883-2432
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NY	Yonkers, J. Brown Elctrn. Sls.	914-779-7330
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Ore	Salem, M.K. Widdekind Co.	503-363-6445
Pa	Monroeville, Nebco Assocs.	412-824-2111
Pa	Philadelphia, S.K. MacDonald, Inc.	215-545-1205
Pa	Reading, Beil-Whitaker	215-779-2610
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Tex	Houston, J. F. McKinney Sls.	713-774-3232
Wash	Seattle, M. K. Widdekind Co.	206-284-8020

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Mo	Florrisant, Marsland Assocs., Inc.	314-278-6949
NM	Albuquerque, R. A. Mayes Co.	505-265-7989
NY	Mamaroneck, Cane Tech Sls., Inc.	914-698-4411
Ohio	Cleveland, Electro Sls. Assocs., Inc.	216-261-5440
Ohio	Dayton, Electro Sls. Assocs., Inc.	513-426-5551
Pa	Pittsburgh, Electro Sls. Assocs.	412-371-9449
Pa	Valley Forge, J. E. Cuesta & Co., Inc.	215-265-5800
Tex	Richardson, R. A. Mayes Co.	214-235-3043
Wash	Bellevue, Topp Engrg. Sls., Inc.	206-747-5401

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Mass	Waltham, Betronic Assocs.	617-894-8400
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NY	Rochester, Gislason	716-454-4741
Ohio	Cincinnati, Irvin W. Grothouse	513-661-8814
Ohio	Cleveland, A.H. Baier	216-461-6161
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Wash	Kirkland, R.R. Chase & Assoc.	206-454-2514

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NY	Far Rockaway, Ed Mann	201-725-8848

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Cal	Burlingame, Leddy Assocs.	415-347-5247
Conn	Danbury, Comaltest, Inc.	203-792-3777
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Pa	Devon, Electech	215-687-5305
Tex	Addison, Campion Sls. Co.	214-239-9196
Va	Annandale, Nine Assocs.	703-256-9105
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NY	Huntington, CDB Entprs.	516-692-5200
NY	Syracuse, Varian Assocs.	315-437-2568
Ohio	Dayton, Varian Assocs.	513-298-7318
Tex	Richardson, Varian Assocs.	214-235-2385
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Minn	Mpls., Comstrand	612-560-5300
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Vt Vergennes, A & M Elctrn. 802-877-2644
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La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY Scarsdale, Logicomp Elctrns. Inc., Box 37H 914-723-3334
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

CONVERSION CHEM. CORP., 210 E. Main St., Rockville, Conn., 06066, Tel: 203-872-0541, TWX: 710-435-2336; Sls. Mgr: G.B. Rynne

Local Sales Offices & Reps.
Cal La Mirada, J. J. Manzella 213-944-4832
Conn Waterbury, R. R. Brouillard 203-755-4692
Ill Chicago, Conversion Chemical Corp. 312-247-7117
Ill Lansing, G. A. Hobbs 312-474-5264
Mass Dudley, J. A. Cristina 617-943-3096
Mich Albion, L. Calicotte 517-629-3502
NY East Syracuse, K. R. MacDonald 315-463-0685
NC Charlotte, Conversion Chemical Corp. 704-394-1378
NC Statesville, B. G. Deal 704-872-3256
Ohio Canfield, G. Reuter 216-533-4690
Ohio Sylvania, E. P. Agnew 419-882-1282
Ohio Toledo, Conversion Chemical Corp. 419-531-3703

COOK ELEC. CO., 6201 Oakton St., Morton Grove, Ill., 60053, Tel: 312-967-6600, TWX: 910-223-3654; Sls. Mgr: D.D. Hutchinson; Mgr. Sls. Eng: R.H. Troxell

Local Sales Offices & Reps.
Cal Inglewood, V & L Assocs. 213-671-7688
Cal Menlo Park, Frauman 322-8461
Ga Atlanta, G. Duckett Sls. 404-451-3529
Iowa Cedar Rapids, Palatine Engrg. 319-365-8071
Kans Andover, Palatine Engrg. 316-683-7512
Kans Overland Pk., Palatine Engrg. 913-262-5643
Md Baltimore, Milan Assocs. 825-1120
Mich Fenton, Kundinger Fluid Power, Inc. 313-629-2248
Mo St. Louis, Palatine Engrg. 314-426-7055
NY Binghamton, Canavan-Scanlon 607-724-7720
NY Rochester, Canavan-Scanlon 716-442-0720
NY Syracuse, Canavan-Scanlon 315-463-9161
NC Greensboro, G. Duckett Sls. 919-273-4617
Ohio Cleveland, D. Steffen 261-5055
Ohio Dayton, D. Steffen 293-3145
Tex Dallas, T. M. Curtis Co., Inc. 361-1666
Wisc Appleton, Kundinger Fluid Power, Inc. 414-739-7463
Exp: Ill., Chicago, E. Magnus 312-334-1503

COOPER GROUP, Elctrns. Div., Box 728, Apex, N.C., 27502, Tel: 919-362-7511; Sls. Mgr: J. Barrese

COOPER Local Distributors
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Conn Fairfield, Utronic Inc., 273 Linwood Ave. 203-255-4521
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971

COORS PORCELAIN CO., 600 Ninth St., Golden, Colo., 80401, Tel: 303-279-6565; Mgr., Mktg. Svcs: R. Barnhart

Local Sales Offices & Reps.
Ariz Phoenix, Hecht, Henschen & Assocs. 602-275-4411
Cal Goleta, J. N. Paxson 714-535-4000
Cal Los Angeles, T. R. Burnett 714-772-9500
Cal San Francisco, L. R. Valek 408-245-2595
Colo Denver, D. L. Kuhlke 303-238-2125
Conn Watertown, J. D. Grady 914-946-4122
Fla Melbourne, Reynolds & Assocs., Inc. 305-727-3205
Ill Chicago, A. L. Tonn 312-726-2421
Ill McHenry, R. J. Ranney 815-385-6880
Ind Indianapolis, J. T. Gagnon 317-783-2856
Kans Kansas City, Mid-America Elctrns. Mktg. 913-236-4800
Md Derwood, W. H. Voth 202-783-5426
Mass Whitman, H. F. Peters 617-222-9520
Mich Southfield, Eynon-Weyand Assocs. 313-354-3430
Minn Minneapolis, D. G. Perry & Co. 612-920-3212
NJ Hopatcong, R. P. Collins 201-526-9050
NY Ithaca, Bob Dean, Inc. 607-272-2187
NC Winston-Salem, Dula Assocs., Inc. 919-768-7166
Ohio Dayton, G. D. Clark 513-293-2818
Pa Allentown, J. Wade 215-432-2721
Tex Hurst, H. L. Moschel 817-336-4721
Tex Richardson, P. J. Scanlon Co. 214-231-4661
Wash Seattle, Carlyle Tech. Sls. 206-632-4290

COPPERWELD BIMETALLICS, Div. Copperweld Corp., Glassport, Pa., 15045, Tel: 412-664-7131, TWX: 710-794-4806; Mgr. Mktg. & Sls: J.W. Atman; Mgr. T&D: D.T. Jones; Mgr. Indust. Sls: A. Pudlak

CORCOM INC., 2635 N. Kildare Ave., Chicago, Ill., 60639, Tel: 312-384-7400, TWX: 910-221-5308; Sls. Mgr: J. Emma ..... Vol 2•558

Local Sales Offices & Reps.
Ariz Phoenix, Gramer & Co. 602-279-1231
Cal Hawthorne, Sutherland Sls. 213-679-0757
Cal Menlo Park, Straube Assocs. 415-323-2476
Colo Boulder, Straube Assocs. 303-443-8600
Conn Milford, Conti-Younger Assocs. 203-929-3294
Fla Altramonte Springs, W. M. M. Assocs. 305-831-4645
Fla Clearwater, W. M. W. Assocs. 813-726-8871
Fla Pompano Beach, N. M. M. Assocs. 305-943-3091
Ga Atlanta, G.S. O'Hara 404-237-0600
Ill Hinsdale, Mo-Mak Sls. 312-654-4524
Iowa Cedar Rapids, Palatine Engrg. Sls. 319-365-8071
Kans Andover, Palatine Engrg. Sls. 316-683-7512
Kans Overland Park, Palatine Engrg. Sls. 913-262-6820
Md Baltimore, D.K. Jones & Assocs. 301-752-0577
Mass Waltham, Conti-Younger Assocs. 617-890-4582
Mich Farmington, Sheridan Assocs. 313-477-3800
Minn Edina, M. Foster Co. 612-835-2252
Mo Kansas City, Palatine Engrg. Sls. 913-262-6820
Mo St. Louis, Palatine Engrg. Sls. 314-426-7055
NJ Haddonfield, Mesa Tech Assocs. 609-429-9531
NM Albuquerque, Straube Assocs. 505-294-1880
NY Buffalo, Telesco Assocs. 716-834-1026
NY Manhasset, Win-Cor Sls. 516-627-9474
NY Vestal, Telesco Assocs. 607-729-6339
Ohio Cincinnati, Sheridan Assocs. 513-761-5432
Ohio Cleveland, Sheridan Assocs. 216-524-8120
Pa Monroeville, Sheridan Assocs. 412-373-1070
Tex Plano, K & H Sls. 214-238-0336
Utah Salt Lake City, Straube Assocs. 801-328-4513
For: Can., Montreal, Quebec, Atlas Elctrns., Ltd. 514-489-8495
For: Can., Toronto, Ontario, Atlas Elctrns., Ltd. 416-781-6174

CORCOM Local Distributors
Ariz Phoenix, Moltronics, Inc., 2746 W. Palm LA. 602-272-7951
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal Mountain View, Terminal Hudson Electrns., 880 Maude Ave. 415-969-9240
Cal San Diego, Moltronics, Inc., 7969 Engineer Rd. 714-278-5020
Cal Santa Clara, Moltronics, Inc., 337 Mathews St. 408-244-7600
Cal South Gate, Moltronics, Inc., 5610 E. Imperial Hwy. 213-773-6521
Cal Sunnyvale, Westland Elctrns. Inc., 1118 Elko Dr. 408-734-1900

Colo Denver, Elctrn. Parts Co., 1212 S. Broadway 303-744-1992
Fla Orlando, Hammond Electrns., 911 W. Central Blvd. 305-241-6601
Ga Atlanta, Lykes-Jackson Electrns., 1135 Chattahoochee 404-355-2223
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
Mass Dedham, Gerber Elctrn., 852 Providence Hwy 617-329-2400
NJ Haddonfield, Mid-Atlantic Elctrns. Corp., 140 Haddon Ave. 609-428-8288, 215-923-6868
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Utah Salt Lake City, Alta-Land Elctrns., Inc., 2280 S. Main St. 801-486-7227
For: Can., Toronto, Ont., Atlas Elctrns. Ltd., 50 Wingold Ave. 416-781-6174

CORDOVER, CARL & CO., 104 Liberty Ave., Mineola, N.Y., 11501, Tel: 516-747-5150; Ptnr: J. Cordover

CORNELL-DUBILIER ELCTRNS., Div. Fed. Pacific Elec. Co., 150 Ave. L, Newark, N.J., 07101; Dir. Sls: J.M. Kaplan ..... Vol 2•559-561,718,719; Vol 3•406-410

Local Sales Offices & Reps.
Ark El Dorado, Bellew Sls. Co. 501-863-8325
Cal Los Altos 415-941-3399
Cal Venice 213-821-5001
Colo Denver 303-722-4641
Haw Honolulu
Ill Des Plaines 312-299-7761
Ind Indianapolis 317-545-6247
Mass Norwood 617-762-5333
Mich Detroit 313-882-1717
Minn Minneapolis 612-546-5361
Mo Florissant 314-831-1155
NJ Newark 201-589-7500
NM Albuquerque 505-298-1875
NY Rochester 716-544-9580
NC Sanford 919-775-2211
Ohio Cleveland 216-271-5429
Ohio Dayton 513-298-7224
Ore Portland 503-297-3776
Pa Norristown 215-272-0118
Pa Pittsburgh 412-563-0303
Tenn Nashville 615-242-5621
Tex Dallas 214-638-1035
Utah Salt Lake City 801-364-4632
Wash Seattle 206-285-1300
For: Can., Montreal 379, Quebec 514-331-2722
For: Can., Scarborough 733, Ont. 416-755-9346
For: Can., Vancouver 9, B.C. 604-731-1013

CORNELL-DUBILIER Local Distributors
Ala Birmingham, J.W. Clary Co., 1713 Second Ave. S. 205-322-2488
Ariz Phoenix, Moltronics, Inc., 2746 W. Palm LA. 602-272-7951
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way 213-685-5511
Cal Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave. 415-961-1500
Colo Denver, Burstein-Applebee 303-244-3336
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.
Ill Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave. 312-282-5400
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Kansas City, Burstein-Applebee 816-561-5460
Kans Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St. 913-362-3250
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Cinnaminson, Wilshire Elctrns/Phila., 855 Industry Hwy 609-786-8990
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NY Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave. 212-492-9590
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Elmsford, Melville Radio, 1 Nepperham Ave. 914-592-7100
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

CORNING GLASS WORKS, Elctrn. Prods. Div., Houghton Pk., Corning, N.Y., 14830, Tel: 607-962-4444, TWX: 510-252-1384; Sls. Mgr: R.E. Rahill Vol 3•412-435,1120-1125

Local Sales Offices & Reps.
Cal Sunnyvale 408-732-5050
Ill Chicago 312-337-6600
Md Hyattsville, Lowery Assocs.
NY New York 212-752-1100
NC Raleigh 919-876-1100
Pa Bradford 814-362-5571
Pa Broomall, Lowery 215-356-5300
Exp: Fla., Coral Gables 305-666-3334
Exp: N.Y., Corning 607-962-4444
For: Can., Leaside, Ont. 416-421-1500

CORNING Local Distributors
Ala Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave.SW 205-539-5722
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Cal Culver City, Avnet Electrns. Div., 10916 Washington Blvd. 213-836-7200
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Gardena, Bell Industries, 306 E. Alondra Blvd. 213-321-5802
Cal Hollywood, Hamilton/Avnet Elctrncs. 305-925-5401
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal Sunnyvale, Acacia Sales, 384 San Aleso
Colo Denver, Cramer/Denver, 5465 E. Evans Place at Hudson 303-758-2100
Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641
Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181
Fla Hollywood, Schweber Elctrns. 305-927-0511
Fla Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214 305-894-1511
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Schweber Elctrns. 312-593-2740
Ill Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave. 312-282-5400
Ind Indianapolis, Graham Elctrncs., 133 S. Penn. St. 317-634-8480
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110
Md Hyattsville, Milgray/Washington, 5405 Lafayette Pl. 301-864-1111
Md Rockville, Schweber Elctrns. 301-881-2970
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mass Newton, Cramer/International, 85 Wells Ave. 617-969-7700
Mass Waltham, Schweber Elctrns. 617-890-8484
Mass Watertown, Sterling Electronics, 51 Spring St. 617-926-9720
Mich Detroit, Schweber Elctrns. 313-583-9242
Minn St. Paul, Ragon, 1136 W. Larpenteur St. 612-488-0201
NJ Pennsauken, Cramer/Pa., 7300 Rte. 130 No. 215-923-5950
NJ Somerset, Schweber Elctrns. 201-469-6008
NM Albuquerque, Cramer/N.M., 137 Vermont N.E. 505-265-5767
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY East Syracuse, Cramer/Syracuse, 6716 Joy Road 315-437-6671
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
NY Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue 516-231-5682
NY Rochester, Cramer/Rochester, 3259 Winton Road South 716-275-0300
NY Rochester, Schweber Elctrns. 716-328-4180
NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474
NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700
NC Raleigh, Schweber Elctrns. 919-832-8881
NC Winston-Salem, Cramer/EW, 938 Burke Street 919-725-8711
Ohio Beachwood, Schweber Elctrns. 216-464-2970
Ohio Cincinnati, Sheridan Sales Co., 10 Kradlecrest Dr. 513-761-5432
Ohio Columbus, Hughes-Peters, Inc., 481 E. 11th Ave. 614-294-5351
Pa Philadelphia, Almo Elctrns, 9815 Roosevelt Blvd. 215-676-6000
Tex Dallas, Solid State Elctrns. 214-352-2601
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
Utah Salt Lake City, Cramer/Utah, 391 West 2500 South 801-487-3681
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
For: Can., Montreal, CESCO Ltd., 4050 Jean Talon St., W. 514-735-5511
For: Can., Toronto, Ont., CESCO Ltd., 24 Martin Roos Ave. 416-628-5353

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

CORNING GLASS WORKS, FLUIDIC PRODUCTS DEPT., Corning, N.Y., 14830, Tel: 607-962-4444, TWX: 510-252-1384; Sls. Mgr: W.T. Greenfield

CORNING GLASS WORKS, Memory Prods. Dept., 3900 Electronics Dr., Raleigh, N.C., 27602, Tel: 919-828-0511; Sls. Mgr: H.S. Craumer

CORNING GLASS WORKS, Corning Scientific Instruments, Medfield, Mass., 02052, Tel: 607-962-4444, TWX: 510-252-1384; Sls. Mgr: R.G. Morrison

CORNING GLASS WORKS, Tech. Prods. Div., Corning, N.Y., 14830, Tel: 607-962-4444, TWX: 510-252-1384; Sls Mgr. Advanced Prods: W.M. Baldwin; Sls Mgr. Indl Mats: F.B. Leibold

CORNING GLASS WORKS, TELEVISION PRODS. DIV., Corning, N.Y., 14830, Tel: 607-962-4444, TWX: 510-252-1384; Sls. Mgr: D.R. Dolan

CORTEC, 890 Production Pl., Newport Beach, Cal., 92660, Tel: 714-642-1877; Pres: H.H. Milligan; V.P. Mfg: A. Herbert

CORVAIR ELCTRNS, 150 Fifth Ave., New York, N.Y., 10011, Tel: 212-255-7007; Sls. Mgr: S. Kass

COSAR CORP., 3121 Benton Street, Garland, Texas, 75042, Tel: 214-BR-6-9487; Sls. Mgr: D.N. Dukes

Local Sales Offices & Reps.

Cal	Los Angeles, P. Wiley Co.	213-663-8028
Cal	Palo Alto, Testco	415-326-5320
Conn	Greenwich, Cosar Corp.	203-661-2325
Ill	Chicago, Cosar Corp.	312-539-6181
Ohio	Vandalia, W.J. Brauer	513-898-1224
Ohio	Wickliffe, W.J. Brauer	216-943-0601
Pa	Newtown Sq., Holdsworth	215-356-8550
Pa	Pittsburgh, W.J. Brauer	412-921-3213
Wash	Bellevue, Testco	206-454-7422

COSMICAR OPTICAL CO., LTD., 424, Higashi-Oizumimachi, Nerima-Ku, Tokyo, Japan, Tel: 03-921-1441; Sls. Mgr: N. Amano

Local Sales Offices & Reps.

NY	NY, Asahi Optical (America) Inc.	212-532-4876

COSMO PLASTICS CO., 3239 West 14th St., Cleveland, Ohio, 44109, Tel: 216-861-5594, TWX: 810-421-8444; Sls. Mgr: B. Gordon

COTO-COIL CO., INC., 57 Pavilion Ave., Providence, R.I., 02905, Tel: 401-941-3355; Sls. Mgr: R.L. Bellem Vol 2•720,721

Local Sales Offices & Reps.

Cal	Palo Alto, P. Nurches	415-DA-6-7842
Cal	Pasadena, P. Nurches	213-MU-1-8957
Conn	Plantsville, Parnetics Co.	203-621-3911
NJ	Sparta, Eastern Elctrn.	
NY	Brookline, Eastern Elctrn.	212-763-5180
Ohio	Cincinnati, J. Olsen	513-922-2176
Ohio	Cleveland, J. Olsen	216-752-5444
Pa	Pittsburgh, J. Olsen Co.	412-279-2550
Wash	Seattle, H. Levinson	206-323-5100
Exp:	N.Y., N.Y., Coto-Coil	

COUCH S.H. DIV., ESB Inc., 36 River St., Boston, Mass., 02126, Tel: 617-298-4147; V.P: B.W. Gray; S.M: E.F. Baker; Sls: J.A. Taber .....Vol 2•723

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Engrg. Sls.	602-945-1927
Cal	Burbank, TransDynamics, Inc.	213-849-6261
Cal	Palo Alto, Engrg. Assoc.	415-326-7842
Cal	San Diego, TransDynamics, Inc.	714-298-8215
Colo	Denver, I. W. Strong	303-292-6900
Conn	Madison, A&M Elctrn. Reps.	203-245-1031
Fla	Orlando, Buchanan & Abrams Assocs.	305-423-8995
Ill	Wheaton, H.J. Batha	312-668-4740
Iowa	Cedar Rapids, Snider Sls.	319-362-4410
Mich	Grand Rapids, Elko Sls.	616-949-1451
Mich	Grosse Pointe Woods, Elko Sls.	313-884-7893
Minn	Mpls., Int'l. Sls. Co.	218-881-6683
Mo	St. Louis, Pem Sls.	314-427-7200
NY	Rochester, J. G. Welch	716-244-1100
NY	Syracuse, H.R. Murray	315-446-5555
NC	Winston-Salem, Radco	919-722-9671
Ohio	Cincinnati, Phister Equip. Co.	513-421-3850
Ore	Portland, J.W. Eckersley	503-246-3183
Pa	Phila, Technicraft Co.	215-483-4700
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Cal	El Segundo	213-640-0443
Cal	Goleta, Delco Elctrns. Div., GMC	805-968-1011
NJ	Union	201-687-3770
Wisc	Milwaukee, Avionics Sls.	414-762-7000
Exp:	N.Y., New York, GMOO	212-486-3723

DELCO Local Distributors

Ala	Birmingham, Forbes Dist. Co., 1416 Fourth Ave. S.	
Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Ariz	Phoenix, Sterling Elctrns., Inc., 1930 No. 22nd Ave.	602-258-4531
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Cramer/San Diego, 8975 Complex Drive	714-565-1881
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	Sunnyvale, Cramer/San Fran., 720 Palomar Ave.	408-739-3011
Colo	Denver, Cramer/Denver, 5465 E. Evans Place at Hudson	303-758-2100
Conn	Norwalk, Harvey/Conn.	203-853-1515
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Miami Springs, Powell Elctrns. Inc., 1740 N.W. 69 Ave., Box 514	
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Fla	Orlando, Powell Elctrns. Inc., 2032 Palmridge Way, Box 5604	305-859-1450
Ill	Rosemont, Kierulff - Chicago, 9340 William St.	312-678-8560
Ill	Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave.	312-282-5400
Ind	Indianapolis, Graham Elctrncs., 133 S. Penn. St.	317-634-8480
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Needham Hgts., Kierulff - Boston, 14 Charles St.	617-449-3600
Mass	Newton, Greene-Shaw Co., 70 Bridge St	617-969-8900
Mich	Farmington, Harvey - Michigan Inc., 23461 Ind'l Pk Dr.	313-477-1650
Minn	Minneapolis, Harry Stark Electrns. Supply, 112 3rd Ave., N.	612-332-1325
Mo	No. Kansas City, LCOMP-Kan City, 1520 Taney St.	910-221-2400
Mo	St. Louis, LCOMP-St. Louis Inc., 2605 S. Hanley Rd.	314-647-5505
NJ	Clifton, Eastern Radio, 312 Clifton Ave.	201-471-6600
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Road	315-437-6671
NY	Rochester, Cramer/Rochester, 3259 Winton Road South	716-275-0300
NY	Vestal, Federal Elctrn., Vestal Pkwy.	
NY	Woodbury, Harvey Radio, 60 Crossways Park W.	516-921-8700
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080

Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Dayton, Kierulff - Dayton, 2030 Drill Ave. 513-278-9411
Pa Philadelphia, Almo Elctrns, 9815 Roosevelt Blvd. 215-676-6000
Pa Pittsburgh, RPC Elctrns., 620 Alpha Dr. 412-782-3770
SC Columbia, Dixie Radio Supply, Box 408 803-253-5333
Tex Dallas, Adleta Elctrns. Co., 214-741-3151 3151
Tex Garland, Kierulff-Dallas, 2815 National Dr. 214-271-2472
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Cramer/Utah, 391 West 2500 South 801-487-3681
Va Richmond, Meridian Electrns., 1001 W. Broad St. 703-355-0669
Wash Seattle, Kierulff - Seattle, 5940 6th Ave. S. 206-763-1550
For: Can., Ont., Scarborough, Lake Engrg. Co. Ltd., 123 Manville Rd. 416-751-5980

DELEVAN DIV. AMERICAN PRECISION IND., Clutch & Brake Prods., 272 Quaker Rd., E. Aurora, N.Y., 14052, Tel: 716-652-3600; Dir. of Sls. J. Mendolia; Sls. Engr: J. Holmes ..... Vol 2*638; Vol 3*526

Local Sales Offices & Reps.
Ariz Phoenix, Southwest Engrg., Inc. 602-944-1521
Cal Los Altos, Servo-Data 415-964-1326
Cal Los Angeles, L-Tronix 213-256-2224
Colo Denver, Walter Engrg. Assoc. 303-777-5585
Fla Boca Raton, Conley & Assocs. 305-395-6108
Fla Oviedo, Conley 305-365-3283
Fla Tampa, Conley & Assoc. 813-933-3183
Ill Hinsdale, Momak Sls. 312-654-4524
Kans Leawood, H.C. Heyde 913-649-8628
Md Towson, J.A. Dougherty 301-823-0431
Mass Boston, P.J. Engrg. Sales 617-924-5950
Minn Minneapolis, E.C. Elctrn. Sls. 612-831-0229
NJ Cranford, Martech Assoc. 201-272-5510
NY Manhasset, Martech Assoc. 516-627-1151
Pa Phila., Loman 215-732-8888
Tex Dallas, Scott Technical 214-FL-2-7698
For: Can., Montreal, Que., J. Weiss 514-489-6887
For: Can., Rexdale, Ont., J. Weiss 416-742-5195
For: Can., Vancouver, B.C., J. Weiss 604-987-3833

DELEVAN DIV., COIL PRODS., American Precision Inds., 270 Quaker Rd., E. Aurora, N.Y., 14052, Tel: 716-652-3600; Sls. Mgr: F. Riehle
Vol 2*638; Vol 3*526

Local Sales Offices & Reps.
Ariz Phoenix, Toward Engrg. 602-955-3193
Cal Los Angeles, L-Tronix Assoc. 213-256-2224
Cal Menlo Park, Long & Assoc. 415-327-1300
Colo Denver, Walter-Engrg. 303-777-5585
Fla Boca Raton, Conley & Assc. 305-395-6108
Fla Oviedo, Conley & Assoc. 305-365-3283
Fla Tampa, Conley & Assoc. 813-933-3183
Ill Hinsdale, MO-MAK Sls. 312-654-4524
Ind Ft. Wayne, W.W. Bieberich 219-432-2537
Iowa Cedar Rapids, Lorenz Sls. 319-366-0774
Kans Leawood, H.C. Heyde Co. 913-649-8628
Md Towson, J. Dougherty Sls. 301-823-0431
Mass Boston, P.J. Engrg. 617-924-5950
NJ Cranford, Martech Assc. 201-272-5510
NJ Haddonfield, Thomas Assocs. 609-854-3011
NY Endicott, Tech-Mark 607-748-7473
NY Fairport, Tech-Mark 716-223-1252
NY Manhasset, Martech Assc. 516-627-1151
Ohio Cleveland, C. Robinson 216-381-9049
Ohio Dayton, C. Robinson 513-275-2412
Okla Broken Arrow, P.J. Scanlon Co. 918-251-1427
Ore Portland, D.G. Weber Co. 503-234-7671
Tenn Shelbyville, R. Mitscher 615-684-4544
Tex Houston, P.J. Scanlon 713-466-6897
Tex Richardson, P. Scanlon 214-231-4661
Wash Seattle, D. G. Weber Co. 206-623-5990
For: Can., Montreal, Que., J. Weiss 514-489-6887

DELEVAN Local Distributors
Cal Glendale, R. V. Weatherford, 6921 San Fernando Rd. 213-849-3451
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal Pasadena, Dow Radio - Milo, 1759 E. Colorado Blvd. 213-681-8111
Cal Sunnyvale, Cramer/San Fran., 720 Palomar Ave. 408-739-3011
Cal Woodland Hill, Rampart Components, 21201 Oxnard St. 213-887-7260
Fla Tampa, Lykes Elctrns Corp., 121 S. Ashley Dr. 813-229-1885
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
Mass Boston, P. J. Engrg. Supply Co., 360 N. Beacon St. 617-783-0510
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
NY Hauppauge, Rampart Components, Engineers Rd. 516-273-1111
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200

DELAVAN ELECTRONICS, 14441 No. 73rd St., Scottsdale, Ariz., 85260, Tel: 602-948-6350; Pres. & Gen. Mgr: H.P. Andreasen

DELTA-BENCO LTD., 70 Ronson Dr., Rexdale, Ont., Can., Tel: 416-241-2651; Sls. Mgr: D. Fear

DELTA DESIGN, 5725 Kearny Villa Road, San Diego, Cal, 92123, Tel: 714-292-5000, TWX: 910-335-1215; Sls. Mgr: E. Kersting; Sls. Spvr: G. Whitlock

DELTARAY CORP., 10A Henshaw St., Woburn, Mass., 01801, Tel: 617-935-3114; Pres: W.D. Bygrave; V.P: B. Skillicorn

Local Sales Offices & Reps.
Cal Los Angeles, West Kensington Engrg. 213-221-4104
For: Can., Downsview Ont., Aptec Engineering Ltd. 416-661-9722

DELTEC CORP., 2775 Kurtz St., San Diego, Cal., 92110, Tel: 714-297-4466; S.M: G. Thomas ..... Vol 1*658,659

Local Sales Offices & Reps.
Cal Los Angeles, Basic Sys. 213-938-2833
Cal Palo Alto, Mauldin Co. 415-326-5291
Cal So. Pasadena, Q.P.L. Inc. 213-682-3705
Md Silver Spring, Sel-Tronics, Inc. 301-589-3391
Mass Waltham, McBar Assoc., Inc. 617-890-0233
NJ Pennsauken, Megargal Himmelstein Assoc. 609-662-3081
Tex Houston, SESCO 713-668-7840
Tex Richardson, SESCO 214-231-9364

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

DELTROL CONTROLS, 2745 S. 19th St., Milwaukee, Wisc., 53215, Tel: 414-671-6800; V.P. Sls: F. Wolf, G. Shepherd

Local Sales Offices & Reps.
Cal Los Angeles, Cummings & Assoc. 213-340-6035
Cal Palos Verdes Estates, Deltrol Controls 213-377-4294
Cal San Francisco, Cummings & Assoc. 408-378-0777
Conn Thomaston, Nelson & Schoonmaker 203-283-5959
Fla Orlando, Gra-Mar Inc. 305-894-3351
Ga Decatur, Deltrol Controls 404-243-1964
Ill Chicago, Deltrol Controls 312-544-5505
Ind Ft. Wayne, W. Bieberich Co. 219-432-2537
Ind New Albany, W. W. Bieberich 812-945-3187
Md Lutherville, Timonium, Naudain Assoc. 301-252-5378
Mich Benton Harbor, Ken-Mor Assoc. 616-927-3134
Mich Rochester, Ken-Mor Assoc. 313-651-1890
Minn St. Paul, Kenco Co. 612-645-7717
Mo Hazelwood, Dy-Tronix 314-731-5799
Mo Kansas City, Dy-Tronix 816-761-6543
NH Milford, Nelson & Schoonmaker 603-673-5333
NJ Marlton, A. E. Luba & Assoc. 609-983-6660
NY Plainview, Deltrol Controls 516-931-3815
NY Rochester, Deltrol Controls 716-473-3340
Ohio Cleveland, Deltrol Controls 216-421-4080
Ohio Dayton, Deltrol Controls 513-223-3502
Okla Tulsa, T. J. Ray Co. 918-627-1515
Ore Portland, Almac/Stroum Elctrns. 503-292-3534
Tex Dallas, E. F. Aymond Co. 214-826-7620
Tex Houston, E. F. Aymond Co. 713-783-3640
Wash Seattle, Almac/Stroum Elctrns. 206-763-2300
Wisc Wauwatosa, F.C. DuBois & Assoc. 414-774-3100

DELTROL Local Distributors
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300

DELTRON, INC., Wissahickon Ave., N. Wales, Pa., 19454, Tel: 215-699-9261, TWX: 510-661-8061; Field Sls. Engr: B. Webb; Sls. Engr: J. Phillips

Local Sales Offices & Reps.
Ariz Scottsdale, Inter-Mountain Engrg. 910-950-0082
Cal Palos Verdes Peninsula, R. Carretta Co. 213-375-6648
Cal Santa Clara, Richards Assoc. 408-246-5860
Colo Littleton, Inter-Mountain Engrg. 303-794-9111
Fla Orlando, F. Fausett & Co., Inc. 305-894-6071
Ga Smyrna, F. Fausett & Co., Inc. 404-436-5169
Haw Honolulu, Aloha Assocs. 808-941-1574
Ill Mt. Prospect, Magnuson Assocs. 312-956-0700
Kans Merriam, Technical Reps. 913-432-4110
Md Silver Spring, Sel-Tronics Corp. 301-589-3391
Mich Detroit, Micro Sls. Corp. 313-482-1229
Minn St. Paul, Magnuson Assocs. 612-227-8495
Mo Hazelwood, Technical Reps. 314-524-6900
NM Albuquerque, Inter-Mountain Engrg. 505-344-2212
NY Baldwinsville, Scibetta Reps. 315-622-3993
NY Tuckahoe, Spectrum Sls. 914-793-1660
NY Tuckahoe, Spectrum Sls. 914-793-1660
Ohio Cleveland, Micro Sls. Corp. 216-243-7430
Ohio Dayton, Micro Sls. Corp. 513-298-3033
Ore Portland, McLaren, Inc. 503-297-2248
Tex Dallas, Data Aids Assocs. 214-620-1551
Tex Houston, Data Aids Assoc. 713-785-0581
Va Vinton, F. Fausett & Co., Inc. 703-890-1128
Wash Bellevue, McLaren, Inc. 206-454-3400
For: Can., Don Mills, Ontario, Componetics Ltd. 416-445-3230
For: Can., Montreal, Quebec, Componetics Ltd. 514-342-4117

DEMEX, INC., 2130 Jefferson, Kansas City, Mo., 64108, Tel: 816-421-3181; Sls. Mgr: J. Clawson

DENISON, R.B., INC., 103 Broadway, Bedford, Ohio, 44146, Tel: 216-232-8200; V.P. Sls: W.H. Houghton

Local Sales Offices & Reps.
Ala Birmingham, J. Spader Co. 205-879-1366
Ariz Scottsdale, J.T. Aldrich 602-945-8598
Ark Fort Smith, J.R. Masterson 501-646-7756
Cal , Artwel Elec. Inc. 415-467-1880
Cal Los Angeles, R.B. Clapp Co. 213-225-2395
Colo Denver, TESSCO 303-744-1119
Conn Hartford, R. Sawtell Assoc. 413-562-6627
Fla Indian Rocks Beach, Kirk Sls. Co. 813-595-7353
Ga Buford, W.E. Cook 404-945-7572
Ill Chicago, G.H. Anderson 312-728-3827
Ind Indianapolis, L.W. Loyen Co. 317-359-0311
Kans Prairie Village, Vern Marlo 913-432-0933
Mass Norwood, R.P. Hyland Co. 617-762-0345
Mich Detroit, R. McBride Co. 313-532-8040
Minn Minneapolis, W.A. Hallock Co. 612-920-6100
Mo St. Louis, R. Greene Co. 314-644-2666
NJ Moorestown, Miller & Dietz Co. 609-234-1050
NY East Amherst, Overs Assoc., Inc. 716-633-8889
NY Flushing, Tri State Comps., Inc. 212-358-1010
NC Charlotte, W.E. Cook & Assoc. 704-525-3384
Ohio Cleveland, J.L. Finnicum & Assoc. 216-226-7076
Pa Pittsburgh, R.F. Clark Co. 412-242-9500
Tex Dallas, Stout Schmidt Co. 214-241-4435
Va Richmond, Reynolds Cowardin Assoc. 703-266-3457
Wash Seattle, H. Campbell Co. 206-634-1200

DERINGER MFG. CO., 1250 Town Line Rd., Mundelein, Ill., 60060, Tel: 312-566-4100, TWX: 910-685-4321; Sls. Mgr: G. Brown

DESCO MFG. CO., 1530 Flower St., Glendale, Calif., 91201, Tel: 213-241-9560; Sls. Mgr: J.A. MacDonald

DESIGN AUTOMATION, INC., 809 Massachusetts Ave., Lexington, Mass., 02173, Tel: 617-862-8998; Sls. Mgr: N.O. Sokal

DESIGN ELEMENTS, 1356 Norton Ave., Columbus, Ohio, 43212, Tel: 614-294-2694; Sls. Mgr: G. Gerhard

Local Sales Offices & Reps.
Cal Los Angeles, M1 Data Sys. 213-641-7092
Pa Philadelphia, M1 Data Sys. 215-647-0797

DESPATCH OVEN CO., P.O. Box 1320, Minneapolis, Minn., 55440, Tel: 612-331-1873; V.P. Dev: H. Melgaard

DETECTO SCALES, INC., 103-00 Foster Ave., Brooklyn, N.Y., 11236, Tel: 212-272-4500; Sls. Mgr: M. Rapp

DEUTSCH FASTENER CORP., 7001 W. Imperial Hwy., Los Angeles, Cal., 90045, Tel: 213-649-1400, TWX: 213-673-1000; V.P: B. Gulistan; V.P: E. Baumgarten

DEUTSCH RELAYS INC., 65 Daly Rd., E. Northport, N.Y., 11731, Tel: 516-864-6000, TWX: 510-226-0233; Sls. Eng: R. Graeb; Sls. Eng: W. Radzvilla ..... Vol 2*698,699

Local Sales Offices & Reps.
Cal Upland, W. Salveson 714-985-9931
Fla Altamonte Springs, Semtronic Assocs. 305-831-8233
Fla Ft. Lauderdale, Semtronic Assocs. 305-566-9917
Ga Smyrna, F. Fausett & Co. 404-436-5169
Ill Chicago, Berndt Assocs. Inc. 312-283-0713

Iowa Cedar Rapids, J.R. Sales Engrg. 319-377-8211
Kans Wichita, D & O Engrg. 316-AM-4-7358
Mo St. Louis, Hitt & Assocs. 314-426-2322
NY Hyde Park, R.P. Kennedy Co. 914-229-2269
NY Rochester, R.P. Kennedy Co., Inc. 716-271-6322
Ohio Cleveland, Electro-Com 216-886-2404
Ohio Dayton, Electro-Com 513-276-3993
Ore Portland, Norwest Co. 503-287-5050
Pa King of Prussia, Monteiro Assocs. 215-265-0634
Tex Dallas, Allied Comps. Inc. 214-348-6660
Tex Houston, Allied Components Inc. 713-782-5406
Va Vinton, Fausett of Georgia 703-890-1128
Wash Seattle, Norwest Co. 206-AT-2-3707
For: Can., Toronto, Patlon Aircraft & Ind. Ltd. 416-239-7389

DEVCO ENGRG., Control Sys. Div., Pier La., W. Caldwell, N.J., 07006, Tel: 201-CA-8-0321; Sls. Mgr: R.S. West

DI-ACRO, Div. Houdaille Inds., Inc., 316 8th Ave., Lake City, Minn., 55041, Tel: 612-345-3331; V.P.-Mktg: E.T. Moe

DI/AN CONTROLS, INC., 944 Dorchester Ave., Boston, Mass., 02125, Tel: 617-288-7700, TWX: 710-333-1732; Sls. Mgr: H.R. Smith, Jr.

DIAL PRODS. CO., 19-21 Cottage St., Bayonne, N.J., 07002, Tel: 201-HE-7-0720; Sls. Mgr: G. Markert

Local Sales Offices & Reps.
Me Liberty, Adcour - A.H. Lindsay 207-589-3290
Mass Sharon, Adcour 617-784-3996

DIALIGHT CORP., 60 Stewart Ave., Brooklyn, N.Y., 11237, Tel: 212-497-7600, TWX: 710-584-5487; Sls. Eng: C. Dombruski; Sls: H. Goodman ..... Vol 2•482,483

Local Sales Offices & Reps.
Ariz Phoenix, R. Stitzer Co. 602-944-6808
Cal Oakland, F. Moulthrop 415-261-7676
Cal Pico Rivera, Westrep 213-949-2551
Colo Denver, R. Bowen 303-722-4641
Fla N. Miami, Cartwright & Bean 305-945-2962
Fla Orlando, Cartwright & Bean 305-425-8284
Ga Atlanta, Cartwright & Bean 404-237-2273
Ill Hinsdale, Hill-Gray 312-325-4810
Ind Angola, Southern Sls. Co. 219-665-3961
Ind Ft. Wayne, K-W Elctrn. Sls. 219-744-0589
Ind Indpls., Southern Sls. 317-257-7575
Ky Louisville, Southern Sls. 502-583-6902
La Charlette, Cartwright & Bean 504-279-4598
Mass Newtonville, C. Segel 617-969-6900
Mich Detroit, Hilltronics 313-342-3242
Minn St. Paul, R.G. Ragon 612-488-0201
Mo Kansas City, K & M Sls. 816-471-1355
NJ Wayne, R. Horne 201-835-7400
NM Albuquerque, Staley Co. 505-294-2660
NY Cazenovia, A. Perkins 315-682-5005
NC Charlotte, Cartwright & Bean 704-333-6457
Ohio Cleveland, KW Elctrn. Sls. 216-831-8292
Ohio Dayton, KW Elctrn. Sls. 513-890-2150
Ore Portland, Almac/Stroum 503-292-3534
Pa Broomall, L. Lowery 215-528-5170
Tenn Memphis, Cartwright & Bean 901-276-4442
Tex Dallas, Texport Co. 214-358-3435
Tex Houston, Texport Co. 713-464-2828
Utah Salt Lake City, R. Bowen 801-364-4632
Wash Seattle, Almac/Stroum 206-763-2300
For: Can., Scarborough, Ont., Lake Eng. Co. Ltd. 416-751-5980

DIALIGHT Local Distributors
Ariz Phoenix, Moltronics, Inc., 2746 W. Palm LA. 602-272-7951
Cal Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr 415-323-9431
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
La Baton Rouge, Ralph's, Inc., 1732 Plank Rd. 504-344-3761
La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Elmsford, Melville Radio, 1 Nepperham Ave. 914-592-7100
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Beaumont, Ralph's, Inc., 1270 Broadway 713-833-9443
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Tex Houston, Lenert Co., Box 2184 713-225-1465
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100

DICKSON ELCTRNS. CORP., Box 1390, Scottsdale, Ariz, 85252, Tel: 602-947-2231, TWX: 910-950-1292; Mktg. Mgr: F.T. Troilo

DICKSON Local Distributors
Ala Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr. 205-539-2731
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DRAKE, R.L., CO., 540 Richard St., Miamisburg, Ohio, 45342, Tel: 513-866-2421; Sls. Mgr: P.W. Drake

DRANETZ ENGRG. LABS., 2385 S Clinton Ave., So. Plainfield, N.J., 07080, Tel: 201-755-7080; Sls. Mgr: A. Ackerman ..... Vol 1•423-427

Local Sales Offices & Reps.

Ala	Huntsville, Kemp Instrs.	205-837-4304
Ariz	Tempe, Tari Engrg.	602-275-1372
Cal	Newport Beach, F. L. Feeger, Lucas & Wolfe	714-540-4412
Cal	No Hollywood, F. L. Feeger, Lucas & Wolfe	213-877-5518
Cal	Palo Alto, Coherent Mktg. Assoc.	415-327-2217
Cal	San Diego, Qualtronics	714-244-6555
Fla	Maitland, Greenstein Assocs.	305-831-5380
Haw	Honolulu, Aloha Assocs.	808-941-1574
Ill	Chicago, L. F. Green & Assocs.	312-286-6824
Ind	Indianapolis, L. F. Green & Assocs.	317-253-2087
Md	Wheaton, Sonco	301-942-9420
Mass	Newtonville, H. J. Schuft Co.	617-527-5304
Mich	Royal Oak, Satullo Co.	313-LI-9-3910
Minn	Minneapolis, L. F. Green & Assoc.	612-781-1611
Mo	Maryland Heights, Delltron Co.	314-434-3804
NJ	Fairfield, KLS Assocs.	201-227-2900
NY	Rochester, Scientific Devices	716-334-2445
NC	Charlotte, Ranson, Wallace & Co.	704-334-4244
Ohio	Cleveland, Satullo Co.	216-486-2800
Ohio	Dayton, Satullo Co.	513-293-7061
Pa	King of Prussia, Sonco	215-CH-2-8460
Pa	Norristown, Holmes Assocs.	215-279-8210
Tex	Fort Worth, C Wolfe Assocs.	817-738-1996
Tex	Houston, C Wolfe Assocs.	713-643-2114
Wash	Bellevue, Topp Engrg. Sls.	206-747-5401
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Local Sales Offices & Reps.

Ala	Huntsville, Young & Lawrence Assoc.	205-539-6575
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Cal	Pasadena, Dressen-Barnes	213-795-7731
Cal	San Diego, Vistronics	714-283-3946
Fla	Ft. Lauderdale, Young & Lawrence Assoc.	305-563-6717
Fla	St. Petersburg, Young & Lawrence Assoc.	813-894-0026
Fla	Winter Park, Young & Lawrence Assoc.	305-647-6929
Ill	Wheaton, Engrg. Prods.	312-653-6826
Kans	Merriam, Technical Reps.	913-432-4110
Md	Rockville, Eastronics	301-762-8445
Mass	Bedford, D. Greene Org.	617-275-6400
Mich	Detroit, Hocker Assocs.	313-431-1403
Minn	St. Paul, Engrg. Prods.	612-646-8819
Mo	Hazelwood, Technical Reps.	314-524-6900
NY	Elmira, A & D Dev.	607-733-0405
NY	Hartsdale, Comp. Sls.	914-725-1050
NY	Rochester, A & D Devices	716-586-8033
NY	Verona, A & D Devices	315-337-7321
Ohio	Dayton, Hocker Assocs.	513-298-8638
Tex	Dallas, Stevens Sls. Co.	214-350-2476
Wash	Seattle, Avionics-Liaison	206-767-3870

DUKANE CORP., 2900 DuKane Dr., St. Charles, Ill., 60174, Tel: 312-JU-4-2300; Dir. of Sls: G.B. Shawn

DUMONT ELECTRON TUBES, Div. of Fairchild Camera & Instr. Corp., 750 Bloomfield Ave., Clifton, N.J., 07015, Tel: 201-773-2000, TWX: 710-989-7149; Mkt. Svc. Mgr: G. Petro; Sls. Engr: M. Nakazono; Sls. Engr: J. Chako

DUMONT OSCILLOSCOPE LABS., INC., 40 Fairfield Pl., W. Caldwell, N.J., 07006, Tel: 201-575-8666, TWX: 710-734-4308; Sls. Mgr: P. Zagaria

DUNCAN ELCTRNS., 2865 Fairview Rd., Costa Mesa, Cal., 92626, Tel: 714-545-8261, TWX: 910-595-1128; Reg. Sls. Mgr: R.L. Rissler; Reg. Sls. Mgr: J. Laughlin Vol 3•1224,1225

Local Sales Offices & Reps.

Ariz	Phoenix, Southwest e/m Engrg., Inc.	602-944-1521
Cal	Costa Mesa, Duncan Elctrns., Inc.	714-545-8261
Cal	Glendora, The Telemart Co.	213-334-7119
Cal	San Mateo, Jack Pyle Co.	415-347-1401
Colo	Wheatridge, Waugaman Assocs., Inc.	303-423-1020
Conn	New Haven, Gerber Sls. Corp.	203-777-6279
Fla	Ft. Lauderdale, Orbe, Inc.	305-771-8915
Fla	Palm Beach Gardens, Orbe, Inc.	305-622-6464
Fla	St. Petersburg, Orbe, Inc.	813-894-0687
Ga	Atlanta, Grady Duckett Sls. Co.	404-451-3529
Ill	Chicago, Carlson Elctrn. Sls. Co.	312-774-0277
Md	Rockville, Marktron, Inc.	301-762-6210
Md	Towson, Marktron, Inc.	301-825-8222
Mass	East Longmeadow, Gerber Sls. Corp.	413-LA-5 -3059
Mass	Waltham, Gerber Sls. Corp.	617-890-8040
Mich	Detroit, Greiner Assocs., Inc.	313-499-0188
Minn	Minneapolis, J-Ex Elctrns. Sls. Co.	612-566-5340
Mo	St. Louis, Carlson Elctrn. Sls. Co.	314-991-0262
NJ	Irvington, Sencor, Inc.	201-371-6927
NY	Binghamton, Reed Elctrns., Inc.	607-722-7929
NY	Copiague, Sencor, Inc.	516-691-2204
NY	Rochester, Reed Elctrns., Inc.	716-473-2767
Ohio	Columbus, Rockford Controls Ohio, Inc.	614-231-5890
Ohio	Dayton, Rockford Controls Ohio, Inc.	513-278-7362
Ohio	Euclid, Rockford Controls Ohio, Inc.	216-731-5250
Okla	Tulsa, Kemp Engrg. Co. Inc.	918-628-0309
Pa	Erie, Rockford Control Ohio, Inc.	814-452-3762
Pa	Pa., Sencor, Inc.	215-342-0223
Tex	Dallas, Kemp Engrg. Co., Inc.	214-357-6663
Tex	Houston, Kemp Engrg. Co., Inc.	713-688-1431
Wash	Seattle, Carlyle Tech. Sls.	206-ME-2 -4290

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Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Mountain View, Terminal Hudson Electrns., 880 Maude Ave.	415-969-9240
Cal	San Carlos, Sterling Electronics, 1061 Industrial Rd.	415-592-2353
Cal	Sun Valley, Richey Elctrn. Inc., 10871 La Tuna Canyon Rd.	213-875-2862
Fla	Miami, Lykes Elctrns. Corp., 1800 N.W. 23 St.	
Fla	Tampa, Lykes Elctrns Corp., 121 S. Ashley Dr.	813-229-1885
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Bodelle Co., Inc., 13803 S. School St.	
Ind	Ft. Wayne, Bodelle Co., Inc., 3342 Terry La.	
Mass	Watertown, Sterling Electronics, 51 Spring St.	617-926-9720
Mich	Detroit, Bodelle Co., Inc., 20441 James Couzens Hwy.	
Minn	Minneapolis, Harry Stark Electrns. Supply, 112 3rd Ave., N.	612-332-1325
NJ	Clifton, Parts Master, 411 Main Ave.	
NJ	Perth Amboy, Sterling Elctrns., 774 Pfieffer Blvd.	
Ohio	Akron, Akron Elctrnc. Supply, 107 S. Arlington St.	
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ohio	Dayton, J. A. Becker Co., 1341 E. 4th St.	513-224-1071
Ohio	Warren, REM Elctrns. Supply Co., 264 W. Market St.	216-399-2777
Ohio	Warren, REM Elctrns. Supply Co., 264 W. Market St.	
Pa	Allentown, A.A. Peters, 404 Union Blvd.	
Pa	Braddock, M. Leff Radio Parts Co., 223 Braddock Ave.	
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Southwest Elctrns. Inc., 5700 Savoy La.	
Tex	Irving, Southwest Elctrns. Inc., 2005 Exeter	

Wash Seattle, Radar Electric Co., 168 Western Ave., W. 206-282-2511

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DURANT DIGITAL INSTRS., Cutler Hammer Co., 901 S. 12th St., Watertown, Wisc., 53094, Tel: 414-261-4070, TWX: 910-260-3713; Sls. Mgr: H.L. Sisson ....Vol 2•335

Local Sales Offices & Reps.

Ala	Birmingham, J. Spader Inc.	205-879-1366
Cal	Belmont, Durant	415-592-5238
Cal	Los Angeles, Durant	213-876-4000
Colo	Denver, Vinson Assoc.	303-757-5151
Conn	Stamford, Durant	203-327-1750
Fla	Clearwater, H. Gross Inc.	813-446-6649
Ill	Chicago, Durant Co.	312-237-1222
Kans	Mission, Durant	913-262-2199
Md	Baltimore, Durant Co.	301-825-6626
Mass	Wakefield, Durant	617-246-0024
Mich	Detroit, Durant	313-535-3630
Minn	Minneapolis, Durant	612-926-0919
Mo	St. Louis, Durant	314-423-3431
NY	Rochester, Durant Co.	716-328-5700
NC	Charlotte, Durant	704-525-3149
Ohio	Cincinnati, Durant	513-531-5073
Ohio	Cleveland, Durant	216-464-8787
Ore	Beaverton, N.R. Schultz Co.	503-646-1345
Pa	Paoli, Durant	215-688-5055
Tex	Houston, Durant	713-528-4183
Wash	Bellevue, N. Schultz Co.	206-454-0300
Wisc	Watertown, Durant	414-261-4070
For:	Can. London, Ont., Wainbee	519-433-7881
For:	Can. Montreal, Que., Wainbee	514-636-4870
For:	Can. Toronto, Ont., Wainbee	416-248-5621
For:	Can., Vancouver, B.C., WainBee Ltd.	604-266-8351

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DYNA-MOD POWER PRODS., Box 152, Little Ferry, N.J., 07643, Tel: 201-440-9112; Mktg. Mgr: D. Western Vol 1•662,663

DYNACO, INC., 3060 Jefferson St., Philadelphia, Pa., 19106, Tel: 215-232-8000, TWX: 831-493; Dir. Mktg: F.D. Lintern

DYNACOR, Div. Vectrol, Inc., 1010 Westmore Ave., Rockville, Md., 20850, Tel: 301-424-6900; Pres: R. Vollmer; V.P: R. Mitchell

DYNAGE, 1331 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-243-0315, TWX: 710-425-6063; Sls. Mgr: J.A. Pfingsten; Applic. Engr: D. Poland; V.P: S. Oakleaf Vol 1•660

Local Sales Offices & Reps.

Ariz	Scottsdale, Meas. Conslts.	602-946-7252
Cal	Burbank, Tech. Sources	213-849-6864
Cal	Palo Alto, Engrg. Assocs.	415-326-7842
Colo	Broomfield, Measurement Conslts.	303-466-1402
Conn	Bloomfield, Dynage, Inc.	
Fla	Melbourne, Markasell Entprs.	305-727-0081
Ga	Atlanta, Electro-Mech Sls. Engrg. Co.	404-256-4414
Ill	Des Plaines, Control Sls.	312-296-5595
Mass	Norfolk, Dynage Regional Sls. Office	617-528-4477
Mich	St. Clair Shores, J. Thorpe	313-779-6363
Minn	St. Paul, Countryman Assoc.	612-645-9151
Mo	St. Charles, Cairns & Hayes Elec. Sls. Co.	314-946-6671
NM	Albuquerque, Measurement Conslts.	505-344-3575
NY	Melville, Astrorep, Inc.	516-423-2266
NY	Rochester, Daner-Hayes	716-467-5100
Ohio	Dayton, Midwest Mktg.	513-433-2511
Pa	Paoli, Stitzer Assocs.	215-644-5500
Tex	Dallas, Merit Co.	214-352-8040
Va	Fairfax, Tom Davis Mkts.	703-591-7390

DYNAIR ELCTRNS. INC., 6360 Federal Blvd., San Diego, Calif., 92114, Tel: 714-582-9211, TWX: 910-335-2040; Sls. Mgr: D.A. Keller

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DYNAMIC CONTROLS CORP., 8 Nutmeg Rd., S. Windsor, Conn., 06074, Tel: 203-289-6807, TWX: 710-425-1994; Sls. Engr: R. Kowalski

Local Sales Offices & Reps.

Cal	Los Angeles, Ledbetter Assocs.	213-454-2421

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Local Sales Offices & Reps.

Cal	Los Angeles, Ledbetter Assoc.	
Fla	Clearwater, W. Wimberly	813-446-7072
Fla	Orlando, W. Wimberly	305-425-3083
Mo	St. Louis, Zak & Assocs.	314-872-3191
NJ	Englewood, Andrews & Andrews Inc.	201-569-8800
NY	Huntington, Andrews & Andrews Inc.	516-692-8686
NY	Massapequa, C.B-Hopkins Co.	516-796-0066
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Pa	Pittsburgh, Automated Equip. & Engrg.	412-931-7616

DYNAMIC DATA CORP., 1183 Chesapeake Ave., Columbus, Ohio, 43212, Tel: 614-488-3189; Chief Ex. Officer: R. Arpino

DYNAMIC INSTR. CORP., 115 E. Bethpage Rd., Plainview, N. Y., 11803, Tel: 516-694-6000, TWX: 510-224-6482; Sales Mgr: J. Gildea Vol 1•665; Vol 2•639

Local Sales Offices & Reps.

Omni-Action Control Div. Reps

Ariz	Phoenix, Runyon Co.	602-959-6060
Ariz	Scottsdale, Runyon Co.	
Cal	Monrovia, Electro Mechanical Instrs.	213-358-1881
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Ill	Northfield, Such-Bohmer, Inc.	312-446-8934
Ind	Fort Wayne, TX Sls., Inc.	219-485-0805
Kans	Shawnee Mission, M. E. Bettis Co.	913-362-0772
Kans	Wichita, M. E. Bettis Co.	316-685-7441
Md	Baltimore, R. P. Luce & Co.	
Mass	Lowell, Zaslow Sls. Co.	617-458-8452
Mass	Northboro, Zaslow Sls. Co.	617-393-8150
Minn	Anoka, Such-Bohmer, Inc.	612-421-0751
Mo	St. Louis, M. E. Bettis Co.	314-429-2099
NJ	Berkeley Hgts., R. P. Luce & Co.	201-464-6440
NY	New Hyde Park, R. P. Luce & Co.	516-437-4550
NY	Plainview, O.E.M. Mectronix Sls.	516-293-1530
NY	Syracuse, Naylor Elec. Co.	315-472-9183
Pa	Philadelphia, R. P. Luce & Co.	215-884-8365
Tex	Dallas, E. B. Robertson, Inc.	214-942-2711
Tex	Houston, E. B. Robertson, Inc.	785-6800
For:	Can., Ottawa, Ont., Orion Elctrns.	613-746-3100

Power Conversion Prods. Div. Reps

Cal	Burlingame, J. Logan & Assocs.	415-697-6100
Cal	Pasadena, Electro-Mechanical Instrs.	213-681-2748
Cal	Sunnyvale, (Export) IMAI Mktg. Assocs.	408-245-3511
Colo	Arvada, Arrowhead Sls.	303-423-5556
Colo	Broomfield, Arrowhead Sls. Corp.	
Colo	Denver, Arrowhead Sls. Corp.	303-222-6462
Conn	Bloomfield, Zaslow Sls. Co.	203-242-7781
Fla	Maitland, Hutto, Hawkins & Peregoy	305-831-2474
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Oakbrook, Whitmore Assocs.	312-325-4727
Minn	St. Paul, H. A. Cullen & Assocs.	612-646-7371
NY	Plainview, O.E.M. Mectronix Sls.	516-293-1530
NY	Syracuse, Naylor Elec. Co.	315-GR-2-9183
Ohio	Englewood, Ad-El-Tek Co.	513-836-2741
Tex	Dallas, E. B. Robertson	214-942-2711
For:	Can., Downsview, Ont., Zaslow Sls. Co.	416-633-5068

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Local Sales Offices & Reps.

Ariz	Scottsdale, J. Smith & Assocs.	602-943-4131
Cal	Palo Alto, Egbert Engrg. Assocs.	415-326-1387
Cal	San Diego, L. L. Stoakes, Inc.	714-274-6281
Colo	Boulder, J. Smith & Assocs.	303-449-7509
Ill	Chicago, P. Lind Elctrns.	312-774-1246
Kans	Lenexa, P. Lind Elctrns.	317-547-9178
Md	Wheaton, K - G Elctrns., Inc.	301-946-4055
Mass	Bedford, Webb Assocs.	617-275-8310
Mich	Detroit, S. Sterling Co.	313-255-1970
Minn	Circle Pines, P. Lind Elctrns.	612-786-5770
Mo	St. Louis, S. Sterling Co.	314-567-3636
NM	Albuquerque, J. Smith & Assocs.	505-255-2111
NY	Great Neck, RDI R. Diamond, Inc.	516-482-8387
Ohio	Cleveland, S. Sterling Co.	216-442-8080
Ohio	Dayton, S. Sterling Co.	513-298-7573
Pa	Pittsburgh, S. Sterling Co.	412-922-5720
Wash	Bellevue, Topp Engrg. Sls. Corp.	206-747-5401

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DYNAPAR CORP., 1675 Delany Rd., Gurnee, Ill., 60031, Tel: 312-662-2666; Sls. Mgr: J. Appelgren

Local Sales Offices & Reps.

NJ	Westfield, Dynapar Corp.	201-654-3111
Ohio	Willowick, Dynapar Corp.	216-944-9616

DYNASCAN CORP., 1801 W. Belle Plaine Ave., Chicago, Ill., 60613, Tel: 312-327-7270; Adv. Mgr: J. Passini; Mktg. Mgr: M. Bond; Off. Mgr: C. Annella .....Vol 1•400,401

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Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
Pa	Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave	
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971

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DYNISCO, 20 S. West Pk., Westwood, Mass., 02090, Tel: 617-326-8210; V.P. Mktg. Mgr: R.T. Carrara; Natl. Sls. Mgr: A.R. Firenze

Local Sales Offices & Reps.

Cal	Long Beach, E. Kirk Engrg. Co.	213-439-9559
Cal	Sunnyvale, Industrial Mktg. Assocs.	408-245-3431
Conn	Newtown, D. Hayes Inc.	203-426-9094
Fla	Palm Beach Gardens, Beacon Elctrn. Assocs. Inc.	305-622-2770
Ga	Atlanta, Beacon Elctrn. Assocs. Inc.	404-351-3654
Ill	Park Ridge, Electrical Materials & Equip. Co.	312-696-1540
Kans	Shawnee Mission, Florence & Meyer Inc.	913-722-5210
Mass	Newton Centre, D. Hayes Inc.	617-969-4650
Minn	Minneapolis, Automated Controls Inc.	612-377-7727
Mo	St. Louis, Florence & Meyer	314-423-7200
NJ	Englewood, Tridon Sls. Co.	201-569-8011
NY	Rochester, D. Hayes Inc.	
Ohio	Cincinnati, Schlemmer Assocs.	513-522-8340
Ohio	Cleveland, Orr Assocs.	216-885-1324
Pa	Jenkintown, PDC Corp.	215-887-9610
Pa	Pittsburgh, Gilson Engrg. Sls.	412-931-6114
SC	Spartanburg, Beacon Elctrn. Assocs. Inc.	803-582-4613
Tex	Arlington, D. Dawson Co.	817-265-6426
Utah	Salt Lake City, Applied Engrg. Prods. Co.	801-582-4942

DYTRO CORP., 63 Tec St., Hicksville, N.Y., 11801, Tel: 516-822-2130, TWX: 710-593-4135; Sls. Mgr: F. Braley Vol 1•342

Local Sales Offices & Reps.

Cal	No. Hollywood, Crown Elctrns.	213-877-3550
Mass	Waltham, Instr., Control & Meas.	617-891-8059
Mich	Detroit, H. Teplitz	313-537-9058
NY	Bronx, Bradley	212-KI-9-8500
Ohio	Cleveland, Teplitz	216-371-2044
Ohio	Dayton, H. Teplitz	513-277-6531
SC	Columbia, J.L.H. Electrodynamics, Inc.	803-772-4856
Tex	Houston, Leeco	713-649-7727
Tex	Richardson, Leeco	214-231-7696

DYTRONICS CO., 4800 Evanswood Dr., Columbus, Ohio, 43229, Tel: 614-885-3303; Sls. Mgr: P.A. Ryan Vol 1•422

Local Sales Offices & Reps.

Instrument Div.

Cal	Downey, Wieler	213-861-2534
Fla	Ft. Lauderdale, Beacon Elctrn.	305-622-2770
Fla	Maitland, Beacon Elctrn.	305-647-3498
Ga	Atlanta, Beacon Elctrn.	404-351-3654
Ill	Des Plaines, Marsland Assoc.	312-775-1309
Ind	Indpls., Marsland	317-924-3568
Minn	Mpls., Marsland	612-545-4481
Mo	St. Louis, Marsland	314-278-6949
NJ	Englewood, Central	201-568-0808
NY	Buffalo, Angus Instr.	716-835-0223
NY	New York, J. Plasencia	212-867-8084
NY	Plainview, Central	516-433-0808
Tex	Dallas, Airep Elctrns.	214-363-5291

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Ala	Huntsville, Tech. Sls.	205-881-1750

Cal Costa Mesa, Robinson Tech. Assoc. 714-557-1622
Cal San Mateo, Dayton Assocs., Inc. (Instrumentation only) 415-347-9419
Colo Wheatridge (Denver), Tech. Mktg. Assoc. 303-423-6106
Fla Orlando, MacKay, Smith & Assoc. (Ind'l. only) 305-277-1513
Ill Des Plaines, S. Sterling Co. 312-298-8454
Ind Indianapolis, Meas. Instr. Inc. 317-631-0909
Kans Lenexa, S. Sterling Co. 913-888-2995
Ky Paducak, Lynn McGuffey Co.
La Shreveport, A.R. Johnson & Assocs. 318-865-1511
Mass Wellesley, Meas. Instr. Inc. 617-235-4577
Mich Marquette, N.W.R. Elctrn. Corp. 906-226-7578
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Tex Houston, Palatine Engrg. Sls. 713-747-6537
Tex Richardson, Palatine Engrg. Sls. 214-231-9489
Utah Salt Lake City, Zeus Inc. 801-466-4924
Wash Seattle, Blair Hirsh Co. 206-783-3423

ELCTRN. ENGRG. Local Distributors
Ala Huntsville, Hall-Mark Elctrns., Box 1133 205-539-0691
Fla Hollywood, Schweber Elctrns. 305-927-0511
Fla Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr. 305-855-4020
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Schweber Elctrns. 312-593-2740
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747
Md Rockville, Schweber Elctrns. 301-881-2970
Mass Waltham, Schweber Elctrns. 617-890-8484
Mich Detroit, Schweber Elctrns. 313-583-9242
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NJ Somerset, Schweber Elctrns. 201-469-6008
NY Rochester, Schweber Elctrns. 716-328-4180
NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474
NC Raleigh, Schweber Elctrns. 919-832-8881
Ohio Beachwood, Schweber Elctrns. 216-464-2970
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wisc Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave. 414-476-1270

ELECTRONIC ENGRG. CO. CAL., Computer Equip., 1601 E. Chestnut Ave., Santa Ana, Cal., 92702, Tel: 714-547-5501, TWX: 910-595-1550; Sls. Mgr: R.T. Clark

ELCTRN. ENTERPRISES, 65 7th Ave., Newark, N.J., 07104, Tel: 201-485-8500

Local Sales Offices & Reps.
Exp: N.Y., Westbury, Minthorne Int'l. 516-334-3303
For: Can., Montreal, Que., Future Elctrns. Corp. 514-481-7701

ELECTRONIC EQUIP., See Omtronics

ELECTRONIC HARDWARE CORP., Div. Hi-Tech Industries, Inc., 180-10 Liberty Ave., Jamaica, N.Y., 11433, Tel: 212-291-2710; V.P: H. Goodman Vol 2•489

Local Sales Offices & Reps.
Cal Hawthorne, Electro-Sonic Comps. 213-679-9781
Colo Denver, A. G. Electronics 303-759-4790
Conn Hamden, Impact Sls. Co. 203-248-9368
Fla Miami Beach, Geartner Assocs., Inc. 305-531-0200
Fla Orlando, Geartner Assocs., Inc. 305-299-1000
Ill Chicago, McBride Sls. Co. 312-775-1080
Kans Overland, Penzner Mankus Assoc. 913-381-0004
La New Orleans, G.V. Peck Co. 504-282-1553
Md Pikeville, A. Wetterhahn Co. 301-484-6376
Mass Waltham, Impact Sls. Co. 617-893-2850
Minn Minneapolis, Bitronics Sls. Co. 612-925-2944
Mo Hazelwood, Penzner Mankus Assoc. 314-731-4334
NJ Oaklyn, A. Wetterhahn Co., Inc. 609-858-3003
NJ River Edge, MEG Sales 201-265-9887
NY Buffalo, Telesco Assoc. 716-834-1026
Ohio Cincinnati, F.E. Kahsar Sls. 513-471-9011
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Tenn Nashville, John L. Cottrell Co. 615-269-9890
Tex Dallas, G.V. Peck Co. 214-328-3511
Tex Houston, G.V. Peck Co. 713-664-1435
Wash Mercer Island, J.H. Andersen Assoc. 206-232-0484

ELCTRN. INSTR. & SPECIALTY, 42 Pleasant St., Stoneham, Mass., 02180, Tel: 617-438-5300; Gen. Mgr: R.A. Painter; Mktg. Mgr: W.K. Crawford Vol 2•740-743

Local Sales Offices & Reps.
Cal Anaheim, L & M Sls. 714-774-0492
Cal San Jose, Grosken, Inc. 408-293-3108
Md Lutherville-Timonium, Naudain Assocs. 301-252-5378
NJ Mount Laurel, Naudain Assocs. 609-235-1801, 215-564-3194
NJ Nutley, I. Brill 201-667-0653
Tex Houston, Texas Special Elctrn. Comps. 713-666-5871

ELECTRONIC LABORATORY SUPPLY, 7208 Germantown Ave., Philadelphia, Pa., 19119, Tel: 215-248-2700 ..... Vol 2•596

ELCTRN. MEAS. INC., 405 Essex Rd., Neptune, N.J., 07753, Tel: 201-922-9300; Sls. Mgr. R.J. Hill Vol 1•673-675

Local Sales Offices & Reps.
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Ariz Scottsdale, Williams-Assocs. 602-947-4297
Cal Sunnyvale, RDP Insts. Inc. 408-735-9040
Cal Van Nuys, Gordon-Elliot Inc. 213-873-6862
Colo Denver, Williams-Assocs. 303-343-2911
Conn Hamden, Applied Measurements 203-288-5288
Fla Fort Lauderdale, W. A. Brown 305-564-8000
Fla Fort Walton Beach, W. A. Brown 904-243-6426
Fla Orlando, W. A. Brown 305-425-5505
Ga Tucker, W. A. Brown 404-939-1674
Haw Honolulu, Aloha Assocs. 808-941-1574
Ill Des Plaines, Marsland Assocs. 312-298-2620
Ind Indianapolis, Marsland Assocs. 317-924-3568
La Gretna, W. A. Brown 504-367-4971
Md Rockville, Farrell Assoc. 301-424-9460
Mass Acton, Applied Measurements 617-263-2766
Mich Royal Oak, The Satullo Co. 313-549-3910
Minn Mpls., Marsland Assocs. 612-545-4481
Mo St. Peters, Marsland Assocs. 314-278-6949
NJ Hackensack, SJS Assoc. 201-488-2444
NM Albuquerque, Williams Assocs. 505-255-1638
NY E. Syracuse, Ossmann Instr. 315-437-6666
NY Rochester, Ossmann Instr. 716-328-2230
NY Vestal, Ossmann Instr. 607-785-9947
NC Research Triangle Park, W.A. Brown Instrs. 919-489-1546
NC Winston-Salem, W.A. Brown Instrs. 919-768-3600
Ohio Cleveland, Satullo Co. 216-486-2800
Ohio Dayton, The Sautullo Co.
Pa Melrose Park, RBT Meyers Assoc. 215-224-1663

ELCTRN. MEMORIES, 12621 Chadron Blvd., Hawthorne, Cal., 90252, Tel: 213-644-9881, TWX: 910-325-6213; Dir. Mktg. Comm. Prod: P. Harding; Dir. Mktg. Mil. Prod: D. Knutson

Local Sales Offices & Reps.
Ill Des Plaines, EMM 312-297-3110
Mass Wellesley, EMM 617-237-4800
Mich Southfield, EMM 313-352-1040
Minn Minneapolis, EMM 612-941-1843
Mo Clayton, EMM 314-863-0015
NJ Saddle Brook, EMM 201-845-0450
Ohio Cleveland, EMM 216-884-1980
Pa Pittsburgh, EMM 412-921-1221
Tenn Memphis, EMM 901-362-9180
Tex Dallas, EMM 214-243-2374
Tex Houston, EMM 713-626-3592
Va Annandale, EMM 703-941-2100
Wash Seattle, EMM 206-623-1477

ELECTRONIC MODULES, INC., 2500 E. Foothill Blvd., Pasadena, Cal., 91107, Tel: 213-795-4231; App. Eng: A. Anderson

ELCTRN. MOLDING CORP., 88 Mill St., Woonsocket, R.I., 02895, Tel: 800-556-6969, 401-769-3800, TWX: 710-387-1350; V.P: J. Murphy; Sls. Mgr: I. Duiude; V.P. Mktg: A. Klepper ..... Vol 3•666

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Cal Gardena, Compar, Coron Corp. 213-327-6550
Conn Hamden, Compar, N.E. 203-288-9276
Fla Orlando, G.F. Bohman Assocs. 305-855-0274
Mass Newton Highlands, Compar, New England 617-969-7140
NY Plainview, R. Smith Assocs. 516-681-3155
NC Thomasville, Powertronics, Inc. 919-476-6727
SC Greenville, Powertronics, Inc. 803-244-1336

Tex Richardson, Semiconductor Sls. Assoc. 214-231-6181

ELCTRN. MOLDING Local Distributors
Tex Houston, Lenert Co., Box 2184 713-225-1465

ELCTRN. NAVIGATION INDS., INC., 3000 Winton Rd. S, Rochester, N.Y., 14623, Tel: 716-473-6900; Sls: L.M. Salmen .....Vol 2•314

Local Sales Offices & Reps.
Ala Huntsville, Scientific Devices 205-536-1969
Ariz Scottsdale, Williams Assocs. 602-947-4297
Cal Burbank, OMNIA 213-843-7240
Cal Portola Valley, Kipp Assocs. 415-851-0123
Colo Denver, Williams Assocs. 303-388-4391
Fla Orlando, Scientific Devices 305-424-6792
Ill Chicago, Carter Elctrns. 312-585-5485
Ind Indianapolis, Carter Elctrns. 317-293-0696
Md Silver Springs, Gawler-Knoop Co. 301-589-4406
Mass So. Chelmsford, Independent Mktg. Rep. 617-256-8251
Mich Ferndale, Tiby Co. 313-547-3550
Minn Minneapolis, Carter Elctrns. 612-544-9393
Mo Hazelwood, Carter Elctrns. 314-731-2237
NM Albuquerque, Williams Assocs. 505-255-1638
NY Greenvale, B. D. Aaron & Co. 516-621-0630
NC Burlington, Scientific Devices 919-584-8311
Ohio Cleveland, Tiby Co. 216-371-5335
Pa Newtown Sq., SWR Assocs. 215-356-8550
Tex Richardson, Lear Assocs. 214-231-5388
Wash Seattle, Underwood & Underwood 206-243-2133
Wisc Milwaukee, Carter Elctrns. 414-464-5555

ELCTRN. PRECISION COMPS., 11 W. Sandford Blvd., Mt. Vernon, N.Y., 10550, Tel: 914-664-2333; Pres: D.R. Edwards; Sls. Mgr: J.V. Daughtrey

Local Sales Offices & Reps.
Mass Burlington, Burlington Sls., Inc. 617-272-7655
NJ Nutley, I. Brill 201-667-0653

ELECTRONIC RESCH. ASSOCS., 311 E. Park St., Moonachie, N.J., 07074, Tel: 201-641-3650, TWX: 710-994-5789; Sls. Mgr: P. Greco

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Cal Mountain View, Telemetry Sls. Corp. 408-732-9033
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Colo Denver, Telemetry Sls. Corp. 303-424-5574
Ill Park Ridge, R. F. Specialists 312-698-2044
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Mass Canton, New England Elctrn. Sls. 617-828-4835
Mo St. Louis, Ensco-Rep 314-567-3935
NJ Cherry Hill, Stemler Assoc., Inc. 609-966-4070
NM Albuquerque, Telemetry Sls. Corp. 505-266-7861
NY Fayetteville, M. P. Andrews 315-637-3144
NY Plainview, R. Smith Assocs. 516-681-3155
NY Spring Valley, R. Smith Assocs. 914-352-1067
Pa Paoli, Stemler Assoc., Inc. 215-644-3477
Tex Dallas, E. B. Robertson, Inc. 214-942-2711
Va Alexandria, Stemler 703-548-7818

ELECTRONIC RESEARCH CO., Div. Textron, Inc., Box 913, Shawnee Mission, Kan., 66202, Tel: 913-631-6700, TWX: 910-749-6477; Sls. Mgr: G.J. Dehnert, Freq. Con. Prods. Sls. Mgr: R.L. Rush, Instrs.; Sls. Mgr., Digital Prod: C.S. Cech .....Vol 1•430,431; Vol 2•405

Local Sales Offices & Reps.
Frequency Control Prods. Div.
Cal Menlo Park, J. S. Heaton Co. 415-369-4671
Cal Van Nuys, Shephard Comps. 213-787-4610
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Fla Clearwater, Dyne-A-Mark 813-446-3229
Fla Pompano Beach, Dyne-A-Mark 305-942-5870
Ill Oak Brook, Whitmore Assocs. 312-325-4727
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Mass Norwood, S Pierce, Inc. 617-762-3164
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Mo Raytown, Centech Inc. 816-358-8100
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NY DeWitt, H. R. Murray 315-446-5555
NY New Hyde Park, Comp-Tech Sls. 516-593-2628
NY Rochester, H. R. Murray 716-244-1100
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Ariz Scottsdale, Williams Assocs. 602-947-4297
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Cal Del Mar, T.L. Snitzer 714-454-2191
Cal Los Angeles, T.L. Snitzer 213-836-6170
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Fla Pompano Beach, Datarep 305-781-9279
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Ind Indianapolis, Couchman-Conant 317-849-9890
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Mass Cambridge, Ken Corp. 617-491-5700
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Mo Kansas City, Production Automation 913-236-6600
Mo St. Louis, Production Automation 314-426-2331
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NY Latham, L-Tron Corp. 518-785-5032
NY Tonawanda, L-Tron Corp. 716-691-8887
NC Winston-Salem, Radco Co. 919-722-9671
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Ohio Centerville, EMA, Inc. 513-433-2800
Pa Abington, Powell-Pendergraph 215-657-0330
Tex Houston, Palatine Engrg. 713-777-4477
Tex Richardson, Palatine Engrg. 214-231-9489
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For: Can., Ottawa, Ont., Whittaker Elctrns. 613-224-1221
For: Can., Roxboro, Que., Whittaker Elctrns. 514-683-3621
For: Can., W Vancouver, B.C., Whittaker Elctrns. 604-926-3411

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ELECTRONIC SPECIALTY DIV., Datron System, 18900 N.E. Sandy Blvd., Portland, Ore, 97220, Tel: 503-665-0121, TWX: 910-469-8782; Relay Prod. Mgr: R. Lisdero .....Vol 2•724-729

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Ill Hinsdale, J. O. Allyn 312-325-0495
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Minn St. Paul, Countryman Assoc. 612-645-9151
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NY Syracuse, C. W. Floring 315-478-2149
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Pa Broomall, L. D. Lowery 215-356-5300
Pa Harrisburg, L. D. Lowery 717-233-0917
Tex Dallas, R. R. Thomas 214-363-8591
Wash Bellevue, H. Thorp Co. 206-454-0667
For: Roxboro, Que., Can., Wilson Entprs. 514-684-0383
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NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121

ELECTRONS CO., Unit of General Signal Corp., 65 Passaic Ave., Fairfield, N.J., 07006, Tel: 201-227-3830; V.P. Sls: D.J. Hall; Sls./Svc: Mrs. J. Yost

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Fla Coconut Grove, Whitman Assoc. 305-448-6770
Fla Gulf Breeze, Whitman Assoc. 904-932-5670
Fla Jacksonville, Whitman Assoc. 904-354-5985
Fla Tampa, Whitman Assoc. 813-877-6091
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Mo St. Louis, H. J. Weisler & Assoc. 314-428-3934
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NC Raleigh, Whitman Assoc. 919-787-2437
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Va Va. Beach, Whitman Assoc. 703-428-8717
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Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
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Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521

ELECTROSPACE SYSTEMS INC., Box 1359, Richardson, Tex., 75080, Tel: 214-231-9303, TWX: 910-867-4768; Sls. Mgr: B.H. Gardner

ELECTROSTATICS, INC., 7718 Clairemont Mesa Blvd., San Diego, CA, 92111, Tel: 714-279-1414; Sls. Mgr: R.D. McCartney .....Vol 1•676

ELECTROVERT, 86 Hartford Ave., Mt. Vernon, N.Y., 10553, Tel: 914-664-6090; Dir. Tech. Info: F.J. Farrell; Chf. Eng: H. Tawil; Tech. Dir: P.J. Bud

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Fla Maitland, Rowe Engrg. Sls. 305-834-2700
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Ga Atlanta, J. Spears Assoc. 404-237-4531
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Ill Chicago, Cumming & Foley Sls. Co. 312-725-8110
Ill Chicago, EMF Co. 312-889-8323
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Ind Indianapolis, Central States Machinery Co. 317-923-5433
Ind Indianapolis, Phillips Sls. of Ind. 317-547-5291
Iowa Cedar Rapids, A. Sell & Assoc. 319-393-3225
Ky Louisville, Phillips Sls. of Ky. 502-459-0796
Md Bethesda, ARA Elctrns. Inc. 301-657-2585
Mass Newtonville, Edcom, Inc. 617-969-9710
Mass Norwood, JMG, Inc. 617-762-5333
Mich Grosse Point Park, J. L. Miner Assoc. 313-886-5878
Mich Lathrup Village, R. C. Nordstrom & Co. 313-444-4417
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Minn Minneapolis, Servco 612-339-8611
Minn St. Paul, Countryman Assoc. Co. 612-645-9151
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Ohio Cleveland, J. B. Clough Co. 216-431-2700
Ohio Cleveland, K. R. Dodge 216-241-3307
Ohio Cleveland, Marlow Assoc. 216-381-4800
Ohio Kettering, Bauer Industrial Sls. 513-294-7070
Ore Portland, Vandy Corp. 503-292-8633
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Pa Narberth, S. A. Jeffries, Inc. 215-664-8500
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Pa Pittsburgh, H. E. Ransford Co. 412-884-3425
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Tex Dallas, R. Matthews Elctrns. 214-341-7989
Tex Irving, Electrovert, Inc. 214-255-1516

Tex Richardson, P. J. Scanlon Co. 214-231-4661
Utah Salt Lake City, Straube Assoc. 801-328-4513
Wash Seattle, Electrical Agents NW Inc. 206-285-3560
Wash Seattle, Vandy Corp. 206-789-3300
Wisc Milwaukee, Electrovert, Inc. 414-321-4840
For: Can., Montreal, Electrovert, Mfg. 514-488-2521
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Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401

ELGAR CORP., 8159 Engineer Rd., San Diego, Cal., 92111, Tel: 714-565-1155, TWX: 910-335-1246; V.P. Mktg: R.H. Wheelock; Chief Applications Engr: W.E. Foy ..... Vol 1•677

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Ala Huntsville, BCS 205-881-6220
Ariz Scottsdale, Barnhill 602-947-7841
Cal Lawndale, Ward/Davis Assocs. 213-542-7740
Cal San Diego, Ward/Davis Assocs. 714-277-8081
Cal Santa Clara, Ward/Davis Assocs. 408-246-9202
Colo Denver, Barnhill 303-934-5505
Conn Hamden, P. Jenks Assocs., Inc. 203-281-0810
Fla Orlando, BCS 305-896-4881
Ill Des Plaines, Cozzens & Cudahy 312-298-3600
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Minn Mpls., Cozzens & Cudahy 612-884-4336
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For: Can., Downsview, Ontario, Zaslow Sls. Co. 416-727-1211

ESCO PRODUCTS, Oak Ridge Rd., Oak Ridge, NJ, 07438, Tel: 201-697-3700; Pres: F.R. Stuhler

ESSEX INTERNATIONAL, INC., Distributor Mrktg. Controls Div., 131 Godfrey St., Logansport, Ind., 46947, Tel: 219-753-7521, TWX: 810-295-0699; Dist. Sls. Mgr: C.E. Dunderman; Sls. Engr: M. Maloy; Sales Engr: R. Erb

ESSEX INT'L, INC., Ind'l. Wire Prods. Div., 445 Park Ave., Sycamore, Ill., 60178, Tel: 815-895-4501, TWX: 910-639-0611; V.P. & Gen. Mgr: G.W. Probst; Sls. Mgr: E.J. O'Reilly

ESSEX INT'L., INC., Magnet Wire Div., 1601 Wall St., Fort Wayne, Ind., 46804, Tel: 219-743-0311, TWX: 219-241-4272; V.P. Sls: J. Gerber

ESSEX, MAGNET WIRE Local Distributors
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230

ESSEX INT'L., RBM Controls, 131 Godfrey St., Logansport, Ind., 46947, Tel: 219-753-7521, TWX: 219-732-8235 D. Kampenga ..... Vol 2•744-751

Local Sales Offices & Reps.

Cal	Corona, Essex Controls Div.	714-737-3511
Ill	Chicago, RBM Controls	312-478-9151
Mass	Needham, A&M Electronic Rep. Inc.	617-444-8170
Mich	Berrien Springs, RBM Controls	616-473-4811
Minn	Mipls., RBM Controls	612-331-6370
Mo	St. Louis, Controls Div., Essex Wire Corp.	314-371-2616
NJ	Hackensack, RBM Controls	201-641-4407
NY	DeWitt, RBM Controls	315-446-0800
Ohio	Cleveland, RBM Controls	216-781-2310
Ohio	Dayton, RBM Controls	513-277-8964
Pa	Blue Bell, RBM Controls	215-542-8476
Tenn	Franklin, Controls Div., Essex Wire Corp.	615-794-8451
Tex	Dallas, RBM Controls	214-369-6541
Exp:	Can., Renfrew, Ont. K7V4A6, R.W. Stark	613-432-5221
Exp:	N.Y., N.Y., Roburn Agency	212-989-5939
NY	N.Y., Roburn Agencies	212-WO-6-2130

ESSEX RBM Local Distributors

Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Ariz	Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd.	602-273-7331
Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Ark	Jonesboro, Bluff City Distrg. Co., 324 Huntington	501-932-7811
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Hayward, Dunlap Elctrns., 25354 Cypress St.	415-352-1933
Cal	Hollywood, Hollywood Radio & Electr., 5250 Hollywood Blvd.	213-466-3181
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr.	415-964-0820
Cal	Redwood City, Electrical Sales Prod., 465 Convention Way	415-364-2621
Cal	San Diego, Kierulff-San Diego, 8797 Balboa Ave.	714-278-2112
Cal	Santa Clara, Fisher Switches Inc., 3381 Edward Ave.	408-244-6182
Colo	Denver, Burstein-Applebee	303-244-3336
Colo	Denver, Newark-Denver Elctrns., 2170 So. Grape St.	303-757-3351
Conn	Stamford, Gerber Elctrns. & Radio Supply, 111 Dunn Ave.	203-322-3253
Fla	Daytona Beach, Hammond Elctrns. Inc., 719 Ridgewood Ave.	904-253-0531
Fla	Ft. Myers, Hammond Elctrns Inc., 2563 4th St.	813-334-2277
Fla	Jacksonville, Hammond Elctrns. Inc., 250 E. First St.	904-356-4851
Fla	Lakeland, Hammond Elctrns. Inc., 930 E. Oak St.	813-686-4145
Fla	Miami, Elctrn. Equip. Co., 2701 NW 42nd Ave.	305-871-3500
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Orlando, Hammond Electrns., 911 W. Central Blvd.	305-241-6601
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Fla	Tampa, Hammond Elctrns. Inc., 1516 Cypress St.	813-253-0104
Ga	Atlanta, Specialty Distributing, 763 Juniper St. N.W.	404-873-2521
Ill	Chicago, Allied Radio Corp., 2400 W. Lake St.	312-421-2400
Ill	Chicago, Burstein-Applebee	312-763-4848
Ill	Chicago, Newark Elctrns, 500 N. Pulaski Rd.	312-638-4411
Ill	Peoria, Klaus Radio & Elec. Co., 8400 N. Pioneer Pkwy	309-691-4840
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	Indianapolis, Graham Elctrncs., 133 S. Penn. St.	317-634-8480
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave. S.W.	319-365-7551
Kans	Kansas City, Burstein-Applebee	816-561-5460
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5216
La	Metairie, Ind'l Distrs. Inc., 710 Papworth Ave.	504-835-7281
Md	Baltimore, ASI Elctrn./Astrex, 1728 Whitehead Rd.	301-265-5100
Md	Beltsville, Powell Elctrns/Washington, 10728 Hanna St.	301-937-4030
Md	Rockville, Pioneer/Washington, 1037 Taft St.	301-427-3300
Mass	Dedham, Gerber Elctrn., 852 Providence Hwy	617-329-2400
Mich	Detroit, RS Elctrns., 12775 Lyndon St.	313-491-1000
Mich	Grand Rapids, Stotts-Friedman, 2035 Eastern Ave. S.E.	616-241-6731
Miss	Columbus, Bluff City Distrg. Co., 116 S. 22nd St., Box 2186	601-328-6212
Miss	Greenville, Bluff City Distrg. Co., Box 5606	601-334-4412
Miss	St. Paul, Gopher Elctrn. Co., 2520 W. Larpenteur Ave.	612-645-0889
Miss	Tupelo, Bluff City Distrg. Co., 210 S. Glaster	601-842-6832
Mo	Kansas City, Burstein Applebee	816-561-5460
Mo	No. Kansas City, LCOMP-Kan City, 1520 Taney St.	910-221-2400
Mo	St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd	314-428-8522
Mo	St. Louis, Olive Ind'l Elctrns., 6662 Olive Blvd.	314-863-7800
Neb	Lincoln, Burstein Applebee	402-434-0678
NJ	So. Plainfield, Brownell-Electro Inc., 500 Hadley Rd. & Durham Ave	201-753-4600
NM	Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E.	505-247-1055
NY	Buffalo, Summit Dist. Inc., 916 Main St.	716-884-3450
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
NY	New York, Brownell Electro Inc., 85 10th Ave.	212-924-6000
NY	New York, Roburn Agencies Inc., 509-N.W. W. 14th St.	212-989-5939
NY	Rochester, Summit Dtstrs., 292 Commerce Dr.	716-884-3450
NC	Charlotte, Dixie Radio, 2220 Tryon St.	704-377-5413
Ohio	Cincinnati, Hughes-Peters, Inc., 4865 Duck Creek Rd.	513-351-2000
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Columbus, Hughes-Peters, Inc., 481 E. 11th Ave.	614-294-5351
Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541
Ore	Portland, Eoff Elec. Co., 509-N.E. 10th Ave.	503-222-9411
Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
Pa	Pittsburgh, RPC Elctrns., 620 Alpha Dr.	412-782-3770
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
SC	Columbia, Dixie Radio Supply, Box 408	803-253-5333
Tenn	Memphis, Bluff City Distr. Co., Box 418, 234 East St.	901-725-9500
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971
Tex	Dallas, Texas Instrs. Supply, 6000 Denton Dr.	214-238-6850
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Solid State Elctrns./Tex., 6400 Westpark Dr.	713-785-5205
Tex	Houston, Texas Instrs. Supply, 3939 Ann Arbor Dr.	713-785-4800
Va	Charlottesville, Piedmont Elec. Supply, 1150 Rose Hill Dr.	703-296-6167
Wash	Seattle, Sterling Electronics, 5608 6th Ave., S.	206-762-9100
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart, 1314 N. 7th St.	414-276-4160

ESSEX INTERNATIONAL, Stemco Controls, Box 1007, Mansfield, Ohio, 44903, Tel: 419-884-1311; Prod. Mgr: J. Shoughnessy; Prod. Mgr: Mel Deerdorf

ESSEX, STEMCO Local Distributors

Colo	Denver, Burstein-Applebee	303-244-3336
Ill	Chicago, Burstein-Applebee	312-763-4848
Kans	Kansas City, Burstein-Applebee	816-561-5460
Mo	Kansas City, Burstein Applebee	816-561-5460
Mo	St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd	314-428-8522
Neb	Lincoln, Burstein Applebee	402-434-0678

ESTERLINE ANGUS DIV., Esterline Corp., Box 24000, Indianapolis, Ind., 46224, Tel: 317-244-7611; Dig. Prod. Mgr: R. Moore; Servo. Prod. Mgr: P. Peek; Direct Writing Mgr: B. Relick ..... Vol 1•538,539

Local Sales Offices & Reps.

Ala	Birmingham, J. Spader Co.	205-879-1366
Ariz	Scottsdale, BFA Corp. of Ariz.	602-946-4215
Ark	Little Rock, Electra-Tech Midsouth	501-562-4090
Cal	City of Industry, Esterline Angus	213-330-1621
Cal	Hayward, Esterline Angus	415-785-8232
Colo	Denver, C. Beabout Co.	303-244-3151
Fla	Orlando, Datarep, Inc.	305-855-8945
Fla	Pompano Beach, Datarep, Inc.	305-781-9279
Ga	Woodstock, James Spader Co.	404-428-0366
Haw	Honolulu, Berkley Eng. & Equip. Co.	808-538-1921
Ill	Elmhurst, Esterline Angus	312-833-4410
Ind	Indianapolis, C.D. Arnold Co.	317-546-4053
Iowa	Cedar Rapids, H. E. Ferris Co.	319-362-9156
Iowa	Des Moines, H.E. Ferris Co.	515-255-5008
La	New Orleans, Mid-South Sls. Co.	504-822-3030
Mass	Holliston, Esterline Angus	617-235-5343
Mich	Berkley, G.R. Peters Assocs.	313-564-6325
Mich	Marquette, NWR Elctrns.	906-226-7578
Minn	Minneapolis, Elec. Jobbers	612-377-7904
Minn	Virginia, NWR Elctrns.	218-741-5080
Mo	Crestwood, C. B. Fall Co.	314-968-3850
NJ	Lodi, Esterline Angus	201-471-0084
NM	Albuquerque, BFA Corp. of Ariz.	505-296-8303
NM	Las Cruces, BFA Corp. of Ariz.	505-523-0601
NY	Buffalo, R.F. Lamb Co.	716-874-4900
NY	Kingston, R.F. Lamb Co.	914-338-8833
NY	Rochester, R. F. Lamb Co.	716-544-5580
NY	Syracuse, R.F. Lamb Co.	315-454-2469
NC	Charlotte, Ranson, Wallace & Co.	704-334-4244
Ohio	Brecksville, Waldrip, Blankenburg & Co.	216-526-1100
Ohio	Cincinnati, Beedle Equip. Co.	513-793-0140
Okla	Oklahoma City, Kennedy Engrg.	405-524-6048
Ore	Portland, McLaren, Inc.	503-297-2248
Pa	Jenkintown, Esterline Angus	215-887-2268
Pa	Pittsburgh, Bollinger & Richards	412-LO-1-2340
Tenn	Knoxville, G.W. Massey Co.	615-577-9553
Tex	Borger, Kennedy Engrg.	806-273-2871
Tex	Euless, Data Aids Assocs.	817-268-3505
Tex	Houston, Data Aids Assocs.	713-785-0581
Va	Fairfax, Hildenbrand Co.	703-280-2330
Wash	Bellevue, McLaren Inc.	206-454-3400
WVa	Charleston, Vynock Engr. Co.	304-722-3525
Wisc	Milwaukee, T. R. Bickler Assocs.	414-453-3772
For:	Can., Burnaby 2, B.C., Ahearn & Soper, Ltd.	604-291-0214
For:	Can., Calgary, Alberta, Showalter Agencies Ltd.	403-269-6411
For:	Can., Montreal, Que., Instro-Test, Ltd.	514-637-1231
For:	Can., Toronto, Ont., Ahearn & Soper, Ltd.	416-789-4325

ESTERLINE Local Distributors

Pa	Reading, Barbey Elctrn., 333 N. 4th St.	

ESTES ENGRG. CO., 543 West 184th St., Gardena, Calif., 90248, Tel: 213-321-9811; Sls. Mgr: S. Estes

ETC, DIV. ITT, 990 East 67 St., Cleveland, Ohio, 44103, Tel: 216-HE-2-0855, TWX: 810-421-8264; Sls. Mgr: F. Hoyle, Jr. ..... Vol 3•664,665

Local Sales Offices & Reps.

Ariz	Phoenix, Toward Engrg. Assoc.	602-955-3193
Ark	Hot Springs, M. Young	501-262-1365
Cal	Anaheim, Lodan South	714-956-1560
Cal	San Carlos, Lo-Dan Inc.	415-592-4600
Colo	Denver, Camel Elctrns.	303-757-6191
Conn	W Simsbury, Anchor Engrg.	203-658-6261
Fla	Pompano Beach, CBC, Inc.	305-782-0804
Ga	Roswell, E. Rushin Co.	404-993-6498
Ill	Chicago, A. J. Ellis	312-262-2708
Iowa	Cedar Rapids, J. Vrbik	319-377-8244
Kans	Leawood, Thunderbird Tech. Sls. & Svcs.	913-642-7220
Kans	Wichita, Thunderbird Tech. Sls.	316-684-3941
Ky	Louisville, B. T. Clark & Assoc. (GE accounts only)	502-425-0746
Mass	Wellesley Hills, Anchor Engrg.	617-235-6330
Mich	Detroit, R. C. Merchant & Co.	313-535-6000
Minn	Hopkins, Grayden & Flemmer	612-941-1120
Mo	St. Louis, Thunderbird Tech. Sls.	314-567-6488
NY	Mount Vernon, Friedman-Smith Sls.	914-664-4866
NY	Rochester, L. Marchese	716-342-7664
Ohio	Cleveland	216-432-0855
Ore	Beaverton, ES/Chase Co.	503-649-6177
Pa	Harrisburg, A. Rados	215-LO-3-4415
Pa	Pittsburgh, C. Dibble	412-391-3149
Tex	Irving, AID Elctrns.	214-259-4761
Va	Roanoke, J. Ramsey	703-362-9749
Wash	Edmonds, ES/Chase Co.	206-774-3586
Wisc	Milwaukee, Devoz-Prinz	414-272-0356

ETC, Local Distributors

Ariz	Phoenix, Faspeco, 2935 McDowell Rd.	602-273-0460
Ariz	Phoenix, Liberty Electrns., 3612 N. 16th St.	602-264-4438
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Carlos, Advance Electrical Sls., 850 Montgomery La., Box 516	415-591-9651

Cal Sun Valley, Richey Elctrn. Inc., 10871 La Tuna Canyon Rd. 213-875-2862
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Colo Denver, Acacia Sales Inc., 785 S. Jason St. 303-744-6356
Fla Miami, Florida Aviation Corp., Box 235 Miami Int'l Airport 305-887-7571
Ill Chicago, Hyland Elec. Supply Co., 623 W. Monroe St. 312-263-4100
Iowa Cedar Rapids, Jerry Vrbik Co., 3 - 50th St., N.E. 319-377-8244
Mass Wellesley Hills, In-Stock Products Co., 40 Washington St. 617-235-6549
Mich Detroit, RS Elctrns., 12775 Lyndon St. 313-491-1000
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Mich Troy, Terminal Supply Co., 500 Oliver St. 313-689-4200
Minn Minneapolis, Berquist Co., 4350 W. 78th St. 612-925-2322
Mo Creve Coeur, Coron Corp., 2260 Grissom Rd. 314-432-3444
NJ Jersey City, Cuny-Guerber, Inc., 3468 Kennedy Blvd 201-227-7722
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NM Albuquerque, Industrial Elctrns, Inc., 310 Val Verde S.E. 505-266-8721
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Plainview, Progress Elctrns, Inc., 205 Express St. 516-433-1700
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rome, Rome Elctrncs., 108-110 Spring St. 315-337-5400
NC Charlotte, J. O. King, Inc., 3300 A Cessna Rd. 704-527-0054
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Menter, Menter Elec. Co., 7444 Tyler Blvd. 216 946-8950
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Erie, Erie Corporate Contractors, 1968 Buffalo Rd. 814-455-8110
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Tex Dallas, National Precision Prods., 10549 Denton Dr. 214-357-3921
Tex Houston, Altair Co., 6345 Beverly Hill 713-781-5300
Tex Houston, Houston Elec. Distr. Co., 1609 Velasco St. 713-224-4771
Tex Houston, Nappco Fastners, 11260 Hempstead Hwy. 713-688-2521
Tex Richardson, Altair Co., 405 N. Plano Rd. 214-231-5166
Utah Salt Lake City, S & H Terminals, Inc., 323 W. 1410 South 801-484-7649
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
WVa Beckley, Halley Elctrns, 713 S. Oakwood Ave. 304-253-2561

EUBANKS ENGRG., 225 W. Duarte Rd., Monrovia, Calif., 91016, Tel: 213-358-4531; Sls. Mgr: N.C. Sallemi

Local Sales Offices & Reps.
Ala Huntsville, Powertronics, Inc. 205-852-6347
Cal Glendale, Tool Tronics, Inc.
Cal Los Angeles, IFM, Inc. 213-851-5641
Cal Mountain View, Charles Morse 415-960-7722
Cal Mountain View, Tool Tronics, Inc. 415-967-5305
Cal Pasadena, O.E.M. Sls. Co. 213-796-9937
Colo Denver, Y. W. Strong & Assocs., Inc. 303-292-6900
Conn Bridgeport, Technical Instrs., Inc. 203-368-4582
Fla Titusville, Powertronics, Inc. 305-267-5699
Ill Lake Forest, Marsland Distributing Corp. 312-295-1616
Md Bethesda, Ara Elctrns. Inc. 301-657-2585
Mass Wilmington, Technical Instrs., Inc. 617-944-3930
Mich Detroit, Electro Entprs., Inc. 313-521-1500*2
Minn Minneapolis, Production Automation Corp. 612-866-5700
Mo Kansas City, Production Automation Corp. 913-236-6600
Mo St. Louis, Production Automation Corp. 314-426-2331
NJ Livingston, Argo Engrg. Co. 201-992-4367
NY Spring Valley, Salit Assocs. 914-352-4443
NY Syracuse, Maloney Sls. Co. 315-488-3440
NC Raleigh, Powertronics, Inc. 919-787-9090
NC Thomasville, Powertronics, Inc. 919-476-6727
Ohio Cleveland, Electro Entprs., Inc. 216-261-7670
Ohio Dayton, Electro Entprs., Inc. 513-426-6071
Ore Portland, Vandy, Inc. 503-292-8633
Pa Glenside, Ara Elctrns. Inc. 215-887-5250
Pa Pittsburgh, Electro Entprs., Inc. 412-371-8497
Tex Dallas, Sivright Co. 214-357-6681
Wash Seattle, Vandy, Inc. 206-789-3300
For: Can., Thornhill, Ontario, Robert Neill Co. 416-889-9971

EVANS, GEORGE CORP., 121-37th St., Moline, Ill., 61265, Tel: 309-762-9456; Sls. Mgr: H.C. Easter Vol 3•1045

EVAPORATED COATINGS, INC., 798 Welsh Rd., Huntingdon Valley, Pa., 19006, Tel: 215-WI-7-1465; Sls. Mgr: C.H. Barto; Business Mgr: R. Schaffer

EWALD INSTRS. CORP., Rte. 7R, Kent, Conn., 06757, Tel: 203-927-3278; Sls. Mgr: M.K. Ewald

EWC, INC., 725 Federal Ave., Kenilworth, N.J., 07033, Tel: 201-245-3200, TWX: 710 996 5993; Sls. Mgr: D.E. Mac Millan

Advertisement

POWER TRANSFORMERS are manufactured to cover the frequency range from 50 Hz to above 20 KHz. The power capacity varies from a fraction of a VA to typically 1 KVA; INVERTER TRANSFORMERS are custom made to cover the full range from micro miniature units supplying a fraction of a watt to units of 1 KW or more; PRECISION RATIO TRANSFORMERS are designed to meet a wide range of requirements. Transformation Ratio accuracy can be held to very tight tolerances, typical +.01%. Other parameters are usually limited by size, frequency of operation, impendance levels, etc.; CURRENT TRANSFORMERS are custom made to your requirements. EWC is designing and producing units that span the range from 60 Hz commercial units to 30 MHz RF units for submarine service; L-C FILTERS are produced for lowpass, highpass, bandpass and bandstop application. The filters are custom made to meet individual requirements in the frequency range of 400 Hz to 200 KHz. The filter size will depend upon the source and load impedances, attenuation, bandwidth, cutoff frequency and the input signal level; INDUCTORS manufactured are of Laminated construction for DC and low frequency filtering. Toroidal inductors for high stability and high Q for mid band application. Ferrite cup core inductors for high frequency and/or adjustable applications.

EXACT ELCTRNS., INC., 455 S.E. 2nd Ave., Box 160, Hillsboro, Ore., 97123, Tel: 503-648-6661, TWX: 910-460-8811; V.P. Gen. Mgr: J.F. Foster; Sls. Mgr: R. Hill

Local Sales Offices & Reps.
Ala Huntsville, BCS Assoc. 205-881-6220
Ariz Phoenix, PLS Assocs., Inc. 602-947-9110
Cal Newport Beach, Feeger, Lucas, Wolfe 714-540-4412
Cal N. Hollywood, Feeger, Lucas, Wolfe 213-877-5518
Cal Palo Alto, Coherent Mktg. Assocs. 415-327-2217
Cal San Diego, Feeger, Lucas, Wolfe 714-277-0993
Colo Denver, PLS Assocs., Inc. 303-771-0140
Conn Hamden, P Jenks Assocs. 203-281-0810
Fla Orlando, BCS Assocs. 305-896-4881
Ill Chicago, Pivan Engrg. 312-539-4838
Ind Indianapolis, Pivan Engrg. 317-253-1681
Kans Shawnee Misson, Pivan Engrg. 913-722-1030
Md Kensington, Elec. Mktg. Assoc. 301-881-5300
Mass Wakefield, P Jenks Assocs. 617-246-1590
Mich Farmington, Carter-McCormic & Pierce 313-477-7700
Minn Minneapolis, Pivan Engrg. 612-537-4501
Mo Manchester, Pivan Engrg. 314-227-3501
NM Albuquerque, PLS Assocs., Inc. 505-255-2330
NY Great Neck, Meas. Tech. 516-482-3500
NY New Hartford, KLM Assoc. 315-735-8525
NY North Syracuse, KLM Assoc. 315-458-6214
NY Rochester, KLM Assocs. 716-442-0820
NC Greensboro, BCS Assoc. 919-273-1918
Ohio Cleveland, Carter-McCormic & Pierce 216-333-5650
Ohio Dayton, Carter-McCormic & Pierce 513-278-5873
Ohio Worthington, Carter, McCormic and Peirce Inc. 614-888-4466, 4469
Pa King of Prussia, Elec. Mktg. Assoc. 215-265-1600
Pa Pittsburgh, Carter-McCormic & Pierce 412-824-3760
Tex Houston, Barnhill Assoc. 713-621-0040
Tex Richardson, Barnhill Assocs. 214-231-2573
Utah Salt Lake City, PLS Assocs., Inc. 801-272-3681
Wash Seattle, Hayes Technical 206-763-2210
Wisc Brookfield, Pivan Engrg. 414-786-1940

EXCEL SPECIALTY CORP., 6335 N. Broadway, Chicago, Ill., 60660, Tel: 312-262-4781; Sls. Mgr: M. Bank

EXECUTONE, INC., 29-10 Thomson Ave., Long Island City, N.Y., 11101, Tel: 212-392-4800, TWX: 710-582-2610; V.P. Mktg. & Sls: H. Hellering

F-DYNE ELCTRNS., 449 Howard Ave., Bridgeport, Conn., 06605, Tel: 203-367-6431; Ch. Eng: A. Horne; Sls. Mgr: M. Koenigsberg ..... Vol 3•442-444

Local Sales Offices & Reps.
Ariz Scottsdale, S. C. Blaker Co. 602-948-3061
Ark Hot Springs, M. Young 501-262-1365
Cal Redwood City, Parks & Pruitt 415-364-1640
Colo Denver, Walter Engrg. 303-777-5585
Conn Wethersfield, Con/Pak 203-563-4784
Del Wilmington, T. Davis Marketeers 302-998-0123
Fla Maitland, Ellis & Assocs. 305-645-1101
Ill Northfield, Pretat & Travis 312-441-6055
Ind Indianapolis, Electric Sls. & Engrg. 317-251-7245
Kans Shawnee, J. Guernsey Co. 913-631-2414
Mass Needham, Com/Pak 617-444-1259
Mich St. Clair Shores, J. M. Thorpe Co. 313-779-6363
Minn Mpls., Int'l. Sls. Co. 612-881-6683
NY Hempstead, Kahgan Sls. 516-538-2300
NY Syracuse, Naylor Elec. 315-472-9183
NC Greensboro, L & D, Inc. 919-292-3201
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FABRI-TEK, INC., Memory Products Div, 5901 S. County Rd. 18, Minneapolis, Minn., 55436, Tel: 612-935-8811, TWX: 910-576-2403; Sls. Mgr: G. Larsen

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FMC CORP., Parts & Mat'l. Handling Div. Syntron, 264 Lexington, Homer City, Pa., 15748, Tel: 412-479-8011, TWX: 510-468-9220; Elctrn. Prod. Line Mgr: T.P. Hoekelman

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Ohio Cleveland, H. Teplitz 216-371-2044
Ohio Dayton, H. Teplitz 513-277-6531
Pa Paoli, Tyler Griffin Co. 215-647-1550
Wash Seattle, Benno Persitz
Exp: Minthorne, International Co. Inc. 516-334-3303

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

FORMA SCIENTIFIC, Box 649, Marietta, Ohio, 45750, Tel: 614-373-4763; Sls. Mgr: J.R. Bergen

FORMICA METAL PRODS. CO., INC., Corporation Way, Dept. M, Medford, Mass., 02155, Tel: 617-395-5656; Sls. Mgr: C. Formica ..... Vol 3•317

FOXBORO CO., 38 Neponset Avenue, Foxboro, Mass., 02035, Tel: 617-543-8750; V.P.-US Sls: H. Thistle

FREDERICK ELECTRONICS CORP., Hayward Rd., Frederick, Md., 21701, Tel: 301-662-5901; Dir. Mkt: J.V. Murphy; Mgr. Applications Engrg: W.W. Rudisill; Applications Engr: R.F. Fogle

Local Sales Offices & Reps.
Cal North Hollywood, Plantronics 213-985-6066
Cal Santa Clara, Plantronics 408-249-1160
Fla Brandon 813-689-0220
Ill Woodridge, Plantronics 312-971-2171
Md Bethesda, Warner Assocs. 202-469-8904
Mo Ballwin, Plantronics 314-391-0209
NY New York, Frederick Elctrns. Corp. 212-422-2449
Tex Conroe, Plantronics 713-353-2466
WVa Charleston, Plantronics 304-949-4398

FREDERICKS CO., Televac Div., Philmont & Anne Sts., Huntingdon Valley, Pa., 19006, Tel: 215-947-2500, TWX: 510-665-5232; V.P. Sls: W. Johnson; Sls. Adm: H. Simons

FREED TRANSFORMER CO., 1795 Weirfield St., Bklyn., N.Y., 11227, Tel: 212-386-1300; Sls. Mgr: M. Salzberg Vol 1•444-447; Vol 3•1254,1255

Local Sales Offices & Reps.
Cal San Gabriel, R. Moye 213-CU-3-1669
Colo Denver, Nelson 303-733-5528
Ga Atlanta, F. Fausett 404-633-3561
Ill Chicago, Tech. Devices 312-774-8252
Md Baltimore, B. White 301-484-5400
NY Geneva, E. Badway
NY Mt. Vernon, Elect. Instrs. 914-OW-9-9717
Ohio Cleveland, Scott Elctrns. 216-TO-1-2626
Pa Pittsburgh, Scott Elctrns. 412-471-5223
Tex Dallas, R.F. Kimball Co. 214-EM-1-6067
Wash Seattle, M. Widdekind 206-284-8020
Exp: N.Y. N.Y., Morhan Exporting 212-925-1257

FREED Local Distributors
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176

FREQUENCY DEVICES, INC., 25 Locust St., Haverhill, Mass., 01830, Tel: 617-372-6930; Sls. Mgr: C.L. Walker; Pres: R.W. Steer; Dir. of Eng: A. Schutz ..... Vol 2•565

Local Sales Offices & Reps.
Ala Huntsville, Reynolds & Assocs. 205-536-1941
Cal Campbell, Sedillo Co. 408-374-5220
Cal Encino, ELTEC 213-981-9881
Colo Englewood, Klein Aerospace Assoc. 303-781-4967
Fla Melbourne, Reynolds & Assocs. 305-727-3205
Ga Atlanta, Reynolds & Assocs. 404-252-5360
Ill Northfield, Torkelson Assocs. 312-446-9085
Ind Indianapolis, Torkelson Assocs. 317-244-7867
Kans Shawnee Mission, Tech Sls. Assoc. 913-888-3330
Md Silver Spring, Rep-Tron Inc. 301-593-4844
Mass Waltham, COM-SALE 617-890-0011
Mich Detroit, Electro Sls. Assoc. 313-526-8800
Minn Minneapolis, Torkelson Assocs. 612-920-1046
Mo Ferguson, Technical Sls. Assoc. 314-725-5361
NJ Fort Lee, Tecnimat 201-461-8686
NM Albuquerque, Klein Aerospace Assoc. 505-344-8020
NY Syracuse, Labtronics Inc. 315-454-9314
Ohio Cleveland, Electro Sls. Assoc. 216-261-5440
Pa Ambler, Wyncote Instru. Co. 215-643-2440
Tex Richardson, Scien. Sls. Co. 214-231-6541
Wash Seattle, Avionics Liason 206-767-3870

FREQUENCY ELCTRNS., 3 Delaware Dr., New Hyde Pk., N.Y., 11040, Tel: 516-328-0100, TWX: 510-223-0418; Exec. V.P: A. Lazar; Sls. Admin: M. Kaufman; Pres: M. Bloch

Local Sales Offices & Reps.
Ala Huntsville, Int'l. Scien. 205-837-1601
Cal Sherman Oaks, Windsor Dynamics 213-989-3631
Cal Woodside, Windsor Dynamics 415-854-4870
Fla Orlando, Truex Assoc. 305-859-2160
Ill Des Plaines, S. Sterling Co. 312-298-8545
Md Rockville, Marktron Inc. 301-762-6210
Mass Newton Highlands, Compar New England 617-969-7140
Mich Ferndale, Tiby Co. 313-547-3550
Mo St. Louis, S. Sterling Co. 314-542-3636
NJ Englewood, Scien. Devices-East 201-871-3916
NY Rochester, Ossmann Comps. 716-442-3290
NC Winston Salem, Int'l. Scien. 919-722-1783
Ohio Cleveland, Tiby Co. 216-371-5335
Pa Glenside, Elcom Inc. 215-885-1325
Tex Houston, R. Martin Assocs. 713-462-4077
Wash Renton, S. Wilson Co. 206-226-0650
Exp: New York, New York, Henley Electronics 212-986-5544

FREQUENCY ENGRG. LABS., Div. Harvard Inds., Inc., Box 527, Farmingdale, N.J., 07727, Tel: 201-938-9221, TWX: 201-938-2456; Sls. Mgr: S.C. Bucher; Prod. Mktg. Mgr: J. Silance

Local Sales Offices & Reps.
Cal San Francisco, Frequency Engrg. Labs 415-327-3633
Tex Ft. Worth, C. Wolf Co. 817-738-1702
Tex Houston, C. Wolf Co. 713-643-2114
Tex Universal City, C. Wolf 512-658-6672

FREQUENCY SOURCES, 166 Middlesex St., No. Chelmsford, Mass., 01863, Tel: 617-251-8747, TWX: 710-343-6506; Sls. Mgr: P.K. Butler

Local Sales Offices & Reps.
Ala Huntsville, FM Assocs. 205-536-9990
Ariz Phoenix, Thorson Co. 602-264-5878
Cal Los Angeles, The Thorson Co. 213-937-0790
Cal Sunnyvale, Waldman Assoc. 408-245-2500
Colo Denver, The Thorson Co. 303-355-3521
Fla Orlando, Currie Aerospace 305-855-0843
Ill Chicago, Techrep, Inc. 312-761-6548
Ind Ft. Wayne, Tx Sls. 219-485-0805
Md Ellicott City, VPI, Inc. 301-465-4060
Mass Weymouth, O'Sullivan Elctrn. Sls. 617-337-3134
Mo Shawnee, John F. Guernsey 913-631-2414
NM Albuquerque, The Thorson Co. 505-265-5655
NY Tuckahoe, Spectrum Sls. 914-793-1660
NY Utica, B.D. Hummel 315-732-2370
NC Greensboro, FM Assocs. 919-294-2754
Tex Dallas, The Thorson Co. 214-233-5744

FREUDENBERG, B., INC., 50 Rockefeller Plaza, New York, N.Y., 10020, Tel: 212-757-9130; Sls. Mgr: W.J. Leonhardt

Local Sales Offices & Reps.
Cal Pasadena, C. Harrison & Assocs. 213-798-0913

FRIEND'S MFG., Rd. 2, Box 74, Williamstown, N.J., 08094, Tel: 609-629-7919; Sls. Mgr: F. Friend

JUNCTION MODULES, INC., 2441 Campus Dr., Irvine, Cal., 92664, Tel: 714-833-8314, TWX: 910-595-1706; Mktg. Mgr: G. Osgood; V.P: T. Cate

FURNAS ELEC. CO., 1197 McKee St., Batavia, Ill., 60510, Tel: 312-879-3410, TWX: 720-458; Mgr. Adv. & PR: C. Witschonke

FUSION SYSTEMS CORP., 12111 Parklawn Dr., Rockville, Md., 20852, Tel: 301-881-5934; Mktg: M. Greenblatt; Engr: M.G. Ury

GABRIEL ELCTRNS. INC., Box 626, Scarborough Ind'l. Pk., Scarborough, Me., 04074, Tel: 207-883-5161; Sls. Mgr., Bell Sys. Accounts: D.B. Crisman; Sls. Mgr., Commercial Accounts: R. McCallum

GAERTNER SCIENTIFIC CORP., 1261A Wrightwood Ave., Chicago, Ill., 60614, Tel: 312-281-5335; Sls. Mgr: E.G. Watson

GAF CORP., 140 W. 51 St., New York, N.Y., 10020, Tel: 212-582-7600, TWX: 212-640-5088; Dir. Mkt. Indl. Prods: F.T. Campagna; Prod. Mgr., Micrographic Prods., Office Sys. Div: S. Tytel

GAGNE ASSOCS., INC., 1080 Chenago St., Dept. 3EE-27, Binghamton, N.Y., 13901, Tel: 607-723-9556; Pres: A.F. Gagne; V/P Sls: J.W. Cady; Sls. Mgr: J. Edwards

GAMBLE, CHARLES T. INDS., New Jersey Ave. & Fairview St., Riverside, N.J., 08075, Tel: 609-461-1900; Pres: C.T. Gamble; V.P: T. Gamble ....Vol 3•1142,1143

Local Sales Offices & Reps.

Cal	Escondido, Andrews Elctrn. Sls.	714-747-3015
Cal	Los Angeles, Penwarden Entprs.	213-785-0773
Fla	Orlando, G. Bohman Assoc.	305-855-0274
Mass	Norwood, JMG Assoc.	617-762-5333
Mich	Detroit, Rathsburg Assocs.	313-882-1717
Okla	Tulsa, Vista Assoc.	918-627-7557
Tex	Richardson, Vista Assoc.	214-235-4547

GAMMA SCI., Dept. 301, 3777 Ruffin Rd., San Diego, Cal., 92123, Tel: 714-279-8034; Applications Engr: G.C. Unangst

Local Sales Offices & Reps.

Ariz	Phoenix, Griot Assocs.	602-275-4991
Cal	El Segundo, Griot Assocs.	213-322-8383
Cal	Los Altos, Griot Assocs.	415-941-2533
Cal	Tustin, Griot Assocs.	714-838-2330
DC	Washington, D.C., Eastern Instrumentation Corp.	301-839-3800
Fla	Winter Park, McMahan Assocs.	305-645-0463
Ill	Chicago, Brooks Engrg.	312-944-1227
Mass	Sudbury, DLG Assocs.	617-877-7880
NJ	Summit, Eastern Metro Assocs.	201-277-2226
NY	Plainview, Eastern Metro Assocs.	516-931-1414
Pa	Elkins Park, Snow Assocs.	215-379-4700
Tex	Plano, Optical Services Co.	214-231-9171
Wash	Bellevue, Griot Assocs.	206-454-8592

GAP INSTR. CORP., 110 Marcus Blvd., Hauppauge, N.Y., 11787, Tel: 516-273-0909, TWX: 510-227-6237; Exec. V-P: W.P. Soboleski

Local Sales Offices & Reps.

Cal	Gardena, Compar/Coron	213-327-6550
Fla	Clearwater, Brennan Assocs., Inc.	813-466-5006
Md	Simpsonville, A/O Elctrns.	301-531-6700
Mass	Attleboro, Electronic Sls. of New England	617-222-4078
Minn	Anoka, A & R Assocs.	612-421-0751
NY	New York, Frathom Co.	212-687-9390
NY	Plainview, O. E. M. Mectronix Sls., Inc.	516-293-1530
Tex	Dallas, Vidal Elctrns.	214-352-9381
Wash	Mercer Island, Penryn Sls. & Engrg.	206-232-3411

GAR ENTERPRISES, 2031 N. Lincoln Ave., Pasadena, Cal., 91103, Tel: 213-798-0785; Sls. Mgr: G. Sugimoto

GARDINER ELCTRNS., 4729 North 7th Ave., Phoenix, Ariz., 85013, Tel: 602-274-9681

GARDINER SOLDER CO., Div. Gardiner Metal Co., 4820 S. Campbell Ave., Chicago, Ill., 60632, Tel: 312-847-0100, TWX: 910-221-2510; Sls: L. Tessier

GARDNER-DENVER CO., Gardner Expwy., Quincy, Ill., 62301, Tel: 217-222-5400; Sls. Mgr: D.E. Kipley

GARNER GLASS CO., 177 S. Indian Hill Blvd., Claremont, Calif., 91711, Tel: 714-NA-4-5071; Sls. Mgr: J.C. Hyatt

GATES ELCTRN. CO., 526 Van Nest Ave., Bronx, N.Y., 10460, Tel: 212-TU-1-5900; Sls. Mgr: J. Regenbogen Vol 1•686-688

GATES ENERGY PRODS. INC., Div. Gates Rubber Co., 999 S. Broadway, Denver, Colo., 80217, Tel: 303-744-4806, TWX: 910-931-2658; Mktg. Mgr: R. Doster; Appl. Mgr: R. Hammel

GATES, GEO. W. & CO., Hempstead Tpke. & Lucille Ave., Franklin Sq., N.Y., 11010, Tel: 212-347-0787; Sls. Mgr: T.E. Schulz

GAVITT WIRE & CABLE DIV., RSC Inds., Inc., Brookfield, Mass., 01506, Tel: 617-867-6476; Sls. Mgr: H.R. Chesson; Mktg. Mgr: J.M. Richardson

GC ELECTRONICS, Div. Hydrometals, 400 S. Wyman St., Rockford, Ill., 61101, Tel: 815-968-9661; Sls. Mgr: B. Aubery; Adv.-Sls. Prom: J. Hogan .....Vol 3•679

Local Sales Offices & Reps.

Mass	Andover, R. Purinton	617-475-7055

GC Local Distributors

Ala	Birmingham, J.W. Clary Co., 1713 Second Ave. S.	205-322-2488
Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
La	Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094	318-423-6131
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Omaha, J-B Distributing Co., 1616 Cass St	402-341-5525
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave.	212-492-9590
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Pattison Supply Co., 4550 Willow Pkwy.	216-441-3000
Ohio	Solon, REPCO, 6835 Cochran Rd.	216-248-8900
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wisc	Madison, Satterfield Elctrn., 1900 S.Park St.	608-257-4801
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

GEMS SENSORS DIV., Delaval, Spring La., Farmington, Conn., 06032, Tel: 203-677-1311; Sls. Mgr: R.J. White; Comm. Sls. Mgr: M.W. Brown

GENERAL ATRONICS, Elctrn. Tube, 1200 E. Mermaid La., Phila., Pa., 19118, Tel: 215-248-3700, TWX: 215-242-1295; Sls. Mgr: R. Koebert

GENERAL AUTOMATIC CORP., 235 W. First St., Bayonne, N.J., 07002, Tel: 201-437-7500; Sls. Mgr: M. Barron

GENERAL COMPUTERS, INC., 5990 W. Pico Blvd., Los Angeles, Calif., 90035, Tel: 213-939-7600, Sls. Mgr: C. Estes

GENERAL CONTROL CO., 1196 Soldiers Field Rd, Boston, Mass., 02134, Tel: 617-782-7440; Pres: W.J. Kelleigh

Local Sales Offices & Reps.

Cal	Los Angelis, Collier Co.	213-389-1223
Ga	Atlanta, O'Hara Assocs.	404-273-0600
Mass	Boston, Electrical Apparatus Co.	617-782-7440
NJ	Pennsauken, Leff Sls.	609-663-4025
Ohio	Cleveland, Electro Com.	216-886-2404

GENERAL DATA INDS. INC. INC., 131 Danbury Rd., Wilton, Conn., 06897, Tel: 203-762-0711, TWX: 710-468-4084; V.P. Sls: D.R. Lehrman

GENERAL DEVICES, INC., P.O. Box 253, Princeton, N.J., 08540, Tel: 609-924-2500; VP/GM: M. Medvin; Ch. Eng: M. Kirzecky; Mfg. Mgr: H. Jerzenski

Local Sales Offices & Reps.

Ala	Huntsville, Reynolds & Assoc.	205-536-1941
DC	Washington, MGI Corp.	202-296-3795
Fla	Bradenton, Reynolds & Assoc.	813-778-5219
Fla	Ft. Lauderdale, Reynolds & Assoc.	305-581-6611
Fla	Melbourne, Reynolds & Assoc.	305-727-3205
Ga	Atlanta, Reynolds & Assoc.	404-252-5360
Mass	Waban, Bawer Assocs.	617-244-8267
Mo	St. Louis, Aerotronics, Inc.	
NJ	Mountainside, Service & Technology Inc.	201-232-2666
NY	Commack, Service & Technology Inc.	516-543-1061
NY	Pompey, S. F. Foster Co., Inc.	315-677-3333
NC	Greensboro, Reynolds & Assoc.	919-275-3725
Ohio	Cleveland, R. K. P. Assocs.	216-526-5260
Ohio	Dayton, R. D. P. Assocs.	513-253-6175
Wash	Seattle, Comptronics	206-284-4842
Exp:	Bala Cynwyd, Tech Impex, Inc.	215-667-3155

GENERAL ELEC. CO., Elctrn. Comps. Sls. Dept., 1 River Rd., Schenectady, N.Y., 12345, Tel: 518-FR-4-2211 Vol 1•448,449,689; Vol 2•491,614,646,754,755, 1052; Vol 3•446,447,680,1237

Local Sales Offices & Reps.

Ariz	Phoenix	602-264-1751
Cal	Los Angeles	213-272-8566
Cal	Portola Valley	415-854-4010
Colo	Denver	303-388-5771
Conn	Bridgeport	203-334-1012
DC	Washington	202-393-3600
Fla	No. Palm Beach	305-844-5202
Fla	Tampa	813-877-8311
Fla	Winter Park	305-647-2030
Ga	Atlanta	404-633-4522
Ill	Chicago	312-777-1600
Ind	Fort Wayne	219-447-1511
Ind	Indianapolis	317-923-7221
Iowa	Cedar Rapids	319-364-9149
La	New Orleans	504-525-4324
Mass	Wellesley	617-237-2050
Mich	Southfield	313-355-3552
Minn	Minneapolis	612-927-5458
Mo	Kansas City	816-221-4033
Mo	St. Louis	314-429-6941
NJ	Clifton	201-472-8100
NY	Albany	518-458-7755
NY	E. Syracuse	315-456-1046
NY	Great Neck	516-466-8800
NY	Rochester	716-436-3480
NC	Charlotte	704-364-6313
NC	Greensboro	919-273-6982
Ohio	Cincinnati	513-281-2547
Ohio	Cleveland	216-266-2900
Ohio	Dayton	513-298-0311
Okla	Oklahoma City	405-943-9015
Pa	Erie	814-455-8377
Pa	Philadelphia	215-568-1800
Pa	Pittsburgh	412-921-4134
Tex	Dallas	214-521-1931
Tex	Houston	713-524-3061
Va	Charlottesville	703-296-8118
Va	Portsmouth	703-484-3521
Wash	Seattle	206-244-7750
Wisc	Milwaukee	414-271-5000

GENERAL ELEC. Local Distributors

Ala	Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave.SW	205-539-5722
Ariz	Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave.	602-269-1391
Ariz	Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd.	602-273-7331
Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	Culver City, Hamilton Electro Sales	213-870-7171
Cal	Hollywood, Hamilton/Avnet Elctrncs.	305-925-5401
Cal	Irvine, Cramer/L. A., 17201 Daimler St.	714-979-3000
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd.	415-961-7000
Cal	Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd.	415-968-6292
Cal	San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd.	714-279-1550, 279-2421
Cal	San Diego, Kierulff-San Diego, 8797 Balboa Ave.	714-278-2112
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Cal	Sunnyvale, Cramer/San Fran., 720 Palomar Ave.	408-739-3011
Colo	Denver, Hamilton/Avnet Electronics	303-534-1212
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue	305-923-8181
Fla	Hollywood, Schweber Elctrns.	305-927-0511
Fla	Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Industrial Court	404-448-9050

Ga Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd. 404-448-0800
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Chicago, Schweber Elctrns. 312-593-2740
Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000
Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Iowa Cedar Rapids, Iowa Radio Supply Co. Inc., 719 Center Point Rd. NE 319-364-6154
Kans Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St. 913-362-3250
La Baton Rouge, Ralph's, Inc., 1732 Plank Rd. 504-344-3761
La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110
Md Hanover, Hamilton/Avnet Elctrns. 301-796-5000
Md Rockville, Schweber Elctrns. 301-881-2970
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Burlington, Hamilton/Avnet Elctrns. 617-273-2120
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mass Newton, Cramer/International, 85 Wells Ave. 617-969-7700
Mass Waltham, Schweber Elctrns. 617-890-8484
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Detroit, Schweber Elctrns. 313-583-9242
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Edina, Cramer/Bonn, 7275 Bush Lake Road 612-835-7811
Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400
Mo Hazelwood, Hamilton/Avnet Electronics 314-731-1144
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Cedar Grove, Hamilton/Avnet Elctrns. 201-239-0800
NJ Cherry Hill, Hamilton/Avnet Elctrns. 609-662-9337
NJ Moonachie, Cramer/N.J., 1 Barrett Ave. 201-935-5600
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Cramer/Pa., 7300 Rte. 130 No. 215-923-5950
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NJ Somerset, Schweber Elctrns. 201-469-6008
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NM Albuquerque, Cramer/N.M., 137 Vermont N.E. 505-265-5767
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave. 212-492-9590
NY East Syracuse, Cramer/Syracuse, 6716 Joy Road 315-437-6671
NY Endwell, Cramer/Binghamtom, 3220 Watson Blvd. 607-754-6661
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
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NY Hauppauge, Cramer/Systems, 29 Oser Ave. 516-231-5682
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NC Research Triangle Park, W. Brown Instrs. 919-489-1546
NC Winston-Salem, W. Brown Instrs. 919-725-5384
Ohio Cleveland, Brush 216-481-7221
Ohio Dayton, Brush 513-433-9586
Pa Bala-Cynwyd, Brush 215-839-7066
Pa Pittsburgh, Brush 412-931-3660
Tex Dallas, Brush 214-241-5131
Tex Houston, Brush 713-644-3671
Va Newport News, Brush 703-877-8819
Wash Seattle, Brush 206-271-1100
For: Can., Calgary, Alberta, A. Crawford Assoc. 403-621-0780
For: Can., Longueuil, Que., A. Crawford Assoc. 514-670-1212
For: Can., Mississauga, Ont., A. Crawford Assoc. 416-678-1500
For: Can., Ottawa, Ont., A. Crawford Assoc. 613-725-3354
For: Can., Vancouver, B.C., A. Crawford Assoc. 604-253-7136

GOULD, INSTR. Local Distributors
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

GOULD INC., Ind'l. Battery Div., 467 Calhoun St., Trenton, NJ, 08607, Tel: 609-392-3111, TWX: 510-681-8489; Sls. Mgr: R. Relf

GOULD LABS., Electro Optic Dept., 540 E. 105th St., Cleveland, Ohio, 44108, Tel: 216-851-5500, TWX: 810-421-8622; Mgr. Crystal Sls: A. Carlson

GOW-MAC INSTR. CO., 100 Kings Rd., Madison, N.J., 07940, Tel: 201-377-3450, TWX: 136-331; Sls. Mgr: R.J. Mathieu

GPS CORP., 14 Burr St, Framingham, Mass., 01701, Tel: 617-875-0607; Sls. Mgr: J.O. Nilsen

GRADO LABS., INC., 4614 Seventh Ave., Brooklyn, N.Y., 11220, Tel: 212-435-5340; Sls. Mgr: R. Krieger

GRALEX INDS., DIV. GEN. MICROWAVE, 155 Marine St., Farmingdale, N.Y., 11735, Tel: 516-694-3607, TWX: 510-224-6406; VP: M. Wind; Mktg. Mgr: M. Neidich Vol 1•450

Local Sales Offices & Reps.
Cal Burlingame, Leddy Assocs. 415-347-5247
Cal Glendora, The Telemart Co. 213-444-7666
Colo Littleton, Leddy Assocs. 303-795-1973
Fla Melbourne, Reynolds & Assocs., Inc. 305-727-3205
Ga Atlanta, Reynolds & Assocs., Inc. 404-252-5360
Haw Honolulu, Aloha Assocs. 941-1574
Ill Lombard, Quadtron Assocs. Inc. 312-627-6800
Md Ellicott City, Whitco, Inc. 301-937-1122
Mass Waltham, Waitt Tech Sls. 617-891-8195
Minn Minneapolis, L. F. Green & Assocs. 612-781-1611
Mo Kansas City, R.R. Burton Sls. Co. 816-471-2850
NY Blasdell, J. E. McCarthy Co. 716-822-8787
NY Roslyn Heights, H.D.E. Assocs. 516-484-4010
NC Greensboro, Reynolds & Assocs., Inc. 919-275-3725
Ohio Cleveland, Data Equip. Sls. Co. 216-252-3151
Pa Glenside, Elcom, Inc. 215-885-1715
Tex Houston, Engrg. Assocs. 713-644-5397
Wash Seattle, Carlyle Tech Sls. 206-632-4290

GRAND TRANSFORMERS, Box 188, Grand Haven, Mich., 49417, Tel: 616-842-5430; Sls. Mgr: G. V. Retzlaff

GRANT HARDWARE CO., Div. Buildex Inc., 525 High St., W. Nyack, N.Y., 10994, Tel: 914-EL-8-4400, TWX: 914-358-3541; Sls. Mgr: J. Del Vecchio; Asst. Sls. Mgr: Mr. J. Bross

Local Sales Offices & Reps.
Cal Menlo Park, The McKnight Co. 415-325-2844
Cal So El Monte, Grant Hardware Co. 213-686-2110
Colo Denver, R & R Associates 303-893-9785
Conn Trumbull, H. Belanger 203-268-5352
Fla Orlando, B. Wimberly Co. 305-425-3083
Ill Des Plaines, Lincoln, Hodges & Associates 312-297-3810
Kans Overland Park, J. Singer 913-381-3684
Mich Farmington, Carter, McCormic & Peirce 313-477-7700
Minn St. Paul, R. G. Ragon, Inc. 612-488-0201
NJ Mountain Lakes, Components For Elctrns. 201-334-2921
NJ Ridgefield, M - D Industries 201-941-3113
NY Liverpool, Vertex Corp. 315-457-6378
NC Charlotte, Bill Henry Associates 704-375-8958
Ohio Cincinnati, Tri State Mktg. Inc. 513-761-7993
Ohio Cleveland, Carter McCormic & Peirce 216-333-5650
Pa Pittsburgh, Carter McCormic & Peirce 412-824-3760
Tex Dallas, Blackburn Associates 214-FL-1-9991
Wash Seattle, F. Jackson Co. 206-782-2211

GRAPHIC CONTROLS CORP., Recording Chart Div., 189 Van Rensselaer St., Buffalo, N.Y., 14210, Tel: 716-853-7500; Sls. Mgr: C.J. Evans; Prod. Mgr: E.J. Gray

GRAPHITE METALLIZING CORP., 1036 Nepperhan Ave., Yonkers, N.Y., 10702, Tel: 914-968-8400; G.M: W.W. Walker ..... Vol 2•647

GRAYHILL INC., 569 Hillgrove Ave., LaGrange, Ill., 60525, Tel: 312-354-1040, TWX: 910-683-1850; V.P.Sls: B. Vinkemulder; Prod. Sls. Mgr: G. Kennedy; Prod. Sls. Mgr: J. Udisches ..... Vol 2•1056-1066; Vol 3•681

Local Sales Offices & Reps.
Ala Huntsville, J.L. Highsmith Co. 205-881-3294
Ariz Scottsdale, Impact Elctrns. 602-949-8432
Cal Garden Grove, Impact Elctrns. 213-431-3581
Cal Los Altos, Nickerson-Gray Assoc. 415-941-5777
Colo Denver, Lindberg Co. 303-758-9033
Fla Orlando, Geartner Assoc. 305-299-1000
Ill Hinsdale, Hill-Gray Assoc. 312-325-4810
Ind Fort Wayne, Menze Sls. 219-747-5616
Iowa Cedar Rapids, Reid Assoc. 319-362-6302
Kans Overland Park, Penzner-Markus Assoc. 913-381-0004
Md Lutherville, Naudain Assocs. 301-252-5378
Mass Wellesley Hills, M. Scott Co. 617-235-0102
Mich Troy, C.B. Jensen & Assoc. 313-643-0506
Minn St. Paul, Northport Engrg. 612-698-3841
Mo Hazelwood, Penzner-Markus Assoc. 314-731-4334
NJ Mount Laurel, Naudain Assocs. 609-235-1801
NM Albuquerque, Lindberg Co. 505-345-2489
NY Great Neck, F. Tylinski Company 516-466-9070
NY Ithaca, B. Dean Inc. 607-272-2187
NC Charlotte, J.L. Highsmith Co. 704-333-7743
Ohio Cleveland, A.H. Baier Co. 216-461-6161
Okla Tulsa, W.P. Fralia Co.
Pa Pittsburgh, Covert & Newman Co. 412-563-0303
Tex Fort Worth, W. P. Fralia Co. 817-738-2394
Utah Salt Lake City, Lindberg Co. 801-364-6409
Va Richmond, J.L. Highsmith Co. 703-272-5888
Wash Seattle, Seatronics 206-767-4330
For: Can., Willowdale 432, Ont., F.P. Taylor Ltd. 416-222-6924

GRAYHILL MOLDTRONICS, INC., 707 Rogers St., Downers Grove, Ill., 60515, Tel: 312-968-7000; Sls. Mgr: J. Collins

GREENLEE TOOL CO., 2136-12th St., Rockford, Ill., 61101, Tel: 815-963-4881, TWX: 910-631-0747; V.P. Sls: M.J. Tuckett

GREENLEE Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801

GREENRAY INDS., INC., 840 W. Church Rd., Mechanicsburg, Pa., 17055, Tel: 717-766-0223, TWX: 510-650-4939; Sls. Mgr: G.R. Kurzenknabe Vol 2•414,415,612,613

Local Sales Offices & Reps.
Cal Burlingame, Westronics Assoc. 415-342-1425
Cal Los Angeles, Cain Technology 213-476-2251
Colo Littleton, Aztec Entprs. 303-795-0250
Fla Palm Beach Gardens, Beacon Elctrns. 305-622-2770
Ga Atlanta, Beacon Elctrns. 404-351-3654
Ill Mt. Prospect, Cain & Co. 312-253-3578
Md Annapolis, Hayden Assocs. 202-296-6059
Mass Reading, Geder-Rotondi Assoc. 617-944-3105
Mo Florissant, KM & B Tech. Sls. 314-831-0015
NM Albuquerque, Aztec Entprs. 505-255-2440
NY Huntington, Andrews & Andrews, Inc. 516-692-8686
NY Syracuse, Electra Sls. 315-455-5783
Ohio Dayton, F. Ohmer Assoc. 513-434-1454
Okla Tulsa, J.A. Green Co. 918-742-4657
Pa Ambler, Wm. Assocs. 215-643-4119
Tex Dallas, J.A. Green Co. 214-631-7450
Tex Houston, J.A. Green Co. 713-526-2959
For: Can., St. Laurent, Que., Rutherford Agencies 514-747-4339

GRI COMPUTER CORPORATION, 320 Needham Street, Newton, Mass., 02164, Tel: 617-969-0800; Mgr. Adutz. & Sls. PR: F.C. Brunner; Mgr. Applications Engrg: R. Kirk

GRIES REPRODUCER CO., Div. Coats & Clark Inc., 162 Beechwood Ave., New Rochelle, N.Y., 10801, Tel: 914-633-8600, TWX: 914-235-2188; Dir. Mkt. Svc: L.R. Chasen

GRIGSBY-BARTON, INC., 3800 Ind'l. Dr., Rolling Meadows, Ill., 60008, Tel: 312-392-5900, TWX: 910-687-3789; Dir-Sales: S.E. Wilson ..... Vol 2•766,767

Local Sales Offices & Reps.
Cal Pasadena, Luscombe Engrg. Co. 213-684-2000
Cal San Mateo, Luscombe Engrg. 415-342-7057
Fla St. Petersburg, Orbe, Inc. 813-894-0687
Ill Chicago, J.G. Twist Co. 312-593-0200
Mass Andover, R Purinton, Inc. 617-475-7055
Minn St. Paul, Kenco Co. 612-645-7717
NJ Mountainside, H. Richter 201-233-4615
NY Fayetteville, H.G. Richter 315-637-6713
NC Raleigh, A.B. Andrews 919-833-5565
Ohio Cleveland, Pinesales & Engrg. 216-247-6198
Ore Beaverton, N.R. Schultz 503-646-1345
Pa Wyncote, Cooper-Clement 215-LI-8-5450
Tex Garland, Whiteside Sls. 214-276-8382
Tex Houston, Whiteside Sls. 713-498-2551
Wash Bellevue, N. Schultz 206-454-0300

GRIGSBY-BARTON, Local Distributors
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544

GRM CORP., Box 337, Medford, N.J., 08055, Tel: 609-267-7950; Sls. Mgr: T.A. McGarrity; Pres: M. Yurko; V.P: J. Fattorini ..... Vol 1•319

Local Sales Offices & Reps.
DC Washington, Instrucom, Inc. 202-223-1759
Neb Omaha, Newton Valve Svc. Inc. 402-397-3414
Tex Richardson, Horizon Engrg. Sls. Co. 214-238-9121
Wash Bellevue, Conrard Engrg. Co. 206-455-1336
Exp: New York, N. Y., J. Plasencia, Inc. 212-867-8084

GROOV-PIN CORP., 1125 Hendricks Causeway, Ridgefield, N.J., 07657, Tel: 201-945-6780, TWX: 710-992-8963; Sls. Mgr: V.J. Manobianco

GTE AUTOMATIC ELEC., 400 N. Wolf Rd., Northlake, Ill., 60164, Tel: 312-562-7100, TWX: 910-226-1975; Prod. Mgr. Comps: J.D. Ashby; Prod. Mgr. Com. Eqpt: B.W. Bishop

Local Sales Offices & Reps.
Ariz Phoenix, Dorton Entprs. 602-263-0414
Ark El Dorado, D. Bellew Sls. 501-863-8325
Cal Burlingame, GTE Automatic Elec. 415-697-6400
Cal North Hollywood, GTE Automatic Elec. 213-766-5203
Colo Denver, Gossard & Assocs. 303-985-0602
Conn Stamford, GTE Automatic Elec. 203-329-0981
Ga Atlanta, GTE Automatic Elec. 404-261-7441
Ill Northlake, GTE Automatic Elec. 312-562-7100
Mich Detroit, GTE Automatic Elec. 313-538-6040
Minn Minneapolis, GTE Automatic Elec. 612-835-4222
Mo Kansas City, GTE Automatic Elec. 816-363-7030
Ohio Cleveland, GTE Automatic Elec. 216-267-6288
Ohio Dayton, GTE Automatic Elec. 513-299-6481
Pa Haverford, GTE Automatic Elec. 215-525-7575
Tex Garland, GTE Automatic Elec. 214-272-3535
Tex Houston, GTE Automatic Elec. 713-333-2300
Va Falls Church, GTE Automatic Elec. 703-533-0636

GTE LENKURT INC., 1105 County Rd., San Carlos, Calif., 94070, Tel: 415-591-8461, TWX: 910-376-4396; Pub. Info. Mgr: T.F. Curry

GTE SYLVANIA, INC., W.M. Chace Sub., 1600 Beard Ave., Detroit, Mich., 48209, Tel: 313-842-7400; Sls. Mgr: W.J. Tait

GTE SYLVANIA, INC., Chem. & Metallurgical Div., Towanda, Pa., 18848, Tel: 717-265-2121; Gen. Mktg. Mgr: J.W. Parks

GTE SYLVANIA, Circuit Module Operation, Box 360, Muncy, Pa., 17756, Tel: 717-546-3191; Mktg. Mgr: S.R. Sisak; Sls. Mgr: R.J. Thorpe

GTE SYLVANIA INC., Consumer Prods. - Lighting Prods., 100 Endicott St., Danvers, Mass., 01923, Tel: 617-777-1900; Natl. Sls. Mgr: G.H. Mulcahy

GTE, CONSUMER Local Distributors
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661

GTE SYLVANIA INC., Wilbur B. Driver Sub., 1875 McCarter Hwy., Newark, N.J., 07104, Tel: 201-481-3100; V.P. Mktg: C. Phayre

GTE SYLVANIA INC., Elctrn. Comps. Grp., 100 First Ave., Waltham, Mass., 02154, Tel: 617-890-9200; V. P: W.T. Buschmann

GTE, ELCTRN. COMPS. Local Distributors

Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	

GTE SYLVANIA INC., Elctrn. Sys. Gp., 100 First Ave., Waltham, Mass., 02154, Tel: 617-890-9200; Dir. Cust. Relations: W.R. Edgington

GTE SYLVANIA INC., Elctrn. Tube Div., Seneca Falls, N.Y., 13148, Tel: 315-568-5881

GTE, ELCTRN. TUBE Local Distributors

Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Mass	Boston, De Mambro Elctrns, 1095 Commonwealth Ave.	617-787-1200
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Mich	Muskegon, Western Elctrn Supply, 1781 5th St	616-722-7628
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Omaha, J-B Distributing Co., 1616 Cass St	402-341-5525
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Farr Elctrns, 5403 Prospect Ave.	216-881-7403
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Tex	Lubbock, R & R Elctrn Supply Co, 1607 Ave. G, Box 1860	806-765-7727

GTE SYLVANIA INC., Gibson Electric Subsidiary, Delmont, Pa., 15626, Tel: 412-468-4121; V.P./Mktg: J.F. Barnyak

GTE SYLVANIA INC., Lighting Prods. Grp., Danvers, Mass., 01923, Tel: 617-777-1900; Sls. Mgr: R.L. Kleinfeld

GTE, LIGHTING Local Distributors

Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000

GTE SYLVANIA INC., Miniature Lighting Prods., W. Main St., Hillsboro, N.H., 03244, Tel: 603-464-5533; Prod. Mktg. Mgr: D.S. Dewsnap; Sls. Mgr: J.J. Donelan; Customer Svc. Mgr: D.F. Smith ..... Vol 2•492-494

Local Sales Offices & Reps.

Cal	Los Altos, W.W. Posey Co.	415-948-7771
Cal	N. Hollywood, Bassett & Moore	213-766-2117
Colo	Arvada, Arrowhead Sls.	303-423-5556
Conn	Waterbury, Coakley, Boyd & Abbett	203-756-8766
Fla	Maitland, Hutto, Hawkins, Peregoy	305-831-2474
Fla	Pompano Beach, Hutto, Hawkins, Peregoy	305-943-9593
Fla	Tampa, Hutto, Hawkins, Peregoy	813-932-1800
Ga	Atlanta, Ho Smoak	404-762-1781
Ga	Atlanta, Millar Elctrns.	404-261-6160
Ill	Oak Park, G. E. Finnegan	312-383-9098
Ind	Indianapolis, Southern Sls.	317-257-7575
Iowa	Atlantic, Kimian Sls.	712-243-1626
Kans	Overland Park, Kimian Sls.	913-648-5191
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Grand Rapids, R.O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R.O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R.O. Whitesell & Assoc.	616-983-7337
Minn	Minneapolis, E. Stoss Assocs.	612-925-2757
Mo	Maryland Heights, Kimian Sls.	314-739-1655
NJ	Kearny, Hudson Lamp Co.	201-997-1850
NJ	Kearny, P. Sweeney	201-997-1850
NY	Rochester, Fowler Beach Corp.	716-586-0468
NC	Raleigh, Millar Elctrns.	919-787-9564
Ohio	Cincinnati, R.O. Whitesell & Assoc.	513-521-2990
Ohio	Columbia, R. O. Whitesell	616-888-9396
Ohio	Dayton, R.O. Whitesell & Assoc.	513-298-9546
Ohio	Lakewood, R.O. Whitesell & Assoc.	216-228-7525
Pa	Glenside, Shelmar Elctrns.	215-885-0800
Pa	Pittsburgh, R.O. Whitesell & Assoc.	412-242-0100
Tex	Dallas, Dunbar Assoc.	214-239-7151
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Wash	Seattle, Blum & Assocs.	206-782-1600
Wisc	Milwaukee, F.C. Du Bois & Assoc.	414-774-3100

GTE, MINIATURE Local Distributors

Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Colo	Denver, Burstein-Applebee	303-244-3336
Ill	Chicago, Burstein-Applebee	312-763-4848
Kans	Kansas City, Burstein-Applebee	816-561-5460
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Mo	Kansas City, Burstein Applebee	816-561-5460
Neb	Lincoln, Burstein Applebee	402-434-0678
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818

GTE SYLVANIA INC., Parts Div., 816 Lexington Ave., Warren, Pa., 16365, Tel: 814-723-2000; Sls. Mgr: R.F. Scalise

GTE SYLVANIA INC., Western Cold & Platinum Sub., 555 Harbor Blvd., Belmont, Cal., 94002, Tel: 415-593-3121, TWX: 415-594-8855; Sales Mgr: W.S. Smith

GTI CORP. (E), Manor Oak 2, 1910 Cochran Rd., Pittsburgh, Pa., 15220, Tel: 412-343-4070

GUARDIAN CALIFORNIA, 5755 Camille Ave., Culver City, Cal., 90230, Tel: 213-870-4642, TWX: 910-343-6464; Sales Mgr: G. Berglin; Pres: J.S. Winkler

Local Sales Offices & Reps.

Ala	Birmingham, Immco Inc.	205-879-0739
Cal	Palo Alto, O'Donnell Assocs.	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Denver, Arrowhead Sls.	303-222-5645
Fla	Winter Park, Floritronics	305-424-5070
Ga	Marietta, Immco Inc.	404-435-0079
Haw	Honolulu, G Piety Factors	808-841-0185
Ill	Chicago, Guardian Elec. Mfg.	312-243-1100
Ind	Fort Wayne, Needler Sls.	219-447-2123
Kans	Wichita, Thunderbird Tech. Sls. & Svcs.	316-684-3941
Md	Ellicott City, Mc Court Co.	301-465-4515
Mass	Concord, Sales Engrg. Co.	617-369-3943
Mich	Westland, Miltimore Sls.	313-349-5820
Mo	St. Louis	314-542-6488
NM	Albuquerque, Arrowhead Sls.	505-247-0287
NY	Massapequa, L.I., Coughlin Assocs.	516-799-7743
NY	Rochester, Elcom Sales	716-385-1400
Ohio	Miamisburg, W. C. Schmidt	513-866-3640
Ohio	Richmond Heights, W. A. Rowell, Jr.	216-291-0647
Pa	Delmont, T. F. Laslo & Assocs.	412-468-5045
Pa	Doylestown, T.O.E. Sls.	215-348-5333
Tex	Dallas, W Reese Assocs.	214-638-6575
Utah	Salt Lake City, Arrowhead Sls.	801-487-3444
Wash	Seattle, R. K. Squibb	206-632-2450
For:	Can., Williowdale, Ontario, A. C. Simmonds & Sons	416-491-1010

GUARDIAN CALIFORNIA Local Distributors

Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	

GUARDIAN ELEC. MFG. CO., 1562 W. Carroll Ave., Chicago, Ill., 60607, Tel: 312-243-1100, TWX: 910-221-5073; Sls. Mgr: G. Ewmett; Market Mgr: J. Rowell ..... Vol 2•768-784

Local Sales Offices & Reps.

Cal	Culver City, Guardian Elec.	213-870-4642
Cal	Palo Alto, O'Donnell	415-327-9260
Cal	Torrance, O'Donnell Assocs.	213-323-9243
Colo	Denver, Arrowhead Sls.	303-423-5556
Fla	Winter Park, Floridatronics	305-886-4818
Ga	Marietta, Immco, Inc.	404-435-0079
Haw	Honolulu, G. Piety Factors	808-841-0185
Ill	Chicago, Guardian Elec.	312-243-1100
Ind	Ft. Wayne, Needler Sls.	219-447-2123
Ind	Ft. Wayne, New/Era Sls.	219-743-5371
Ind	Indianapolis, Needler Sls.	317-255-8056
Kans	Prairie Vlg., Thunderbird Tech.	913-642-7220
Kans	Wichita, Thunderbird Tech.	316-684-3941
Md	Ellicott City, McCourt	301-465-4515
Mass	W. Concord, Sls. Engrg. Co.	617-369-3943
Mich	Novi, Miltimore Sls.	313-349-5820
Minn	St. Paul, R. A. Karr	612-739-4021
Mo	St. Louis, Thunderbird Tech.	314-567-6488
NJ	Englewood, Tech. Oriented Sls.	201-568-5747
NY	Binghamton, Elcom Sls.	607-723-9270
NY	Massapequa, J.F. Coughlin	516-799-7743
NY	Rochester, Elcom Sls.	716-385-1400
NY	Whitesboro, Elcom Sls.	315-732-6445
Ohio	Miamisburg, W.C. Schmidt	513-298-4451
Ohio	Richmond Hgts., W. Rowell	216-292-3633
Pa	Delmont, T.F. Laslo	412-468-5045
Pa	Doylestown, Tech. Oriented Elec.	215-348-5333
Tex	Dallas, W. Reese	214-638-6575
Tex	Houston, W. Reese	713-621-3134
Utah	Salt Lake City, Arrowhead Sls.	801-485-3362
Wash	Seattle, R. Squibb	206-632-2450
Wisc	Milwaukee, F.A. Nitti	414-933-1975
For:	Can., Willowdale, Ont., A. Simmond	416-491-1010

GUARDIAN ELEC. Local Distributors

Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Colo	Denver, Burstein-Applebee	303-244-3336
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Burstein-Applebee	312-763-4848
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Kans	Kansas City, Burstein-Applebee	816-561-5460
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	Baton Rouge, Ralph's, Inc., 1732 Plank Rd.	504-344-3761
La	Lafayette, Ralph's Inc., 3004 Cameron St.	318-234-4507
La	New Orleans, Ralph's, Inc., 4334 Stemway Dr.	504-242-2731
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
Mo	Kansas City, Burstein Applebee	816-561-5460
Mo	St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd	314-428-8522
Neb	Lincoln, Burstein Applebee	402-434-0678
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Buffalo, Radio Equip. Corp., 196 Vulcan St	716-874-2690
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Farr Elctrns, 5403 Prospect Ave.	216-881-7403
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tenn	Nashville, Electra Distributing, 1914 W. End Ave.	615-329-3971
Tex	Beaumont, Ralph's, Inc., 1270 Broadway	713-833-9443
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

GUDEMAN CORP., 340 W. Huron St., Chicago, Ill., 60610, Tel: 312-337-7400, TWX: 910-221-3863; Sls. Mgr: P.J. LoVecchio; Sls. Co-Ordinator: E. Kacheris Vol 2•567; Vol 3•454-476

Local Sales Offices & Reps.

Ariz	Scottsdale, Piper Sales Co.	602-946-4437
Cal	El Sequndo, Varigon	213-644-3611
Cal	San Carlos, Melchior	415-591-7383
Cal	San Diego, D. Thurston Assocs.	714-565-8411
Colo	Denver, Walker Associates	303-623-8713
Fla	Orlando, Geartner Assoc.	305-299-1000
Ga	Atlanta, Electro-Mech Sls. Engrg.	404-256-4414
Ill	Hinsdale, Momak Sls.	312-654-4524
Ill	Oak Pk., Wasson-Gallagher	312-CO-1-7517
Ind	Indianapolis, Tech. Rep.	317-546-4967
Md	Baltimore, Callas Elctrns.	301-744-7711
Mass	Chelmsford, Underwood Sls.	617-256-8191
Mich	Grand Rapids, Elko Sls.	616-949-1451
Mich	Grosse Pt. Woods, Elko Sls.	313-884-7893
Minn	St. Paul, Cullen & Assocs.	612-646-7371
Mo	Kansas City, R. Burton	816-471-2850
NJ	Fanwood, King & Assocs.	201-561-5464
NY	Liverpool, George Corp.	315-457-1188
NY	New York, E. Glass Assocs.	212-JU-6-8440
NY	Rochester, J.L. Semple	716-342-1413
NC	Winston-Salem, C. Dula	919-723-4205
Ohio	Cincinnati, A. C. Wahl & Assocs.	513-821-3270
Ohio	Dayton, R.G. Siff	513-CR-8-4779
Tex	Richardson, Vista Engrg. Assocs.	214-AD-5-4547
Wash	Seattle, Bergford & Assocs.	206-937-6664

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

GUILDLINE INSTRS., INC., 1997 Palmer Ave., Larchmont, N.Y., 10538, Tel: 914-834-8100; Sls. Mgr: E. Nemeroff

GULTON BATTERY CORP., 212 Durham Ave., Metuchen, N. J., 08840, Tel: 201-548-2800, TWX: 710-998-0592; Mktg. Mgr: J.J. Spanos; Mktg. Mgr: J.B. Schuster; Mktg. Mgr: P.L. Mendelsohn

GULTON INDS., INC., Elctrn. Comps. Div., Metuchen, N.J., 08840, Tel: 201-548-2800, TWX: 710-998-0592; Sls. Mgr: A. Currie

GULTON INDS., Connector Div., 822 Production Pl., Newport Bch., Cal., 92660, Tel: 714-642-0163, TWX: 910-596-1352; Dir. Mktg: D. Allen ..... Vol 3•682,683

Local Sales Offices & Reps.

Ariz	Scottsdale, Barnhill Five	602-947-7841
Cal	Cupertino, P M Sls.	408-255-1771
Colo	Denver, Barnhill Five	303-934-5505
Conn	W. Simsbury, Anchor Engrg.	203-658-6261
Fla	Altamonte Springs, Wm. Assocs.	305-831-4645
Fla	Clearwater, Wm. Assocs.	813-446-0075
Fla	No. Palm Beach, Wm. Assocs.	305-848-9042
Fla	Pompano Beach, Wm. Assocs.	305-943-3092
Ga	Smyrna, Electro-Rep Assocs.	404-435-0079
Mass	Wellesley Hills, Anchor Engrg.	671-235-6330
Mich	Warren, KVA Assocs.	313-756-9070
Mo	Grandview, L. R. Harry & Assocs.	816-763-3634
NY	Huntington Sta., K/R Mktg.	516-549-1300
NC	Charlotte, Electro-Rep Assocs.	704-333-0451
Ohio	Centerville, Myers Assocs.	513-299-3215
Ohio	Dayton, A. D. Dircksen & Assocs.	513-256-0351
Tex	Hurst, Kentron Engrg. Sls. Co.	817-268-1155
Utah	Salt Lake City, Barnhill Five	801-487-1327

GULTON INDS., Piezo Prods. Div., Box 4300, Fullerton, Cal., 92634, Tel: 714-871-2150, TWX: 910-592-1247; Exec. V.P: D. Herzfeld; Pres: D.P. Faulk

GULTON INDS., Servonic/Instr. Div., 1644 Whittier Ave., Costa Mesa, Cal., 92626, Tel: 714-642-2400, TWX: 714-642-1346; Sales Mgr: S. Pope

GYROSYSTEMS, INC., 120 Marine St., Farmingdale, N.Y., 11735, Tel: 516-293-5240; Sls. Mgr: E. Sandfort

H-B INSTR. CO., American & Bristol Sts., Phila., Pa., 19140, Tel: 215-DA-9-9125; V.P: C.G. Roveran

H-P-M DIV., Koehring Co., Marion Rd., Mt. Gilead, Ohio, 43338, Tel: 419-946-0222; Sls. Mgr: T.G. Bishop

HACKENSACK CABLE CORP., 110 Orchard St., Hackensack, N.J., 07602, Tel: 201-487-1100; V.P-Sls: R.H. Wilson

HACKER INSTRS., INC., Box 646, Fairfield, N.J., 07006, Tel: 201-226-8450; Mktg. Mgr: I.E. Hills; Asst. V.P: K.S. Lange

HADRON INC., 800 Shames Dr., Westbury, N.Y., 11590, Tel: 516-334-4402; V.P: P. Ratoff; Mgr., Laser Prod: J.E. Dennis

Local Sales Offices & Reps.

Cal	Anaheim, Applied Inst.	714-535-6551
Cal	San Jose, Applied Inst.	415-941-5928
Ill	Hoffman Estates, Mist Engrg.	312-529-0170
NY	Hauppauge, Barnett Assoc.	516-724-0202
NY	Syracuse, Labtronics	315-454-9314
Ohio	Cleveland Hgts., Witt Sls.	216-752-0011

HALE INSTRS., INC., Box 7487, Houston, Tex., 77008, Tel: 713-861-7574

HALEX, INC., Box 2940, Torrance, Cal., 90509, Tel: 213-772-4461; Mgr.-Rep. Sls: M.J. Bergquist

HALLMARK STANDARDS, INC., 257 Washington St., Mt. Vernon, N.Y., 10551, Tel: 914-664-4288, TWX: 710-566-1104; Sls. Mgr: M. Steinberg

HALMAR ELCTRNS., INC., 1544 W. Mound St., Columbus, Ohio, 43223, Tel: 614-276-0131; Inside Sls: M. Hunt

HAMAMATSU CORP. (E), 120 Wood Ave., Middlesex, N. J., 08846, Tel: 201-469-6640; Pres: T. Hiruma; Exec. V.P: R. Eno ..... Vol 2•1185,1186

Local Sales Offices & Reps.

Cal	Burlingame, California Eastern Labs	415-342-7744

HAMAMATSU TV CO., LTD., 1126 Ichino-Cho, Hamamatsu City, Shizuoka Pref., Japan, Tel: 0534-34-3311; Sls. Mgr: M. Aiba

HAMILTON STANDARD, Div. United Aircraft Corp., Windsor Locks, Conn., 06096, Tel: 203-623-1621, TWX: 710-420-0584; Sls. Mgr: H.W. Weinberg

HAMILTON TECHNOLOGY, INC., a div. of HMW Industries Inc., Box 1707, Lancaster, Pa., 17604, Tel: 717-394-7161, TWX: 510-657-4444; Sls. Mgr: J.F. Biehle; Mgr. Cust. Serv: P.L. Payonk

Local Sales Offices & Reps.

Cal	Costa Mesa, Hamilton Tech., Inc.	714-546-0780
Cal	Los Angeles, E. A. Wilcox Co.	213-723-6436
Colo	Denver, Electro-Rep, Inc.	303-744-2655
Conn	W. Hartford, R. S. Pettigrew & Co.	203-233-8533
Ill	Chicago, Electro-Comp Sls., Inc.	312-763-3636
Mass	W. Newton, R. S. Pettigrew & Co.	617-969-5770
Minn	Navarre, MagCo, Inc.	612-471-8538
Mo	St. Louis, Holtgrieve & Co.	314-725-6602
NJ	Asbury Park, Lancaster Ind'l. Sls., Inc.	201-988-5401
NM	Albuquerque, Electro-Rep, Inc.	505-256-1749
Ohio	Cincinnati, A. C. Wahl & Assocs., Inc.	513-821-3270
Ohio	Grafton, A. W. Risser Co.	216-458-5091
Pa	Lancaster, Lancaster Ind'l. Sls., Inc.	717-397-2942
Tex	Dallas, D. V. Falk & Assocs.	214-369-3408
Wash	Seattle, E. A. Wilcox Co.	206-243-5450

HAMLIN, INC., Lake & Grove Sts., Lake Mills, Wisc., 53551, Tel: 414-648-2361, TWX: 910-260-3740; Sls. Mgr: K. Deans ..... Vol 2•1068,1069; Vol 4•543*

Local Sales Offices & Reps.

Ariz	Phoenix, Elctrn. Comps. Sls.	602-258-7519
Cal	Encino, Cardinal Assocs.	213-787-5511
Cal	Los Angeles, C. Holmes	213-256-2255
Cal	Palo Alto, Testco Sls.	415-326-5320
Colo	Denver, Elctrn. Comp. Sls.	303-771-6200
Conn	Berlin, White Sls. Co.	203-224-0423
Fla	Miami, S.K. Wallace Assoc.	305-691-1654
Fla	Tampa, S.K. Wallace Assoc.	813-932-3568
Ga	Jonesboro, S.K. Wallace Assoc.	404-471-6297
Ill	Des Plaines, Lincoln, Hodges	312-297-3810
Iowa	Marion, Thomas & Modrcin	319-377-6261
Kans	Shawnee Mission, Thomas & Modrcin	913-432-2131
Md	Lutherville-Timonium, Nauclain Assocs.	301-252-5378
Mass	Needham, White Sls. Co.	617-444-3676
Mich	Dearborn, Villani-Pitcher	313-271-4600
Minn	Minneapolis, R-J, Inc.	612-922-1425
Mo	Hazelwood, Thomas & Modrcin	314-838-6446
NJ	Mount Laurel, Nauclain Assocs.	609-235-1801
NM	Albuquerque, Elctrn. Comp. Sls.	505-256-9831
NY	Hyde Pk., R. Kennedy	914-229-2269
NY	Manhasset, Win-Cor Elctrn.	516-627-9474
NY	Rochester, R. Kennedy	716-271-6322
NC	Greensboro, S.K. Wallace Assoc.	919-292-0487
NC	Kernersville, S. Wallace Assoc.	919-993-3993
Ohio	Bedford, G&H Sales Co.	216-248-8490
Ohio	Cincinnati, G & H Sls.	513-771-8231
Ohio	Grove City, G & H Sales Co.	614-878-1128
Tenn	Memphis, S. Wallace	901-682-2281
Tex	Dallas, Allied Comp., Inc.	214-348-6660
Tex	Houston, Allied Comp., Inc.	713-782-5406
Utah	Salt Lake City, Elctrn. Comp.	801-486-2317
Wash	Bellevue, Testco Sls.	206-454-7422
Wisc	Waukesha, Lincoln, Hodges	414-542-3087

HAMLIN, Local Distributors

NJ	Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys.	609-662-4000

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

HAMMOND MFG. CO. (U.S.) INC., 1051 Clinton St., Buffalo, N.Y., 14240, Tel: 519-822-2960; Sls. Mgr: R. F. Hammond

Local Sales Offices & Reps.

Cal	San Mateo, J.E. Lape Co.	415-345-3021
Fla	North Miami, L. Haas Co.	305-949-9143
Mass	Waltham, Conti-Younger Assoc.	617-890-4582
Mich	Royal Oak, McAuliffe Sls.	313-545-7177
NJ	Haddonfield, Boenecke Assoc.	609-429-7449
NJ	Irvington, M. Gallagher Inc.	201-399-4350
NY	Pittsford, C. Daniels	716-334-3834
NY	Williamsville, W. S. Stamp & Assoc.	716-634-2240
Ohio	Euclid, Control Dynamics Corp.	216-692-2818
Tex	Dallas, Berthold Sls. Co.	214-526-8329

HANDY & HARMAN, 850 Third Ave., New York, N.Y., 10022, Tel: 212-752-3400, TWX: 212-867-4894; Sls. Mgr: R.E. Burke

Local Sales Offices & Reps.

Cal	El Monte (Los Angeles), Handy & Harman	213-283-8181
Ill	Elk Grove Village (Chicago), Handy & Harman	312-437-3883
Mass	Attleboro, Handy & Harman	617-226-1000
Mich	Southfield (Detroit), Handy & Harman	313-356-5390
NY	New York, Handy & Harman	212-752-3400
Ohio	Cleveland, Handy & Harman	216-333-2166
Tex	Dallas, Handy & Harman	214-351-5890

HANSCOM, H.F. CO., INC., 225 Chapman St., Providence, R.I., 02905, Tel: 401-941-1456; Pres: J.F. Hanscom; V.P: W.E. Taplin

HANSEN MFG. CO., Div. P. R. Mallory & Co., Box 23, Princeton, Ind., 47670, Tel: 812-385-3415; Sls. Mgr: A.F. Bridger

HAPCO, Box 1205, Boulder, Colo., 80302, Tel: 303-447-0441; Sls. Mgr: J. Snyder

HARBISON IND'L. PRODS., INC., 7205 Hibbs La., Levittown, Pa., 19057, Tel: 215-943-9000; S/M: F.J. McCartny; Pres: R.J. Harbison

HARDER, DONALD C. CO., INC., 2580 "K" St., San Diego, Calif., 92102, Tel: 714-239-8021; Gen. Mgr: D.P. Ebenezer

HARDMAN INC., Belleville, N.J., 07109, Tel: 201-751-3000, TWX: (710) 995-4969; Mktg. Dir: G.M. Scales

HAROWE SERVO CONTROLS, 48 Westtown Rd., W. Chester, Pa., 19380, Tel: 215-692-2700, TWX: 510-663-0335; Mktg. Dir: W.J. Cuff

Local Sales Offices & Reps.

Ariz	Scottsdale, Fred Schoeffler Assoc. Inc.	602-948-3470
Cal	Hollywood, Westaironics	213-466-6201
Colo	Denver, Franklin Sls.	303-922-3623
Conn	Bloomfield, Zaslow Sls.	203-242-7781
Fla	Ormond Beach, Technology Mktg. Assoc.	904-672-2314
Ill	Chicago, Carlson Elctrn.	312-SP-4-4812
Ind	Ft. Wayne, McDonald Sls.	219-745-9214
Mass	Lowell, Zaslow Sls. Co.	617-458-8452
Minn	Minneapolis, Nortec Sls. Inc.	612-926-2855
Mo	St. Louis, Carlson Elctrn. Sls.	314-991-0262
NJ	Fairfield, Electra Mec. Assoc. Inc.	201-664-1241
NY	Jericho, Electro Rep.	516-938-0540
Ohio	Cleveland, Rockford Controls	216-731-5250
Ohio	Dayton, Rockford Controls	513-274-1931
Okla	Tulsa, Oklahoma Engineers Intl. Co.	918-747-0303
Tex	Dallas, Engineers Int'l.	214-352-2666
Exp:	D.C., Washington, Aeromaritime	202-659-8140
For:	Can., Pierrefonds, Que., Avotronics Ltd.	514-626-6511
For:	Can., Willowdale, Ont., Avotronics Ltd.	416-491-7941

HARREL, INC., 16 Fitch St., E. Norwalk, Conn., 06855, Tel: 203-866-2573; Sls. Mgr: J.C. Parry ..... Vol 2•1163

Local Sales Offices & Reps.

Ala	Birmingham, McConnel Sls.	205-871-3501
Cal	Fountain Valley	714-776-4450
Cal	Walnut Creek, Viking Instr.	415-933-1221
Colo	Denver, Electro-Rep.	303-744-2821
Fla	Hialeah, Shaw Engrg. & Sls.	308-888-0835
Ill	Glen Ellyn	312-668-6622
NJ	Yardville	609-365-2171
NM	Albuquerque, Electro-Rep.	505-256-1749
NY	Cazenovia, P.M. Decew, Inc.	315-065-8602
Ohio	Willoughby	216-942-0920

HARRIS SEMICONDUCTOR, Box 883, Melbourne, Fla., 32901, Tel: 305-727-5430, TWX: 510-954-6259; Mktg. Comm. Mgr: J. Kompan

Local Sales Offices & Reps.

Ariz	Scottsdale, Harris Semiconductor	602-946-3556
Cal	Long Beach, Harris Semiconductor	213-426-7687
Cal	San Francisco, Harris Semiconductor	415-964-6443
Colo	Denver, Elmar Elctrns.	303-287-9611
DC	Washington, D.C., Harris Semiconductor	202-337-3170
Fla	Hollywood, Schweber Elctrns.	305-927-0511
Ga	Atlanta, Schweber Elctrns.	404-449-9170
Ill	Illinois, Semiconductor Specialists	312-279-1000
Ill	Schaumburg, Harris Semiconductor	312-894-8824
Ind	Indianapolis, Semiconductor Specialists	313-255-0300
Md	Rockville, Schweber Elctrns.	301-881-2970
Mass	Waltham, Impact Sales	617-893-2850
Mass	Wellesley Hills, Harris Semiconductor	617-237-5430
Minn	Minneapolis, Semiconductor Speacialists	612-854-8841
Mo	Kansas City, Semiconductor Specialists	816-452-3900
NM	Albuquerque, R.V. Weatherford	505-265-5671
NY	Melville, Harris Semiconductor	516-249-4500
NY	Syracuse, Harris Semiconductor	315-463-3373
Ohio	Dayton, Harris Semiconductor	513-667-6680
Pa	Wayne, Harris Semiconductor	215-687-6680
Tex	Richardson, Harris Semiconductor	214-231-9031
Wash	Seattle, R.V. Weatherford	206-243-6340

HARRIS Local Distributors

Ariz	Phoenix, Liberty Electrns., 3612 N. 16th St.	602-264-4438
Cal	El Segundo, Liberty Elctrns., 124 Maryland St.	213-322-8100
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Colo	Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave.	303-287-9611
Fla	Hollywood, Schweber Elctrns.	305-927-0511
Ga	Atlanta, Schweber Elctrns.	404-449-9170
Ill	Chicago, Schweber Elctrns.	312-593-2740
Ill	Chicago, Semiconductor Specialists, Inc.	312-279-1000
Md	Rockville, Schweber Elctrns.	301-881-2970
Mass	Waltham, Schweber Elctrns.	617-890-8484
Mich	Detroit, Schweber Elctrns.	313-583-9242
NJ	Somerset, Schweber Elctrns.	201-469-6008
NY	Rochester, Schweber Elctrns.	716-328-4160
NY	Westbury, Schweber Elctrns., Jericho Tpke	516-334-7474
NC	Raleigh, Schweber Elctrns.	919-832-8681
Ohio	Beachwood, Schweber Elctrns.	216-464-2970
Wash	Seattle, Liberty Elctrns., 5303 2nd Ave. S.	206-763-8200

HARSHAW CHEM. CO., 1945 E. 97th St., Cleveland, Ohio, 44106, Tel: 216-721-8300

HARTMAN ELECTRICAL MFG., Div. A-T-O, Inc., 175 N. Diamond St., Mansfield, Ohio, 44902, Tel: 419-524-1411, TWX: 810-448-2814; V.P.-Sls: O.C. Walley

HARTWELL CORP., 9035 Venice Blvd., Los Angeles, Calif., 90034, Tel: 213-870-3781, TWX: 910-340-6761; Sls. Mgr: R.E. Bryant; Prod. Mgr: David Bates

HARWIL CO., 903 Colorado Ave., Santa Monica, Calif., 90401, Tel: 213-394-4710; Pres: H. Hutchinson; V.P: W. Gregge

HATFIELD WIRE & CABLE DIV., Continental Copper & Steel Inds., Inc., 360 Hurst St., Box 558, Linden, N.J., 07036, Tel: 201-925-4000, TWX: 138-301; Mgr., Application Engrg: W.O. Hansen; Mgr. Comm. Prods: G.A. Lohsl; Mgr. Mining Prods: P. Hronich

HATHAWAY INDUSTRIES INC., 11616 51st St., Tulsa, Okla., 74145, Tel: 918-663-0110, TWX: 910-845-2129; S/M: C.H. Brunell; App. Eng: L.H. Spellman; App. Eng: Francis D. Leynaert
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Local Sales Offices & Reps.

RELAYS & SWITCHES

Ariz	Phoenix, Airsupply Co.	602-267-3916
Cal	Dublin, Airsupply Co.	415-829-0870
Cal	Gardena, Compar L.A.	213-327-6550
Colo	Denver, R & G Entprs.	303-744-2464
Conn	Wethersfield, Com/Pak	203-563-4784
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ill	Chicago, Memac Sls. Co.	312-545-1033
Kans	Wichita, Airsupply	316-683-7518
Mass	Needham Hghts., Com/Pak	617-444-1259
Mich	Grosse Pointe Pk., Greiner Assoc.	313-499-0188
Minn	Minneapolis, M. Franklin Co.	612-835-6422
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Huntington, Airsupply Co.	516-249-1410
NY	Syracuse, Naylor Elec.	315-472-9183
NC	Winston, Industrial Products, Inc.	919-725-5385
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Landdowne, W.F. Satterthwaite Co.	215-623-5100
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-335-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, A. Smith Co.	206-746-6770
For:	Can., Downsview, Ont., Applied Tech.	416-636-8722

TERMINALS

Ariz	Phoenix, Airsupply Co.	602-267-3916
Cal	Dublin, Airsupply Co.	910-343-6861
Cal	Santa Monica, Airsupply Co.	213-829-1781
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ind	Indianapolis, Airsupply Co.	317-925-3528
Kans	Wichita, Airsupply Co.	316-683-7518
Mass	Medway, Airsupply Co.	617-533-2078
Minn	Bloomington, Airsupply Co.	612-884-8950
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Clinton, Airsupply Co.	315-735-8341
NY	Huntington, Airsupply Co.	516-249-1410
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-335-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, Airsupply Co.	206-454-7922

MOTORS

Ariz	Phoenix, Airsupply Co.	602-267-3916
Cal	Dublin, Airsupply Co.	415-829-0870
Cal	Santa Monica, Airsupply Co.	213-829-1781
Fla	Orlando, Von Kamecke Assoc.	305-423-3418
Ga	Marietta, Airsupply Co.	404-422-8242
Ill	Berkeley, Airsupply Co.	312-544-7400
Ind	Indianapolis, Airsupply Co.	317-925-3528
Kans	Wichita, Airsupply Co.	316-683-7518
Mass	Medway, Airsupply Co.	617-533-2078
Minn	Bloomington, Airsupply Co.	612-884-8950
Mo	Bridgeton, Airsupply Co.	314-731-3011
NY	Clinton, Airsupply Co.	315-735-8341
NY	Huntington Sta., Airsupply Co.	516-249-1410
Ohio	Columbus, Airsupply Co.	614-861-1129
Ohio	Dayton, Airsupply Co.	513-224-0728
Pa	Valley Forge, Airsupply Co.	215-933-8924
Tex	Fort Worth, Airsupply Co.	817-335-4541
Va	Arlington, Airsupply Co.	703-525-1191
Wash	Bellevue, Airsupply Co.	206-454-7922
For:	Can., Toronto, Ont., Wilson Entprs.	416-231-7536

HATHAWAY INSTRUMENTS, INC., 5250 E. Evans Ave., Denver, Colo., 80222, Tel: 303-756-8301, TWX: 910-931-0568; Sls. Mgr: M.M. Burgess
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HAWKEYE INSTRUS., INC., 3545 Third Ave., Marion, Iowa, 52302, Tel: 319-377-8241; Sls. Mgr: D. Meuler

HAYDON SWITCH & INSTR., 1500 Meriden Rd., Waterbury, Conn., 06720, Tel: 203-756-7441, TWX: 710-477-2580; V.P./Mktg: E.R. Kambrich

Local Sales Offices & Reps.

Cal	Los Angeles, Fetty/Schoenduve, Inc.	213-651-4050
Cal	Palo Alto, Fetty/Schoenduve, Inc.	415-321-7041
Colo	Denver, A. G. Electronics	303-722-5814
Conn	Waterbury, Haydon Switch & Instr.	
Conn	Wolcott, Bennett Assocs.	203-879-2478
Fla	Fern Park, M.G. Assocs.	305-841-8793
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ind	Fort Wayne, R. O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assoc.	317-453-6868
Iowa	Cedar Rapids, J. G. Twist Co.	319-365-1401
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Ky	Louisville, R. O. Whitesell & Assocs.	502-893-7303
Md	Timonium, Heller Sls. Co.	301-252-4780
Mass	Woburn, All Star Engrg.	617-449-2634
Mich	Grand Rapids, R. O. Whitesell & Assocs.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assocs.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Minn	Eden Prairie, F. Peterson Co.	612-941-5400
Mo	St. Louis, J. G. Twist Co.	314-432-2830
NY	Syracuse, J. V. Costello	315-472-0322
Ohio	Cincinnati, R. O. Whitesell & Assoc.	513-521-2290
Ohio	Cleveland, R. O. Whitesell & Assoc.	216-228-7525
Ohio	Columbus, R. O. Whitesell & Assoc.	614-888-9396
Ohio	Dayton, R. O. Whitesell & Assoc.	513-298-9546
Pa	Pittsburgh, R. O. Whitesell & Assoc.	412-242-0100
Tenn	Bristol, R. O. Whitesell & Assocs.	615-968-4195
Wash	Bellevue, Willis Sls. Co.	206-454-3029
Wisc	Waukesha, J. G. Twist Co.	414-786-6330
Exp:	N.Y., New York, Aviquipo, Inc.	212-943-6580

HAYDON Local Distributors

Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Md	Baltimore, Arrow Elctrns., 5207 E. Drive	301-247-5200
Mass	Burlington, Arrow Elctrns., 15 A Street	617-273-0100
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521

HAYSITE DIV., Synthane-Taylor, 5599 New Perry Hwy., Erie, Pa., 16512, Tel: 814-868-3691; Sls. Mgr: R.W. Amundsen

HB ENGINEERING CORP., 11511 Maryland Ave., Beltsville, Md., 20705, Tel: 301-937-5181; Dir. Mktg: F.E. Colonna; Pres: H.M. Baker

HEADWAY RESEARCH, INC., 3713 Forest La., Garland, Tex., 75042, Tel: 214-272-5431; Mktg. Mgr: R.L. Rich

HEATH CO., Dept. 180, Benton Harbor, Mich., 49022, Tel: 616-YU-3-3961, TWX: 616-983-3897; Sls. Mgr: C.A. Robertson

Local Sales Offices & Reps.

Ariz	Phoenix, Heathkit Electronic Center	602-279-6247
Cal	Anaheim	714-776-9420
Cal	El Cerrito	415-236-8870
Cal	La Mesa	714-461-0110
Cal	Los Angeles	213-749-0261
Cal	Pomona, Heathkit Electronic Center	714-623-3543
Cal	Redwood City	415-365-8155
Cal	Woodland Hills	213-883-0531
Colo	Denver	303-422-3408
Conn	Avon, Heathkit Electronic Center	203-678-0323
Fla	Hialeah, Heathkit Electronic Center	305-823-2280
Ga	Atlanta	404-252-4341
Ill	Chicago	312-583-3920
Ill	Downers Grove	312-852-1304
Ind	Indianapolis, Heathkit Electronic Center	317-257-4321
Kans	Mission, Heathkit Electronic Center	913-362-4486
Md	Baltimore, Heathkit Electronic Center	301-661-4446
Md	Rockville	301-881-5420
Mass	Wellesley	617-237-1510
Mich	Detroit	313-535-6480
Mich	East Detroit, Heathkit Electronic Center	313-772-0416
Minn	Hopkins	612-938-6371
Mo	St. Louis	314-638-5100
NJ	Fair Lawn	201-791-6935
NY	Amherst, Heathkit Electronic Center	716-837-3090
NY	Jericho	516-334-8181
NY	New York	212-765-4590
NY	Rochester, Heathkit Electronic Center	716-227-4750
Ohio	Cleveland	216-886-2590
Ohio	Woodlawn	513-771-8850
Pa	Philadelphia	215-288-0180
Pa	Pittsburgh	412-824-3564
Tex	Dallas	214-826-4053
Tex	Houston	713-623-2090
Wash	Seattle	206-682-2172
Wisc	Milwaukee	414-873-8250
Exp:	Mich., Benton Harbor	616-983-3961

HECON CORP., 31 Park Rd., New Shrewsbury, N.J., 07724, Tel: 201-542-9200; Adv. Mgr: W. Fuelleman
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Local Sales Offices & Reps.

Cal	Sherman Oaks, Hecon Western	213-788-3931
Colo	Denver, D. E. Bond Assocs.	303-756-1234
Fla	Maitland, Hutto-Hawkins-Peregoy	305-831-2474
Fla	Pompano Beach, Hutto-Hawkins-Peregoy	305-943-9593
Ga	Atlanta, Hecon Corp.	404-758-7306
Ill	Hanover Park, Hecon Corp.	312-289-2859
Kans	Prairie Village, Engrg. Svcs. Co.	913-649-4000
Mass	Boston, Hecon Corp.	617-262-5043
Mo	St. Louis, Engrg. Svcs. Co.	314-726-2233
NJ	Laurel Springs, Hecon Corp.	609-784-2334
NJ	Wayne, Hecon Corp.	201-839-5454
NY	Pennellville, Hecon Corp.	315-463-3661
Ohio	Port Clinton, Hecon Corp.	419-734-4556
Okla	Tulsa, Hecon Corp.	918-627-2774
Utah	Salt Lake City, e l h distributing	801-277-9539
Va	Lynchburg, Royelec Sls. Assocs.	703-846-7117
Wash	Seattle, Fairman B. Lee Co.	206-244-7262
For:	Can., Rexdale, Ont., Hecon of Canada, Ltd.	416-678-2441

HECON Local Distributors

Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Cal	Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr.	415-964-0820
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Md	Beltsville, Powell Elctrns/Washington, 10728 Hanna St.	301-937-4030
NY	Scarsdale, Logicomp Elctrns. Inc., Box 37H	914-723-3334
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Warren, REM Elctrns. Supply Co., 264 W. Market St.	216-399-2777
Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	

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HEI, INC., Jonathan Ind'l. Ctr., Chaska, Minn., 55318, Tel: 612-448-3510, TWX: 910-578-0832; Sls. Eng: R.O. Young

HEIMANN GMBH, 63 E. Sandford Blvd., Mt. Vernon, N.Y., 10550, Tel: 914-699-0050; Prod. Mgr: H.F. Maier

HEINEMANN ELEC. CO., 2636 Brunswick Pike, Trenton, N.J., 08602, Tel: 609-882-4800; Mktg. Mgr: B.A. Plesser
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Local Sales Offices & Reps.

Ala	Birmingham, J. Spader Co.	205-879-1366
Ariz	Phoenix, M. Richardson Assocs.	602-278-6296
Cal	Burlingame, Campbell & George	415-697-2965
Cal	Encino, Porter Co.	213-788-2350
Colo	Denver, P.A. Douden	303-744-1497

Fla Oviedo, Conley & Assocs., Inc. 305-365-3283
Fla Tampa, Conley 813 933-3183
Ill Chicago, D. Dolin Sls. 312-286-6200
Ind Marion, O. Bromberg 317-664-5384
Ky Louisville, O. Bromberg 502-245-8916
Md Ellicott City, McCourt 301-465-4515
Mass Boston, Elec. Apparatus 617-782-7440
Mich Dearborn, G. Horne 313-561-1360
Minn Minneapolis, H. Smith 612-335-8911
Mo St. Louis, Hill & Co. 314-621-1818
NJ Ridgewood, Ballou, Inc. 201-444-6990
NJ Trenton, Kriegner Sls. 609-882-6330
NY Binghamton, Canavan Scanlon 607-724-7220
NY Buffalo, Canavan-Scanlon 716-839-3373
NY Rochester, Canavan-Scanlon 716-442-0720
NY Syracuse, Canavan-Scanlon 315-437-1271
NC Charlotte, J. Rudisill Assocs., Inc. 704-377-6901
Ohio Cincinnati, O. Bromberg 513-381-5728
Ohio Cleveland, Brown Elect. Prod. 216-861-0114
Okla Tulsa, Comps. Inc. 918-583-9149
Pa Pittsburgh, Brown Elec. Equip. 412-563-4444
Tenn Memphis, Ransom Sls. 901-332-0036
Tex Dallas, Glidden Electro Equip. 214-363-6539
Tex Houston, Glidden Electro Equip. 713-681-1415
Wash Mercer Island, J. Andersen 206-232-0484
Wisc Milwaukee, E. Dickinson 414-CO-4-1080

HEINEMANN Local Distributors
Ala Huntsville, Hall-Mark Elctrns., Box 1133 205-539-0691
Fla Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr. 305-855-4020
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NJ Cherry Hill, Hamilton/Avnet Elctrns. 609-662-9337
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Farmingdale, Hall-Mark Elctrns., 167 Marine St. 516-293-7500
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wisc Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave. 414-476-1270

HEITZ, KARL, INC., 979 Third Ave., New York, N.Y., 10022, Tel: 212-421-5220; Sls. Mgr: M. Schlapfer

HELI-COIL PRODS., Div. Mite Corp., Shelter Rock La., Danbury, Conn., 06810, Tel: 203-743-7651, TWX: 710-456-0336; Sls. Mgr: B.B. Morgan, Jr.

Local Sales Offices & Reps.
Cal El Monte, Western Regional Office 213-579-0181
Ga Atlanta, J. O. King, Inc. 404-355-7660
Ill Downers Grove, S. W. Anderson Co. 312-964-2600
Mich Detroit, A. A. Geisler Co. 313-255-1450
Tex Arlington, G. J. Fix Co. 817-261-8241
Exp: New York, N.Y., Resources & Facilities 212-687-4741

HELICAL PRODS. CO., INC., P.O. Box 4, Hermosa Beach, Cal., 90254, Tel: 213-374-9941; Pres: H.L. Merrell

HELIOTEK, Div. Textron, Inc., Box 4158, Sylmar, Calif., 91342, Tel: 213-365-4611, TWX: 910-496-1488; Aerospace Business Mgr: C.W. Quillin; Sls. Mgr. (Solar Cells): K. Eacrett; Sls. Mgr. (PV devices): R. Harper

HELIX SPRING CORP., 35-10 10th St., Long Island City, N.Y., 11106, Tel: 212-YE-2-0303; Sls. Mgr: S. Treibish

HENES MFG. CO., 4301 E. Madison St., Phoenix, Ariz., 85034, Tel: 602-275-4126; Gen. Mgr: R.W. Henes; Office Mgr: M.L. Chesnut

Local Sales Offices & Reps.
Ariz Scottsdale, Allen Assocs. 602-946-4903
Cal Costa Mesa, Scrantom Engrg. Inc. 714-979-6373
Cal Los Altos, C. D. Buerki Co. 415-941-3343
Conn Bridgeport, Technical Instrs., Inc. 203-368-4582
Fla Clearwater, H. R. Gross & Co. 813-446-6649
Ill Des Plaines, Automated Process, Inc. 312-299-3656
Ind Cumberland, Automated Process, Inc. 317-251-0708
Kans Overland Park, Production Automation Corp. 913-236-6600
Mass Wilmington, Technical Instrs., Inc. 617-944-3930
Mich Detroit, Electro Entprs., Inc. 313-521-1500
Minn Minneapolis, Automated Process, Inc. 615-545-4481
Mo St. Louis, Production Automation Corp. 314-426-2331
NJ Saddle Brook, L & M Assocs., Inc. 201-843-8700
NY Brentwood, L & M Assocs., Inc. 516-231-8363
NY New York, L & M Assocs., Inc. 212-675-7486
NC Raleigh, F. G. Speidel 919-787-4521
Ohio Cleveland, Electro Entprs., Inc. 216-261-7670
Ohio Dayton, Electro Entprs., Inc. 513-426-6071
Ore Yamhill, Walsh-Ehlers, Inc. 503-662-3207
Pa Andalusia, L & M Assocs., Inc. 215-639-3100
Tex Dallas, R. W. Mureen Co. 214-350-8142
Wash Bellevue, Walsh-Ehlers, Inc. 206-454-2211
Wisc Milwaukee, Automated Process, Inc. 414-354-4370
Exp: New York, N. Y., E. D. Allmendinger, Inc. 212-269-0090

HENRY PRODS. CO., INC., 500 Bayview, Inwood, N.Y., 11696, Tel: 516-371-4100; Sls. Mgr: J. Dorino

Local Sales Offices & Reps.
Ohio Dayton, Rixan Assocs., Inc. 513-278-4216

HENSCHEL CORP., 14 Cedar St., Amesbury, Mass., 01913, Tel: 617-388-1103; V.P. Mktg: G. Landers; Sls. Engr: F.L. Clark

HERMES PLASTICS, INC., 20 Cooper Square, New York, N.Y., 10003, Tel: 212-533-5100; V. P: Z. Kozak

HERMETIC SEAL CORP., 4232 Temple City Blvd., Rosemead, Cal., 91770, Tel: 213-283-0411, TWX: 910-587-3352; Engrg. Sls. Mgr: E.E. Harrison

HERTZ FILTER, 3 Aerial Way, Syosset, N.Y., 11791, Tel: 516-822-4770; Sls. Mgr: B. Dworkin

HEWLETT-PACKARD, 1501 Page Mill Rd., Palo Alto, Cal., 94304; Sls. Mgr: J. Petrak ..... Vol 1•695-698

HEWLETT-PACKARD Local Distributors
Ala Huntsville, Hall-Mark Elctrns., Box 1133 205-539-0691
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Fla Hollywood, Schweber Elctrns. 305-927-0511
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Schweber Elctrns. 312-593-2740
Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747
Md Rockville, Schweber Elctrns. 301-881-2970
Mass Waltham, Schweber Elctrns. 617-890-8484
Mich Detroit, Schweber Elctrns. 313-583-9242
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NJ Somerset, Schweber Elctrns. 201-469-6008
NY Rochester, Schweber Elctrns. 716-328-4180
NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474
NC Raleigh, Hall-Mark Elctrns., 3000 Indust. Dr. 919-832-4465
NC Raleigh, Schweber Elctrns. 919-832-8881
Ohio Beachwood, Schweber Elctrns. 216-464-2970
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200

HEXACON ELEC. CO., 621 W. Clay Ave., Roselle Park, N.J., 07204, Tel: 201-CH-5-6200, TWX: 138812; V-P, Mktg. & Sls: R.J. Benes ..... Vol 3•1238,1239

Local Sales Offices & Reps.
Ariz Phoenix, MD. Rebco Sls. 301-592-8907
Cal Burlingame, Dillon Stevens 415-697-3022
Cal L.A., Dillon Stevens Co. 213-747-9221
Colo Denver, Bax & Co. 303-756-1804
Conn Woodstock, HDQ & HV Neff 203-974-1281
Fla Winter Pk., Young & Lawrence Assoc. 305-647-6929
Ill Chicago, EMF Co. 312-889-8323
Ind Carmel, R. Ribaudo 317-846-4021
Kans Kansas City, L.E. Bruns 913-287-5242
NJ Cherry Hill, Hunt Assoc. 609-428-6666
NY New Hartford, V. Clair 315-735-8122
NY New York City, Dunn & Bryan 212-964-8091
NY New York City, Lincoln Export Co. 212-344-0210
Ohio Berea, Mid American Mktg. 216-826-1033
SC Greenville, J.B. Jackson 803-244-2508
Tenn Memphis, H. Carson 901-398-6194
Tex Richardson, P.J. Scanlon 214-AD-1-4661
Wash Seattle, Latham Sls. Assoc. 206-284-5024
Wisc Milwaukee, Process Tech 414-464-6620-6621
Exp: Hato Rey, P.R., M. Anderson 809-722-1654
For: Can., Montreal W. P. Q., W. P. Q. Adtool 514-482-2548

HEXACON Local Distributors
Conn Fairfield, Utronic Inc., 273 Linwood Ave. 203-255-4521
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621

HEYMAN MFG. CO., E. Michigan Ave., Kenilworth, N.J., 07033, Tel: 201-245-2345, TWX: 710-996-5986; Sls. Coor: R. Zednick

HGA ELCTRNS., 519 S. Fifth Ave., Mt. Vernon, N.Y., 10550, Tel: 914-664-5393

H H CONTROLS CO., INC., 16 Frost St., Arlington, Mass., 02174, Tel: 617-646-2626; Sls. Mgr: G. Armstrong

HI-G, Spring St. & Rte. 75, Windsor Locks, Conn., 06906, Tel: 203-623-2481, TWX: 710-420-0592; V.P. Mktg: R.R. Carroll ..... Vol 2•785-796

Local Sales Offices & Reps.
Ala Huntsville, Interep Assocs. 205-881-3677
Ariz Scottsdale, Barnhill Five 602-947-7841
Cal Menlo Pk., J.S. Heaton 415-369-4671
Cal Woodland Hills, Interstate Mktg. 213-883-4235
Colo Denver, Barnhill Five 303-934-5505
Fla Hialeah, Shaw Engrg. 305-888-0835
Fla Oviedo, Conley & Assocs. 305-365-3233
Fla Tampa, Conley & Assocs. 813-933-3183
Ill Chicago, Engineered Sls. 312-867-8434
Ind Ft. Wayne, The Given Corp. 219-432-5585
Md Timonium, Heller Assocs. 301-252-4780
Mass Lexington, J.E. Boeing Co. 617-862-2500
Mich Southfield, Rep Elctrn. Prods. 313-354-9066
Minn St. Paul, R. G. Ragon 612-488-0201
Mo St. Charles, Buse Sls. 314-739-1613
NM Albuquerque, Barnhill Five 505-265-7766
NY Jericho, HRC Assocs. 516-822-5550
NY Rochester, Canavan-Scanlon 716-442-0720
NY Syracuse, Canavan-Scanlon 315-463-9161
NC Bethania, Candor Co. 919-924-1480
Ohio Cincinnati, Comps., Inc. 513-721-2997
Ohio Cleveland, Comps., Inc. 216-842-2737
Ohio Dayton, P.E. Montplaisir 513-434-4316
Pa Ardmore, Freedman Assocs. 215-649-3679
Tex Dallas, Blackburn Assocs. 214-351-9991
Tex Dallas, Jacobsen Co. 214-363-7584
Wash Bellevue, Ruggles Tech. 206-455-2778
For: Can., Cooksville, Ont., Anbak Sls. 416-625-1061
For: Can., Ile Perrot Sud, Que., Anbak Sls. 514-453-6375

HI-G Local Distributors
Ariz Phoenix, Mirco Electrn. Dist., 2104 W. Peoria Ave. 602-944-2281
Cal Chatsworth, Westates Elctrns. Corp., 20151 Bahama St. 213-341-4411
Cal Goleta, Radio Prods. Sls., 350 S. Kellogg Ave 805-964-6823
Cal Hollywood, Hollywood Radio & Electr., 5250 Hollywood Blvd. 213-466-3181
Cal Los Angeles, Radio Prods. Sls., 1501 S. Hill St. 213-748-1271
Cal San Carlos, Sterling Electronics, 1061 Industrial Rd. 415-592-2353
Cal San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd. 714-292-5611
Fla Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr. 305-855-4020
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Ind Indianapolis, Graham Elctrncs., 133 S. Penn. St. 317-634-8480
Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
Mass Lexington, Harvey R & D Electrnc., 44 Hartwell Ave. 617-861-9200
Mass Watertown, DRW Electronics, 600 Pleasant St. 617-923-1900
Minn St. Paul, Ragon, 1136 W. Larpenteur St. 612-488-0201
Mo St. Charles, Lectronix, Inc., 214 N. 2nd St. 314-946-6424
NJ Fairfield, Delburn Electronics, 345 Kaplan Dr. 201-227-6200
NY Farmingdale, DRW Electronics, 100 Milbar Blvd. 516-249-2660
NY Vestal, Federal Elctrn., Vestal Pkwy.
NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Pa Harrisburg, Pyttronic Inds. Inc., 2325 No. 7th St. 717-233-6591

Pa Montgomeryville, Pyttronic Inds. Inc., Stump Rd., Box 433 215-643-2850
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Vol 3•1047

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Vol 1•460

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JAY-EL PRODS., 1859 W. 169th St., Gardena, Calif., 90247, Tel: 213-FA-1-3260, TWX: 213-327-1471; Sls. Mgr: L.K. Miller
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Cal Santa Clara, Nova Tronix, Representative 408-243-9530
Mass Chelmsford, Great Northern Elec. Co. 603-668-1372
Pa Lafayette Hill, R. Tschopp (Direct Sls.) 215-825-3666
Wash Seattle, Norwest Co. 910-444-2119
JB ELCTRN. TRANSFORMERS, INC., 2300 W. Armitage Ave., Chicago, Ill., 60647, Tel: 312-342-0080; V.P: N.K. Yost
JEFFERSON ELEC., Div. Litton Inds., 840 S. 25th Ave., Bellwood, Ill., 60104, Tel: 312-626-7700; Sls. Mgr: W. Beam
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Fla Orlando, O.C. Puckett Co. 305-422-7197
Ga Atlanta, Chastain-Powell 404-875-0755
Haw Honolulu, R.J. Austin & Assoc. 808-395-4011
Ill Chicago, Elec. Mktg. Corp. 312-681-1180
Ind Indianapolis, C. Warble & Assoc. 317-632-1465
Kans Kansas City, D. Hatfield Sales Co. 913-281-0533
Ky Covington, Hackman Elec. Sls. 606-291-3800
La New Orleans, Corrigan Mktg. Agency 504-865-7301
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Mich Detroit, Benfield Assoc. 313-846-3200
Minn Minneapolis, C.R. Krenik Sls. 612-338-5661
Mo St. Louis, Elec. Mktg., Inc. 314-726-2920
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NY Hartford, F.W. Laver & Son 315-724-2304
NY Jamaica, Warshaw Elec. Co. 212-525-8150
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Tex Dallas, Rich Co. 214-742-1758
Tex Houston, McIver & Slavin Co. 713-861-3888
Utah Salt Lake City, J. D. Stephens Co. 801-355-3540
Wash Seattle, Bangs Assoc. 206-762-0262
Wisc Milwaukee, A.J. Gaertner & Assoc. 414-273-6162
JENSEN SOUND LABS., Div. Pemcor, Inc., 4310 Trans World Rd., Schiller Park, Ill., 60176, Tel: 312-671-5680, TWX: 910-227-3728; Service Mgr: R. Engelmann; Eastern Sls. Mgr: P. Fredrickson; Western Sls. Mgr: F. Hackendahl
JERROLD ELECTRONICS CORP., Distributor Sales Div., 401 Walnut St., Philadelphia, Pa., 19105, Tel: 215-925-9870, TWX: 215-569-8603; Div. Mgr: B. Wolf
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Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
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JETTRON PRODS., 58 Rte. 10, Box 7, Hanover, N.J., 07936, Tel: 201-887-0571, TWX: 710-986-8243; Sls. Mgr: J.M. Schill

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Cal Culver City, E. V. Roberts & Assoc. 213-870-9561
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Ga Atlanta, Cartwright & Bean, Inc. 404-237-2273
Ill Barrington, F. J. Peck Co. 312-381-3388
Kans Shawnee Mission, Kathrinus, Kelly & Co. 913-722-0000
La Chalmette, Cartwright & Bean 504-279-4598
Me Denmark, Great Northern Elec. Co. 207-783-6131
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Mo St. Louis, Kathrinus, Kelly & Co. 314-962-5627
NJ Cherry Hill, Trinkle Sales 609-667-3500
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NY Garden City, Comtronic Assoc. 516-741-8966
NY N. Syracuse, L. D. Allen Inc. 315-458-7470
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NC Raleigh, Cartwright & Bean, Inc. 919-832-7128
Ohio Chagrin Falls, Elctrns. Salesmaster, Inc. 216-247-8201
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Pa Allison Park, Trinkle Sales, Inc. 412-487-1645
Tenn Memphis, Cartwright & Bean 901-276-4442
Tex Dallas, J. Y. Schoonmaker Co. 214-357-8481
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Ariz Tempe, Argus Sls. 602-947-8355
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Cal Van Nuys, Riker-Maxson 213-785-0487
Colo Denver, Randy Smith Assoc. 303-399-1132
Fla Altamonte Springs, SemTronic Assocs. 305-831-6233

Fla Pompano Beach, SemTronic Assocs. 305-772-8735
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Md Elicott City, Doss Elctrns. 301-465-1336
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Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
NY Syracuse, Hamilton/Avnet Elctrns. 315-437-2642
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

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Cal Menlo Pk., Straube Assocs. 415-323-2476
Cal Sherman Oaks, J.B. Microelctrns. Inc. 213-789-0418
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Fla Clearwater, Perrott Assocs. 813-531-5513
Fla Orlando, Perrott Assocs., Inc. 305-275-1132
Ill Rolling Meadows, Sumer, Inc. 312-394-4900
Ind South Bend, Valentine & Schillinger 219-291-6258
Md Silver Springs, Rep-Tron, Inc. 501-593-4844
Mass Seekonk, J. Murphy Assocs. 617-761-7153
Minn Minneapolis, Stoss Assocs. 612-925-2757
NY Fayetteville, Graydon-Sherman 315-637-9861
NY Mt. Vernon, Friedman-Smith Elctrn. Sls. 914-664-4866
Ohio Cleveland, Electro-Com 216-886-2404
Pa Philadelphia, Professional Svc. Assocs. 215-722-8222
Pa Pittsburgh, Covert & Newman Co. 412-563-0303
Tex Ft. Worth, W. Pat Fralia Co. 214-264-3491
Wash Seattle, R. Johnston Co. 206-524-5170
Exp: N.Y., New York, Multiparts Corp. 212-944-4370
For: Can., Mont., Que., Braydon Electro 514-341-3330

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Cal Sherman Oaks, J.B. Microelctrns. 213-789-0418
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Fla Pompano Beach, Hutto, Hawkins, Peregoy 305-943-9593
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NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cleveland, Farr Elctrns, 5403 Prospect Ave. 216-881-7403
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
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Ind Indianapolis, Garstang Engrg. Co. 317-632-9903
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WVa Huntington, Foster-McClinton Inc. 304-736-5161
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Cal	Palo Alto, Coherent Mktg.	415-327-2217
Cal	Pasadena, Luscombe Engrg.	213-684-2000
Cal	San Mateo, Luscombe Engrg.	415-681-1398
Conn	Hamden, Instr. Consits.	203-248-4174
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Ill	Des Plaines, S. Sterling Co.	312-298-8454
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NC	Winston-Salem, Int'l. Scien. Instrs.	919-722-1783
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Cal	Pasadena, Luscombe Engrg.	213-684-2000
Cal	San Mateo, Luscombe Engrg.	415-681-1398
Conn	Hamden, Instr. Consits.	203-288-5246
Fla	Orlando, Datarep, Inc.	305-855-8944
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Mo	St. Louis, S. Sterling Co.	314-567-3636
NY	E. Syracuse, Ossmann Instruments, Inc.	315-437-6666
NY	Mt. Vernon, Q.E.D. Elctrns.	914-664-0080
NC	Winston-Salem, Int'l. Scien. Instrs.	919-722-1783
Ohio	Cleveland, S. Sterling Co.	216-442-8080
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Ohio Cleveland, Components 216-842-2737
Ohio Dayton, H. Pipe 513-434-7900
Okla Tulsa, Norvell Assocs., Inc. 918-663-1247
Tex Dallas, Norvell Assocs. 214-350-6771
Tex Houston, Norvell 713-774-2568
Va Lynchburg, Burgin-Kreh 703-845-5600
Wash Bellevue, A. Smith 206-746-6770
For: Can., Downsview, Ont., Whittaker Elct. 416-247-7454
For: Can., Ottawa, Ont., Whittaker Elct. 613-224-1221
For: Can., Roxboro, Que., Whittaker Elct. 514-683-3621
For: Can., W. Vancouver, B.C., Whittaker Elctrns. 604-926-3411

KILOVAC Local Distributors
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

KILOVOLT CORP., 238 High St., Hackensack, N.J., 07602, Tel: 201-488-7373 ..... Vol 1•756,757

Local Sales Offices & Reps.
Cal Sherman Oaks, Windsor Dynamics, Inc. 213-989-3631
Cal Woodside, Windsor Dynamics 415-854-4870
Colo Denver, PLS Assocs. 303-771-0140
Conn Meriden, Abbott-Allison Co., Inc. 203-237-9232
Ill Chicago, P. Lind Elctrns. Co. 312-774-1246
Ind Indpls, P. Lind Elctrns. 317-547-9178
Mich Farmington, Carter, McCormic & Peirce 313-477-7700
Minn Circle Pines, Lind Elctrns. 612-786-5770
NM Albuquerque, PLS Assocs. 505-255-2330
NY Elbridge, L-Tron Corp. 315-689-3787
NY Latham, L-Tron Corp. 518-785-5032
NY Rochester, L-Tron Corp. 716-436-4410
NY Tonawanda, L-Tron Corp. 716-691-8887
Ohio Cleveland, Carter McCormic & Peirce 216-333-5650
Ohio Dayton, Carter, McCormic & Peirce 513-888-4466
Pa Pittsburgh, Carter, McCormic & Peirce 412-824-3760
Tex Dallas, J.A. Green Co. 214-631-7450
Tex Houston, J.A. Green Co. 713-526-2959
Utah Salt Lake City, PLS Assoc. 801-262-2866

KINETIC TECH., INC., 3393 De La Cruz Blvd., Santa Clara, Cal., 95050, Tel: 408-296-9305; Sls. Mgr: R. S. Smith; Dir. Mktg. Svs: F. Glynn

Local Sales Offices & Reps.
Ariz Scottsdale, Compar of Ariz.
Cal Burlingame, Compar San Francisco 415-347-5411
Cal Gardena, Compar Los Angeles 213-327-6550
Colo Denver, Omega Ltd. 303-758-1508
Conn Hamden, Compar New England 203-288-9276
Fla Boca Raton, Southeastern Comp. Sls. 305-391-9067
Fla Clearwater, Southeastern Comp. Sls. 813-531-8324
Ill Chicago, DJM Elctrn. Sls., Inc. 312-774-1212
Md Baltimore, Compar Chesapeake 301-484-5400
Mass Newton Highlands, Compar New England 617-969-7140
NJ Clifton, Compar 201-546-3660
NY Conklin, Ramcom, Inc. 607-775-0641
NY Williamsville, Ramcom, Inc. 716-632-6913
Ohio Dayton, Compar Ohio 513-435-1301
Ohio Fairview Park, Compar Ohio 216-333-4120
Pa Philadelphia, Compar Philadelphia 609-854-1222
Wash Kirkland, Compar Northwest 206-822-4191

KINETRON CORP., 1416 Roller Rd, Asbury Park, N.J., 07712, Tel: 201-776-9595; Sls. Mgr: V.H. Triwedi

KINGSLEY MACH. CO., Aero-Space Div., 850 Cahuenga Blvd. - EEM, Hollywood, Calif., 90038, Tel: 213-469-7243; V.P. Sls: J.M. Butler

KISTLER INSTR. CO., div. Sundstrand Data Control, Inc., Overlake Ind'l. Pk., Redmond, Wash., 98052, Tel: 206-885-3737, TWX: 910-449-2860; Pres: W.P. Kistler

KLEIN, MATHIAS & SONS, 7200 McCormick Rd., Chicago, Ill., 60645, Tel: 312-JU-8-6820; Sls. Mgr: C.F. Castino

KLEIN, Local Distributors
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971

KMC SEMICONDUCTOR CORP., Parker Rd., RD 2, Long Valley, N.J., 07853, Tel: 201-876-3811, TWX: 510-235-3350; Sls. Mgr: P. Breen, Jr

KNOWLES ELCTRNS., INC., 3108 N. Mannheim Rd., Franklin Park, Ill., 60131, Tel: 312-455-3600; Dir. Mktg: C.K. Apel

KOH-I-NOOR RAPIDOGRAPH, 100 North St., Bloomsbury, N.J., 08804, Tel: 201-479-4124, TWX: 510-235-3340; Sls. Mgr: R. La Barre

KOLLSMAN INSTR. CO., 575 Underhill Blvd., Syosset, N.Y., 11791, Tel: 516-921-4300, TWX: 510-221-2191; Quotations Dir: J. Mooney

KORRY MFG. CO., 223-8th Ave. N., Seattle, Wash., 98109, Tel: 206-624-4066, TWX: 910-444-2295; Sls. Mgr: J.A. Hevly

Local Sales Offices & Reps.
Ala Huntsville, Craft Assocs. 205-837-0221
Ariz Phoenix, Howe & Howe Sls., Inc. 602-264-7971
Cal Pico Rivera, Westrep 213-949-2551
Cal Santa Clara, Cal-Tronix, Inc. 408-296-1366
Conn Stratford, G. Rosen Co. 203-375-5456
Fla Maitland, Craft Assocs. Co. 305-645-2242
Ga Atlanta, Craft Assocs. Co. 404-252-5001
Ill Chicago, Engineered Sls. Co. 312-867-8434
Kans Overland Park, ENSCO-Rep. 913-381-7557
Md Glen Arm, Billis Sls. Co. 301-592-7047
Minn St. Paul, Northport Engrg., Inc. 612-698-3841
Mo St. Louis, ENSCO-Rep. 314-542-3935
NJ Cherry Hill, Billis Sls. Co. 609-428-3650
NY New Rochelle, Display Comps. Sls. Co. 914-636-4664
Ohio Dayton, Whelan Corp. 513-434-7551
Tex Fort Worth, W. Pat Fralia Co. 817-738-2394

KRATOS, 403 S. Raymond Ave., Pasadena, Cal, 91105, Tel: 213-449-3090, TWX: 910-588-3288; Pubs. Mgr: R. Blehr

Local Sales Offices & Reps.
Cal San Carlos, Electro-Pacific 415-776-8582
Fla Miami, Ludlum Assoc. 305-885-2514
Fla Orlando, Ludlum Assoc. 305-894-7761
Ga Smyrna, IMMCO, Inc. 404-435-0079
Ill Addison, R. Edward Stemm, Inc. 312-279-2440
Md Baltimore, Stemler Assoc. 301-944-8262
Md Lutherville-Timonium, Naudain Assoc. 301-252-5378
Mass Peabody, JSR Assocs. 617-532-0348
Minn St. Paul, Cullen & Assocs. 612-646-7371
Mo St. Louis, PEM Sales Co. 314-427-7200
NJ Cherry Hill, Stemler Assoc. 609-966-4070
NJ Mt. Laurel, Naudain Assoc. 609-235-1801
NY Great Neck, F. Tylinski Co. 516-466-9070
NY N. Massapequa, C. B. Hopkins Co. 516-796-0066
NY Syracuse, Labtronics, Inc. 315-454-9314
Ohio Cleveland, Imtech Corp. 216-382-9090
Ohio Dayton, L. Fedotin 513-275-9345
Tex Dallas, V. Sykes 214-243-2222
Va Alexandria, Stemler Assoc. 703-548-7818
Wash Bellevue, Doland Co. 206-454-4952

KRATOS PRECISION PRODS., 11161 W. Pico Blvd., Los Angeles, Cal., 90064, Tel: 213-478-0635; Gen. & Sls. Mgr: J.M. Phipps

Local Sales Offices & Reps.
Ariz Phoenix, Lange Assocs.
Cal Los Altos, Nickerson-Gray 415-941-5777
Cal Pasadena, Nurches Co. 213-681-8957
Colo Englewood, A-G Elctrns. 303-771-8805
Fla N. Miami, Barrett Assocs. 305-68-4957
Fla Orlando, Barrett Assocs. 305-277-2857
Ill Highland Pk., Feller Assocs. 312-433-3651
Md Baltimore, Stitzer Assocs. 301-823-2600
Mich Plymouth, Romarc Co. 313-455-0300
Minn Mpls., Tec Sls. 612-884-1180
NH Manchester, Engrg. Assoc. of New Eng.
NJ Collingswood, Burdette Co. 609-858-6768
NJ Livingston, Varrelman-Gorman 201-992-2505
NY Centerport, Varrelman-Gorman 212-463-5000
NY Liverpool, Varrelman-Gorman 215-458-4774
Ohio Cleveland, K.W. Elctrn. Sls.
Ohio Dayton, K.W. Elctrn. Sls. 513-890-2150
Pa Delmont, K.W. Elctrn. Sls. 412-468-4020
Pa Erie, K.W. Elctrn. Sls. 814-455-1615
Pa Paoli, Stitzer Assocs. 215-644-5500
Tex Ft. Worth, Dyna-Reps, Inc.
Tex Houston, Dyna-Reps 817-451-1392
Wash Seattle, Blum & Assocs. 206-782-1600
Exp: Can., Ottawa 4, Ont., Communications Sys.

KRECKMAN, HERB CO., Cresco, Pa., 18326, Tel: 717-595-2212; Sls. Mgr: H. Kreckman

KRL ELECTRONICS, 28 Bridge St., Manchester, N.H., 03101, Tel: 603-668-3210; Sls. Mgr: R.G. Leinsing Vol 3•1145

Local Sales Offices & Reps.
Cal El Monte, Western Controls 213-443-9376
Cal Fullerton, Magna-Com Inc. 714-579-9084
Cal Mountain View, Belmont Sls. 415-961-4775
Cal Mountain View, Tri-Rep, Inc. 415-965-1822
Colo Denver, Omega Ltd. 303-758-1508
Fla Maitland, Hutto-Hawkins-Peregoy 305-831-2474
Fla Pompano Beach, C.B.C. Electronics, Inc. 305-782-0804
Fla Pompano Beach, Hutto-Hawkins-Peregoy 305-943-9593
Fla Tampa, Hutto-Hawkins-Peregoy 813-932-1800
Ill Palatine, C & C Elctrn. 312-359-9599
Ill Palatine, C & C Electronics Sls. 312-359-9599
Ind Fort Wayne, J & B Engrg. Sls. 219-483-2813
Md College Park, J & B Elctrns. 301-441-2457
Mass Burlington, Contact Sls., Inc. 617-273-1520
Mich Grand Rapids, R.P. Urban & Assocs. 616-245-0511
Minn Minneapolis, Heimann Co. 612-861-6051
NJ Shrewsbury, C. R. Hocker Assocs. 201-747-2797
NY Camillus, C. P. Dixon 315-471-6663
NY Camillus, C. P. Dixon Co. 315-471-6663
NY Port Washington, TMA 516-883-2432
NY Port Washington, T.M.A. Assocs. 516-883-2432
Ohio Reading, Sheridan Assocs. 800-543-7042
Ore Portland, J. J. Backer Co. 503-297-3776
Tex Houston, Engrg. Assocs. 713-729-0862
Tex Houston, Engrg. Assocs. 713-643-0460
Wash Lynwood, 9 Westcon Power Sys. 609-654-8209
For: Can., Scarborough, Ontario, Banke Elctrns., Ltd. 416-291-7529

KROHN-HITE, 580 Massachusetts Ave., Cambridge, Mass., 02139, Tel: 617-491-3211, TWX: 710-320-6583; Sls. Mgr: E.C. Lutfy; Applications Engr: D.J. Forsythe Vol 1•474; Vol 2•574

Local Sales Offices & Reps.
Ala Huntsville, Gentry Assoc., Inc. 205-534-9771
Alas Anchorage, H.J. Lang 279-5741
Cal Inglewood, L & M Engrg. 213-674-6850
Cal Santa Clara, L & M Engrg., Inc. 408-243-2891
Colo Littleton, Aztec Enterprises, Inc. 303-795-0250
Conn Glastonbury, Instr. Rep. 203-633-0777
Fla Orlando, Gentry Assoc., Inc. 305-894-4401
Ill Des Plaines, Cozzens & Cudahy, Inc. 312-298-3600
Ind Indpls, Cozzens & Cudahy 317-244-2456
Mass Lexington, Instr. Rep. 617-861-8620
Mich Detroit, Electro Sls. 313-526-8800
Minn So. Mpls, Cozzens & Cudahy 612-884-4336
Mo St. Louis, Cozzens & Cudahy, Inc. 314-423-1234
NJ Bordentown, Dyna Rep. Co. 609-298-6700
NM Albuquerque, Aztec Enterprises, Inc. 505-255-2440
NY Elmont, Crane & Egert 516-488-2100
NY Syracuse, Ossmann Instrs., Inc. 315-437-6666
NC Burlington, Gentry Assoc., Inc. 919-227-3639
Ohio Cleveland, Electro Sls. Assoc. 216-261-5440
Ohio Dayton, Electro Sls. Assoc. 513-426-5551
Pa Pittsburg, Electro Sls. 412-371-9449
Tex Dallas, R. Martin Assocs. 214-FL-6-3704
Tex Houston, R. Martin Assocs. 713-462-4077
Va Springfield, Dyna Rep. Co. 703-321-8630
Wash Seattle, Showalter-Judd 206-762-2310

KRYLON, Div. Borden, Box 390, Norristown, Pa., 19404, Tel: 215-279-1950, TWX: 510-660-0335; Sls. Srv. Mgr: R.R. Adams

KRYLON Local Distributors
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121

KRYSTINEL CORP., Fox Island Rd., Port Chester, N. Y., 10573, Tel: 914-937-5252, TWX: 914-937-5370; Sls. Mgr: Merle Breiland; Pres: S. Schwartz .....Vol 3•1019

KSC SEMICONDUCTOR CORP., KSC Way, Katrina Rd., Chelmsford, Mass., 01824, Tel: 617-256-3321, TWX: 710-343-0576; Sls. Mgr: J.Q. Adams Jr.

KSC Local Distributors

NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370

KULITE SEMICONDUCTOR PROD., 1030 Hoyt Ave., Ridgefield, N.J., 07657, Tel: 201-945-3000; V.P., Mktg: A. Brosh; Sls. & Prod. Eng. Mgr: J.C. Kicks; Sls. Engr: J.W.G. Budd

KULKA ELEC. CORP., 520 S. Fulton Ave., Mt. Vernon, N.Y., 10551, Tel: 914-664-4024, TWX: 710-562-0104; Sls. Mgr: J.D. Murphy

Local Sales Offices & Reps.

Ariz	Phoenix, Shefler-Kahn Co.	602-258-7893
Cal	Los Angeles, E E Strassner	213-666-1511
Cal	Redwood City, Warren-Hickey Sls.	415-368-3849
Colo	Denver, Koether-Cox	303-733-5561
Conn	Waterbury, Coakley, Boyd & Abbett	203-756-8766
Fla	North Miami, Winfield Elctrns. Sls.	305-751-5566
Ga	Atlanta, Winfield Southeast	404-636-3023
Ill	Chicago, R.A. Hanke	312-528-5800
Ind	Fort Wayne, B. F. Homsher	219-432-1164
Kans	Overland Park, Lowell-Kangas & Assocs.	913-888-3200
La	Metairie, J. F. McKinney Sls.	504-887-1723
Md	Hyattsville, L.D. Lowery	301-773-4977
Mass	Needham, Coakley, Boyd & Abbett	617-444-5470
Mich	Ferndale, Shalco	313-547-4771
Mo	St. Louis, Lowell-Kangas & Assocs.	314-821-4050
NJ	South Orange, Simberkoff Sls.	201-763-7900
NM	Albuquerque, Shefler-Kahn	505-265-7077
NY	Buffalo, Telesco Assocs.	716-834-1026
NY	New York, Simberkoff Sls.	212-943-7023
NY	Ontario, Telesco Assocs.	716-872-6417
NY	Vestal, Telesco Assocs.	607-729-6339
Ohio	Dayton, Neal Bear	513-299-3566
Ohio	Richfield, Neal Bear	216-659-3131
Okla	Tulsa, J. F. McKinney Sls.	918-742-6791
Ore	Portland, Earl & Brown	503-292-9145
Pa	Broomall, L.D. Lowery	215-356-5300
Pa	Pittsburgh, Trymac Co.	412-823-8400
Tex	Bellaire, J. F. McKinney Sls.	713-665-3653
Tex	Dallas, J. F. McKinney Sls.	214-631-9450
Wash	Seattle, Earl & Brown	206-274-1121
Wisc	Milwaukee, A.J. Gaertner & Assocs.	414-273-6162
For:	Can., Ajax, Ont., Munro Elctrn. Comps.	416-364-6920

KULKA Local Distributors

Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Ga	Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd.	404-448-0800
Md	Baltimore, Arrow Elctrns., 5207 E. Drive	301-247-5200
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Md	Hyattsville, Milgray/Washington, 5405 Lafayette Pl.	301-864-1111
Mass	Burlington, Arrow Elctrns., 15 A Street	617-273-0100
Neb	Lincoln, Scott Elctrn Supply Corp., 4040 Adams St	403-434-8308
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NY	Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave.	212-492-9590
NY	Elmsford, Melville Radio, 1 Nepperham Ave.	914-592-7100
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Cleveland, Pattison Supply Co., 4550 Willow Pkwy.	216-441-3000
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA-9-1880
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tex	Dallas, Hamilton/Avnet Elctrns., 2403 Farrington	

KURZ-KASCH INCORPORATED, 1421 South Broadway, Dayton, Ohio, 45401, Tel: 513-223-8161; Mktg. Mgr: T. Barth; Sls. Mgr: R. Novic .....Vol 1•475; Vol 4•415*

Local Sales Offices & Reps.

Ala	Birmingham, M. F. Taylor Co.	205-853-0336
Cal	Burlingame, W.J. Purdy Co.	415-347-7701
Cal	Los Angeles, W.S. Harmon Co.	213-937-1460
Colo	Denver, Walter Engineering	303-777-5585
Conn	Wallingford, Adams-McGregor, Inc.	203-269-5816
Fla	Casselberry, M. F. Taylor Co.	305-838-0821
Ill	Libertyville, R. Klipp Assoc.	312-362-4676
Iowa	Des Moines, KSW Associates	515-279-9235
Md	Catonsville, M. F. Taylor Co.	301-747-5718
Md	Silver Spring, M.F. Taylor Co.	301-589-4002
Mass	Scituate, Adams-McGregor, Inc.	617-545-2213
Mich	Farmington, Carter, McCormic & Peirce	313-477-7700
Minn	St. Paul, Skor	612-645-6461
Mo	Kansas City, KSW Assocs.	816-358-5240
Mo	St. Louis, KSW Associates	
NJ	Lake Pine, M. F. Taylor Co.	215-552-0383
NY	Great Neck, F. Tylinski Co.	516-466-9070
NY	Rochester, Marsey Sls., Inc.	716-442-9700
NC	Charlotte, M. F. Taylor Co.	704-537-4878
Ohio	Cleveland, Carter, McCormic & Pierce	
Ohio	Dayton, Carter, McCormic & Pierce	512-278-5873
Ore	Portland, D.G. Weber Co.	503-234-7671
Pa	Philadelphia, M. F. Taylor Co.	215-676-5332
RI	Lincoln, Adams-McGregor, Inc.	401-726-1300
Tex	Dallas, G. U. Peck Co.	214-328-3511
Tex	Houston, The Gordon V. Peck Co.	713-664-1435
Exp:	New York, N.Y., Singer Products Co.	

KURZ-KASCH Local Distributors

Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Colo	Denver, Burstein-Applebee	303-244-3336
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Burstein-Applebee	312-763-4848
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Kans	Kansas City, Burstein-Applebee	816-561-5460
Mo	Kansas City, Burstein Applebee	816-561-5460
Neb	Lincoln, Burstein Applebee	402-434-0678
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA-9-1880
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

KWIKSET POWDERED METAL PRODS., Kwikset Div-Emhart Corp., Box 3579, Anaheim, Cal., 92803, Tel: 714-535-8111; Sls. Mgr: J. Mikitka

KYBE CORP., 132 Calvary St., Waltham, Mass., 02154, Tel: 617-899-0012; VP-Sls: P. Garland

KYROS CORP., Box 406, Madison, Wisc., 53701, Tel: 608-238-3587; Sls. Mgr: E. Cox

L & L MFG. CO., 166 Conchester Rd., Twin Oaks, Pa., 19016, Tel: 215-HU-5-6334; Pres: S. Lewicki

LAB-LINE INSTRS., INC., 15th & Bloomingdale Aves., Melrose Park, Ill., 60160, Tel: 312-345-7400

L.A.B. CORP., Sub. Mech. Tech., 981 Onondaga St., Skaneateles, N.Y., 13152, Tel: 315-685-5781; Sls. Mgr: J.T. Hubbard; Field Sls. Engr: R.E. Whitman; Gen. Mgr: R.W. Mackey

LABCONCO CORP., 8811 Prospect, Kansas City, Mo., 64132, Tel: 816-363-6330; Sls. Mgr: J.N. McConnell; Exec. V.P: W.I. McGennes

LABELON CORP., 10 Chapin St., Canandaigua, N.Y., 14424, Tel: 315-394-6220; Sls. Mgr: R.O. Dill

LABORATORY DATA CONTROL, Div. M. Roy Corp., Box 10235, Riviera Beach, Fla., 33404, Tel: 305-844-5241; Sls. Mgr: R.M. Weller

Local Sales Offices & Reps.

Ala	Huntsville, Newcomb, Assoc.	205-852-0304
Cal	Palo Alto, Analytical Aids	415-321-6245
Del	Newark, Bonchmark	302-366-8797
Fla	Riviera Beach, Laboratory Data Control	305-844-5241
Ill	Joliet, Utopia Instr.	815-727-5431
Iowa	Ames, Midwest Instr.	515-292-5413
Mass	Boston, Richman Assoc.	
Mass	Holliston, Richman Assoc.	617-879-5011
Minn	Minneapolis, Midwest Inst.	612-333-0319
Mo	St. Louis, Gateway Scientific	314-725-3464
NJ	South Amboy, Laboratory Data Control	201-721-9331
NM	Albuquerque, Air Row Inc.	505-268-1733
NC	Raleigh, Newcomb Assoc.	919-893-5721
Pa	Pittsburg, Kurt Leskoe Co.	412-653-0800
Tex	Houston, Antek Instr.	713-691-2265
Wash	Seattle, VWR Scientific	206-682-3460

LAKE CHEMICAL CO., 250 N. Washtenaw Ave., Chicago, Ill., 60612, Tel: 312-826-1700; V.P. Sls: C. Kleiman

LA MARCHE MFG. CO., 106 Bradrock Dr., Des Plaines, Ill., 60018, Tel: 312-299-1193 .....Vol 1•759

Local Sales Offices & Reps.

Alas	Anchorage, J.P. Bagoy	809-277-0911
Ariz	Phoenix, B. Hartley	602-258-2552
Ark	El Dorado, L. Byrne	501-UN-3-9435
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Cal	Encino, R. J. Meyers	213-981-6552
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Tex	Houston, Hamilton/Avnet Elctrns., 1216 W. Clay	
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For:	Can., Toronto, Ont., Hamilton/Avnet Elctrns.	416-789-1838

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Local Sales Offices & Reps.

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Fla	Orlando	305-855-6353
Haw	Honolulu, Earl Assocs.	808-949-6953
Ill	Chicago	312-775-9455
Mass	Watertown	617-924-2214
Mich	Birmingham	313-645-1490
Minn	Minneapolis	612-944-2870
Mo	St. Louis	314-727-8695
NJ	Hillsdale, P. R. Mallory & Co.	201-666-3600
NY	Manhasset, F. Spellman	516-627-3399
NC	Lexington	704-249-9101
Ohio	Dayton	513-299-5505
Ohio	Maple Hgts.	216-663-6600
Okla	Tulsa, G.V. Peck Co.	918-585-5853
Ore	Portland, Earl & Brown	503-292-9145
Pa	Philadelphia	215-844-8891
Tex	Dallas, G.V. Peck Co.	214-328-3511
Tex	Houston, G.V. Peck	713-664-1435
Wash	Seattle, Earl & Brown	206-284-1121
Wisc	Milwaukee	414-342-3616
For:	Can., Tor., Ont., J. Matthey & Mallory	416-763-5111
For:	Can., Willowdale, Ont., A. Simmons	416-445-9111

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Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Diego, Shanks and Wright Inc., 2045 Kettner Blvd.	714-239-0176
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Colo	Denver, Burstein-Applebee	303-244-3336
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Conn	Hamden, Connecticut Electro Sls., 1601 Dixwell Ave.	203-288-8266
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Burstein-Applebee	312-763-4848
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Kans	Kansas City, Burstein-Applebee	816-561-5460
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
Mo	Kansas City, Burstein Applebee	816-561-5460
Mo	St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd	314-428-8522
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Lincoln, Burstein Applebee	402-434-0678
Neb	Lincoln, Scott Elctrn Supply Corp., 4040 Adams St	403-434-8308
Neb	Omaha, J-B Distributing Co., 1616 Cass St	402-341-5525
NY	Farmingdale, Harrison Elctnc., 20 Smith St.	516-293-7990
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
NY	Rochester, Rochester Radio, 140 Main St.	716-454-6300
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
NY	White Plains, Westchester Elctrns., 602 Mamaroneck Ave.	914-949-2400
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541
Ore	Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd	503-292-3534
Pa	Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave	
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521
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Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
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Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
La	Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094	318-423-6131
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565
NY	Buffalo, Summit Dist. Inc., 916 Main St.	716-884-3450
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ohio	Cleveland, Farr Elctrns, 5403 Prospect Ave.	216-881-7403
Ohio	Warren, REM Elctrns. Supply Co., 264 W. Market St.	216-399-2777
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Tenn	Chattanooga, Curle Elctrns., 1813-S. Market	
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wisc	Madison, Satterfield Elctrn., 1900 S.Park St.	608-257-4801
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

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Md	Baltimore, Arrow Elctrns., 5207 E. Drive	301-247-5200
Mass	Burlington, Arrow Elctrns., 15 A Street	617-273-0100
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Cleveland, Farr Elctrns, 5403 Prospect Ave.	216-881-7403
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176

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Ill	Chicago, Mallory Metallurgical Co.	312-282-7100

Mass Watertown, Mallory Metallurgical Co. 617-924-2214
Mich Birmingham, Mallory Metallurgical Co. 313-645-1490
NJ Hillsdale, Mallory Metallurgical Co. 201-666-3600
NC Lexington, Mallory Metallurgical Co. 704-249-9101
Ohio Dayton, Mallory Metallurgical Co. 513-299-5505
Pa Philadelphia, Mallory Metallurgical Co. 215-844-8891
Pa Pittsburgh, Mallory Metallurgical Co. 412-563-3142
Wisc Milwaukee, Mallory Metallurgical Co. 414-342-3616
For: Can., Toronto 15, Ontario, Johnson Matthey & Mallory Ltd. 416-763-5111

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Ga Atlanta 404-349-3560
Ill Chicago 312-261-1133
Ill Melrose Park, Manhattan Electric Cable Co. 312-261-1133
Mo St. Louis, Midwestern Elec. Cable 314-865-5050
NY Rye 914-WO-7-4080
Ohio Independence 216-749-7500
Tex Houston, Texas Elect. Insulated Cable 713-227-5228

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Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621

MANN, DAVID W. CO., Div. GCA Corp., 174 Middlesex Tpke., Burlington, Mass., 01803, Tel: 617-272-5600; Sls. Mgr: A.J. O'Malley

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Tex Arlington 817-261-9511
Tex Hurst, Edmar Tech. Sls. Co. 817-282-5561
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Wisc Oak Creek, Erdman Sls. 414-761-2120

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MARCAL ELECTRO-SONICS, Div. Elroy-Randoll-Upshaw, Inc., 206 N. Western Ave., Los Angeles, Cal., 90004, Tel: 213-HO-2-6891; Sls. Mgr: A. Berberich

MARCO-OAK, Sub. of Oak Inds. Inc., Box 4011, 207 S. Helena, Anaheim, Cal., 92803, Tel: 714-535-6037, TWX: 910-591-1185; Sls. Mgr: P.J. Landvogt Vol 2•519,1101

Local Sales Offices & Reps.
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Colo Denver, I. Strong 303-292-6900
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Fla Lauderhill, Oak Inds. Inc. 305-735-4495
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NC Raleigh, Oak Inds. Inc. 919-876-7591
Ohio Columbus, Oak Inds. Inc. 614-878-6470
Okla Tulsa, Palatine Sls. Inc. 918-622-0321
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NJ Clifton, Eastern Radio, 312 Clifton Ave. 201-471-6600

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Ill Chicago, K.W. Meyers 312-774-6440
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Mass Cambridge, Vector Sls. 617-491-5700
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Ohio Chagrin Falls, Electrolock 216-543-5125
Okla Oklahoma City, J. Cole 405-235-2447
Ore Portland, C. Riggs 503-226-3286
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Ga Atlanta, MSC 404-363-9947
Ill Chicago, Master Specialties Co. 312-671-4586
Mass Lynn 617-599-0566
Minn St. Paul, MSC 612-854-7535
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Mass Burlington, Hamilton/Avnet Elctrns. 617-273-2120
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400
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NJ Cedar Grove, Hamilton/Avnet Elctrns. 201-239-0800
NJ Cherry Hill, Hamilton/Avnet Elctrns. 609-662-9337
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
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NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
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Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
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Ariz	Scottsdale, F. Board Assocs.	602-949-9561
Cal	Downey, Bertram-Zoolalian	213-927-4406
Cal	Mountain View, Nor-Cal Assocs.	415-961-8121
Colo	Denver, Brown Tech.	303-233-0863
Fla	Orlando, G.F. Bohman Assoc.	305-855-0274
Fla	Palm Beach Gardens, G.F. Bohman Assocs.	305-842-7188
Ill	Bellwood, Fiat Engrg. Assocs.	312-547-6201
Md	Towson, J.A. Dougherty Sls.	301-823-0431
Mass	Waltham, Impact Sls.	617-352-8881
Mich	Southfield, Sterling-Lowell	313-352-8881
Minn	Mpls., Bitronics Sls.	612-888-7044
Mo	Grandview, Centech. Sls.	816-763-2900
NJ	Livingston, Varrelman-Gorman	201-992-2505
NY	Liverpool, Varrelman-Gorman	315-458-4774
Ohio	Dayton, Gibson Elctrns.	513-433-3521
Pa	Ambler, Griffin-Campbell	215-646-7535
Tex	Richardson, Thornton-Leeper Elctrn. Sls.	214-231-6891
Wash	Seattle, Blair Hirsh Assocs.	206-SU-3-3423

MICROSEMICONDUCTOR Local Distributors

NY	New Hyde Park, Lafayette Ind'l. Elctrns., Inc., 1327 Second Ave.	516-488-6600

MICROSONICS, INC., Div. Sangamo Elec. Co., 60 Winter St., Weymouth, Mass., 02188, Tel: 617-337-4200, TWX: 710-388-6833; Sls. Mgr: J. Klayman; Prod. Sls: F. Manning

Local Sales Offices & Reps.

Cal	Los Angeles, E. Landa Co.	213-879-0770
Cal	San Diego, Tauber Assocs.	714-274-7242
Cal	Sunnyvale, Waldman	408-245-2500
Fla	Ormond Beach, Technology Marketing Assoc.	904-672-3214
Fla	Pompano Bch., Technology Mktg. Assoc.	305-942-0774
Ind	Ft. Wayne, G & D Electrn. Sls., Inc.	219-432-5585
Md	Baltimore, Burgin-Kreh Assocs.	301-788-5200
Mass	Weymouth, Reptron	617-449-4141
NY	Rochester, F. Young Assoc.	716-482-1555
NC	Winston-Salem, Burgin-Kreh Assoc.	919-768-4174
Ohio	Cleveland, Whelan Corp.	216-692-1266
Ohio	Dayton, Whelan Corp.	513-434-7551
Pa	Fairview Vill., Danco	215-539-9300
Tex	Richardson, Lear Assocs.	214-231-5388
Va	Lynchburg, Burgin-Kreh	703-845-5600
For:	Can., Islington, Ont., D.T. Shaw Co., Ltd.	416-231-2706
For:	Can., Montreal, Que., D.T. Shaw Co., Ltd.	514-332-1163

MICROTRAN CO. INC., 145 E. Mineola Ave., Valley Stream, N.Y., 11582, Tel: 516-561-6050, TWX: 510-225-8412; Gen. Sls. Mgr: W. Benscher; Mktg. Mgr: A. Eisenberg .....Vol 3•1260-1265; Vol 4•562*

Local Sales Offices & Reps.

Ala	Birmingham, F. Nickerson Co.	205-853-3181
Ariz	Scottsdale, F. Schoeffler	602-948-3470
Cal	Hawthorne, Sutherland Sls., Inc.	213-679-0757
Cal	Los Altos, Westec Elctrns.	415-948-8880
Colo	Denver, Gossard & Assocs.	303-985-0602
Fla	Miami Beach, Geartner Assocs.	305-861-3661
Fla	Orlando, Geartner Assocs.	305-299-1000
Ga	Decatur, F. Nickerson	404-377-1575
Ind	La Fontaine, Kirsch Sls.	317-981-2801
Kans	Shawnee, J. Guernsey Co.	913-631-2414
Md	Baltimore, J.R. Daniel	301-825-3330
Mass	Newtonville, C. Segel Co.	617-969-6900
NY	N.Y., E. Glass Assocs.	212-JU-6-8440
NC	Kannapolis, F. Nickerson Co.	704-932-6907
Ohio	Cincinnati, J. Olsen	513-922-2176
Ohio	Cleveland, J.O. Olsen	216-752-5444
Ohio	Dayton, R.G. Siff	513-878-3547
Pa	Jenkintown, Arnold Assocs.	215-887-7870
Pa	Pittsburgh, J.O. Olsen Co.	412-279-2550
Tex	Grand Prairie, Howell Sls., Inc.	214-AN-2-5153
Wash	Seattle, Westec Elctrn., Inc.	206-CH-3-7070
Exp:	N.Y., Valley Stream, Microtran	516-561-6050

MICROTRAN Local Distributors

Ala	Birmingham, MG Electric & Equip. Co., 3112 6th Ave. So.	205-328-4525
Ariz	Phoenix, Cramer/Ariz., 2816 N. 16th St.	602-263-1112
Ariz	Phoenix, Moltronics, Inc., 2746 W. Palm LA.	602-272-7951
Cal	San Diego, Moltronics, Inc., 7969 Engineer Rd.	714-278-5020
Cal	Santa Clara, Moltronics, Inc., 337 Mathews St.	408-244-7600
Cal	South Gate, Moltronics, Inc., 5610 E. Imperial Hwy.	213-773-6521
Cal	Sunnyvale, Cramer/San Fran., 720 Palomar Ave.	408-739-3011
Colo	Denver, Elctrn. Parts Co., 1212 S. Broadway	303-744-1992
Conn	Waterbury, Bond Radio Supply, 439 W. Main St.	
Fla	Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue	305-923-8181
Fla	Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr.	305-855-4020
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Newark Elctrns, 500 N. Pulaski Rd.	312-638-4411
Ind	Indianapolis, Graham Elctrncs., 133 S. Penn. St.	317-634-8480
Iowa	Cedar Rapids, Deeco, Inc., 2500 16th Ave. S.W.	319-365-7551
Kans	Wichita, Radio Supply Co., 115 Laura	316-267-5216
Md	Baltimore, Pyttronic Ind., Inc., 2035 Worcester St.	301-539-6525

Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mich Oak Park, Newark-Detroit Elec., Inc., 20700 Hubbell Ave. 313-548-0250
Minn Minneapolis, Newark-Minneapolis Elec Corp., 336 Hoover St. NE 612-331-6350
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NJ Moorestown, Arrow/Angus, Pleasant Valley Ave. 609-235-1900
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NJ Springfield, Route Electr. Inc., Echo Plaza, Rte. #22 201-379-7710
NM Albuquerque, Elctrn Parts Co., 222 Truman St. N.E. 505-265-8401
NY Binghamton, Federal Elec., Inc., Box 1208 607-748-8211
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Terminal-Hudson, 236 W. 17th St.
NC Raleigh, Cramer/EW, 3901 Winton Road 919-876-2371
Ohio Cincinnati, Newark-Herrlinger Elec., 112 E. Liberty St. 513-421-5282
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Dayton, J. A. Becker Co., 1341 E. 4th St. 513-224-1071
Pa Mc Keesport, Barno Radio Co., 5403 W. Smithfield St. 412-664-9392
Tenn Nashville, Electra Distributing, 1914 W. End Ave. 615-329-3971
Tex Dallas, Hall-Mark Elctrns, 9100 Markville Dr. 214-AD-1-6111
Tex Houston, Lenert Co., Box 2184 713-225-1465
Utah Salt Lake City, Cramer/Utah, 391 West 2500 South 801-487-3681
Wash Seattle, Washington Elec., Inc., 2217 Third Ave. 206-682-8981
For: Can., Downsview, Ontario, Cramer/Can., 920 Alness Ave. 416-661-9222

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MICROWAVE DEVELOPMENT LABS., INC., 87 Cresent Rd., Needham Hgts., Mass., 02194, Tel: 617-449-0700, TWX: 710-325-1739; Sls. Mgr: R. Tucker

Local Sales Offices & Reps.
Cal Arcadia, J. E. Hachten Co. 213-681-2361
Cal Palo Alto, J. E. Hachten Co. 415-326-1252
Fla Orlando, Hi Co Assocs., Inc. 305-273-0571
Kans Prairie Village, Engrg. Svcs. Co. 913-649-4000
Md Lanham, Brimberg Sls., Inc. 301-552-2200
Mass Wayland, Wayland Engrg. Sls. 617-655-6080
Mo St. Louis, Engineering Svcs. Co. 314-726-2233
NY DeWitt (Syracuse), D.B. Assocs., Inc. 315-446-0220
NY Great Neck, Trionic Assocs., Inc. 516-466-2300
Pa Lafayette Hill, M. Lader Co. 215-825-3177
Tex Dallas, Texas Microwave 214-358-1172
Wash Seattle, Jon B. Jolly 206-938-4166
Exp: Stamford, Conn., Dage Corp. 203-324-3123
For: Can., Don Mills, Ontario, Tacan Assocs., Inc. 416-445-7490

MICROWAVE FILTER CO., INC., 135 W. Manlius St., East Syracuse, N.Y., 13057, Tel: 315-437-4529; Sls. Mgr: G. Bostick; Mgr.-Advtg. & Publ: E. Bostick

MICROWAVE POWER DEVICES, Adams Ct., Plainview, N. Y., 11803, Tel: 516-433-1400, TWX: 510-221-1862; Dir. Mktg: R. Sheloff

MICROWAVE SEMICONDUCTOR CORP., 100 School House Rd., Somerset, N.J., 08873, Tel: 201-469-3311, TWX: 710-480-4730; Sls. Engr: A. Laconti; Sls. Engr: C. Lump

MICROWAVE PRODS., INC., 9533 Irondale Ave., Chatsworth, Cal., 91311, Tel: 213-882-3434; Sls. Mgr: C. Troesken

MICROWAVE/SYS., INC., 1 Adler Dr., E. Syracuse, N.Y., 13057, Tel: 315-437-9951, TWX: 710-541-0406; Microwave Sls. Mgr: D.L. Bush; Digital Sls. Mgr: R.C. Sheldon

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Cal Anaheim, Blair Assocs. 714-635-1350
Cal Dublin, R. W. Healy Co. 415-828-6044
Cal Portola Valley, Kipp Assocs. 415-851-0123
Colo Denver, DLS Assocs. 303-771-0140
Conn Hamden, Scientific Devices E. of Conn. 203-248-9361
Fla Orlando, E.G. Holmes & Assocs. 305-894-8901
Ga Chamblee, E.G. Holmes & Assocs. 404-451-6161
Ill Des Plaines, S. Sterling Co. 312-298-8454
Kans Lenexa, S. Sterling Co. 913-888-2995
Md Kensington, Elctrn. Mktg. Assocs. 301-744-7700
Mass Waltham, Meas. Consits. Corp. 617-890-4400
Mass Waltham, Scientific Devices-New England 617-894-5637
Mich Detroit, S. Sterling Co. 313-255-1970
Mo St. Louis, S. Sterling Co. 314-567-3636
NJ Englewood, Scientific Devices E. 201-871-3916
NM Albuquerque, PLS Assocs. 505-255-2330
NY Syracuse, Ossmann Instrs. 315-437-6666
Ohio Cleveland, S. Sterling Co. 216-442-8080
Ohio Dayton, S. Sterling Co. 513-298-7573
Pa King of Prussia, Elctrn. Mktg. Assocs. 215-265-1600
Pa Pittsburgh, S. Sterling Co. 412-922-5726
Tex Richardson, Lear Assocs. 214-231-5388
Wash Bellevue, Scientific Devices N.W. 206-454-0900

MID-EASTERN INDS., Div. of Eanco, Inc., 660 Jerusalem Rd., Scotch Plains, N.J., 07076, Tel: 201-233-5900, TWX: 510-665-6752; Gen. Mgr: D.R. Ellenback; Eng: R. Hauser; Sales: R. Daisey Vol 1•762,763

Local Sales Offices & Reps.
Cal Los Angeles, Dyna Sls. 213-268-1175
Conn New Canaan, R. H. Sturdy Co. 203-966-2580
Fla Alamonte Spg., WMM Assocs. 305-831-4645
Fla Clearwater, WMM Assocs., Inc. 813-446-0075
Fla No. Palm Beach, WMM Assoc. Inc. 305-848-9042
Fla Pompano Bch., WMM Assocs., Inc. 305-943-3091
Ill Evanston, Mauer & Co. 312-869-1644
Ind Indianapolis, G "Red" Graham & Assoc. 317-547-3259
Iowa Ft. Dodge, Heimann 515-576-2374
Md Baltimore, J. R. Daniel & Co. 301-825-3330
Mass Wellesley Hls., R. Sturdy 617-235-2330
Mich Brighton, Dietrich & Assoc. 313-961-4540
Minn Mpls., Heimann Co. 612-861-6051
NY Huntington, C.R. Mayer Co. 516-WA-1-7876
Ohio Cleveland, Dietrich & Assoc. 216-781-1855
Ohio Dayton, Dietrich & Assoc. 513-223-6042
Pa Mt. Penn, Mer Mon Elctrn. Instrumentation 215-779-1640
Pa Pittsburgh, Dietrich & Assoc. 412-892-2992
Wash Seattle, Eicher-Richards Co. 206-LA-3-7888

MID-WEST METAL PRODS., INC., 456 E. Donovan Rd., Kansas City, Kans., 66115, Tel: 913-342-8171, TWX: 913-553-9260; Sales: G.H. Turner

MIDGET LOUVER CO., 800 Main Ave., Norwalk, Conn., 06852, Tel: 203-866-2342; Secretary: F. Nolan

MIDLAND STANDARD INC., 603 E. Chicago St., Elgin, Ill., 60120, Tel: 312-741-6600; Sls. Mgr: J. McGill

MIDTEX/AEMCO, 10 State St., Mankato, Minn., 56001, Tel: 507-388-6286, TWX: 910-565-2244; Sls. Mgr: C.R. May ..... Vol 2•637

Local Sales Offices & Reps.
Ala Huntsville, Twentieth Century Mktg. 205-772-9237
Ariz Scottsdale, Barnhill Five 602-947-7841
Cal Inglewood, J. Berman 213-678-1281
Cal San Francisco, Shonin, Inc. 415-467-8700
Colo Denver, Barnhill Five 303-934-5505
Fla Maitland, Hutto-Hawkins-Peregoy 305-831-2474
Ill Downers Grove, Richmar Elctrn. Comps. 312-968-0118
Kans Kansas City, Beams 913-888-6110
Md Baltimore, Burgin-Kreh 301-788-5200
Mich Grosse Point, Greiner Assocs. 313-499-0188
Minn Mankato, D.C. Larson 507-388-2985
Mo St. Louis, Beams 314-781-6855
NH Nashua, BELL Controls 603-882-6985
NY Buffalo, R. F. Lamb Co. 716-874-4900
NY Hempstead, Kahgan Sls. 516-538-2300
NC Winston-Salem, Burgin-Kreh Assocs. 919-768-4174
Ohio Dayton, K.W. Elctrn. Sls. 513-890-2150
Pa Philadelphia, Professional Sls. Assocs. 215-722-8222
Tex Richardson, Oeler & Menelaides 214-234-6334
Va Lynchburg, Burgin-Kreh Assocs. 703-845-5600
Wash Seattle, C.B. Parsons 206-762-7373
For: Can., Montreal, Que., Coba Elctrns., Ltd. 514-381-2523

MIDTEX/AEMCO Local Distributors
Ariz Phoenix, Moltronics, Inc., 2746 W. Palm LA. 602-272-7951
Cal Los Angeles, Master Distrs., Box 25662 213-395-2637
Cal San Diego, Moltronics, Inc., 7969 Engineer Rd. 714-278-5020
Cal Santa Clara, Moltronics, Inc., 337 Mathews St. 408-244-7600
Cal South Gate, Moltronics, Inc., 5610 E. Imperial Hwy. 213-773-6521
Colo Denver, Elctrn. Parts Co., 1212 S. Broadway 303-744-1992
Fla Oakland Park, Peerless Radio/Fla., 1040 N.E. 43rd Ct. 305-566-5966
Ill Des Plaines, S & R Corp., 2420 E. Oaktron Rd.
Kans Wichita, Allen Elec. Supply, 1134 N. Washington
Mass Cambridge, Apollo Elctrns, Inc., 101 Binney St 617-868-3120
Ohio Akron, Sun Radio Co., 110 E. Market St.
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cincinnati, Midwest Equip. Co., 11315 Williamson Rd.
Okla Oklahoma City, Elctrn. Supply Co., 212 NW 10th St.
Pa Erie, Erie Corporate Contractors, 1968 Buffalo Rd. 814-455-8110
Wisc Oshkosh, Electronic Industries Inc., 19 E. Irving Ave.
For: Can., Scarborough, Ont., Carsten Elctrns., 52 Howden Rd.

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

MIDWEC CORP., Ind'l. Div., Box 417, Scottsbluff, Neb., 69361, Tel: 308-632-4127, TWX: 910-627-0061; S.M: J. Tierney ..... Vol 3•492,493

Local Sales Offices & Reps.
Ariz Phoenix, Elcom of Ariz. 602-258-7519
Cal Long Bch., Emerson Kirk Engrg. Co. 213-439-9559
Cal Santa Clara, Cal-Tronix 408-296-1366
Colo Denver, Checkmate Sls. 303-771-4920
Conn New Canaan, S. Pierce 203-966-4630
Ga Atlanta, G. Duckett Sls. 404-451-3529
Ill Chicago, Kemp Sls. Co. 312-622-1121
Ind Greenwood, Valentine-Schillinger 317-888-2260
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Md Baltimore, Kaufholz Assoc. 301-488-6561
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Minn St. Paul, Knox Assoc. 612-488-5402
Neb Lincoln, Mktg. Assoc. 402-434-5244
Neb Scottsbluff, Midwec Corp. 308-632-4127
NJ N. Syracuse, L.D. Allen, Inc. 315-458-7470
NJ Port Washington, P.D. Aaron Assoc. 516-767-2600
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Tex Dallas, United Comps. 214-324-1448

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Local Sales Offices & Reps.
Va Annandale, J. Hopkins Assocs. 703-280-2086

MILFORD RIVET & MACH., 857 Bridgeport Ave., Milford, Conn., 06460, Tel: 203-878-4631, TWX: 710-462-0538; V.P. Mktg: W.Clark

MILLEN, JAMES MFG., 150 Exchange St., Malden, Mass., 02148, Tel: 617-324-4108; Sls: A.B. Caputo; Appl. Engr: O.I. Haszard; Sls. Mgr: R.W. Caywood Vol 1•482; Vol 2•520,521; Vol 3•491,527,1034,1035

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Ala Huntsville, Reynolds & Assocs., Inc. 205-536-1941
Cal Los Angeles, W. Harmon 213-937-1460
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Conn New Haven, Gerber Sls. 203-777-6279

Fla Clearwater, Reynolds & Assocs. Inc. 813-726-2373
Fla Ft. Lauderdale, Reynolds & Assocs. Inc. 305-581-6611
Fla Hollywood, Reynolds & Assoc. Inc. 305-987-6720
Fla Melbourne, Reynolds & Assocs., Inc. 305-727-3205
Fla Palm Beach Gardens, Reynolds & Assocs. Inc. 305-622-6850
Ga Atlanta, Reynolds & Assocs., Inc. 404-252-5360
Ill Chicago, Carlson Elctrn. 312-SP-4-0277
Md Lutherville, L.D. Lowery, Inc.
Md Silver Spring, L. D. Lowery, Inc.
Mass E. Longmeadow, Gerber Sls. 413-525-3059
Mass Waltham, Gerber Sls. 617-890-8040
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Pa Harrisburg, L.D. Lowery, Inc. 717-233-0917
Tex Richardson, Air Quip Sls. Co. 214-271-2624
Va Charlottesville, L. D. Lowery, Inc. 703-973-6672
Exp: N.J., Iselin, Tech. Equip. 201-283-2340

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Cal Palo Alto, Zack Elctrns., 654 High St. 415-326-5432
Cal San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd. 714-292-5611
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal San Francisco, Zach Elctrns., 1444 Market St. 415-626-1444
NJ Springfield, Route Electr. Inc., Echo Plaza, Rte. #22 201-379-7710
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121

MILLER DIV., J.W., See Bell Inds.

MILLER, L.C. CO., 717 Monterey Pass Rd., Monterey Park, Calif., 91754, Tel: 213-268-3611; Sls. Mgr: E.J. Thompson

MILLER, SANFORD CORP., See Sandford Miller Corp.

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MILLER, W. A. CO., Mingo Loop, Oquossoc, Me., 04964, Tel: 207-864-3344; V.P: D. Wentzell; Sls. Mgr: D. Hunger

MILLER, Local Distributors
Tex Houston, Lenert Co., Box 2184 713-225-1465

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Ohio Brecksville, Waldrip, Blankenburg & Co. 216-526-1100
Pa Pittsburgh, Milletron 412-781-5300

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MILWAUKEE RESISTOR, 700 W. Virginia St., Milwaukee, Wisc., 53204, Tel: 414-271-9900; V.P-Sls. Mgr: R.J. Amacher; Sls. Engr: W.R. Pollock
Vol 3•1148-1151

Local Sales Offices & Reps.
Ala Birmingham, F.C. Nickerson 205-853-2852
Cal Mountain View, Wes-K Assocs. 404-436-5169
Cal San Diego, Wes-K Assocs. 714-278-7643
Cal Van Nuys, Wes-K Assocs. 213-989-3070
Colo Denver, Nelson Co. 303-733-5528
Fla Oldsmar, F. Nickerson 813-855-4209
Fla Orlando, F.C. Nickerson 305-843-0957
Fla Tampa, F.C. Nickerson 813-833-4321
Ga Decatur, F. Nickerson 404-377-1575
Ill Arlington Heights, E.T. Champion 312-593-1150
Ill Evanston, W.F. Swinke 312-248-4343
Ind Ft. Wayne, W. Bieberich 219-432-2537
Ind New Albany, W.W. Bieberich, Inc. 812-945-3187
Kans Prairie Village, R.E. Gooley Co. 913-642-3233
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Mich Detroit, R.S. Lohmann Co. 313-535-6144
Minn Mpls., C. Gibb 612-377-1200
Mo Maryland Hghts., Kattelmann & Co. 314-434-6875
NJ Haddonfield, Braddock Assocs. 609-429-0087
NY Forest Hills, Miller Co. 212-263-4446
NY Rochester, Gislason Sls. 716-454-4741
NC Kannapolis, F. Nickerson 704-932-6772
Ohio Novelty, Prutton Sls. Co. 216-247-6667
Ore Portland, R. Minthorne 503-246-4556
Tex Dallas, R. E. Nesbitt Co. 214-357-4601
Tex Houston, R. E. Nesbitt Co. 713-224-3633
For: Can., Downsview, Ont., F. Eakin Ltd. 416-638-0451

MINI-CIRCUITS LAB., Div. Scientific Comps. Corp., 2913 Quentin Rd., Brooklyn, N.Y., 11229, Tel: 212-252-5252; Sls. Mgr: H. Kaylie ..... Vol 2•616,617

Local Sales Offices & Reps.
Cal Los Altos, Cain-White & CO. 415-948-6533
Cal N. Hollywood, Crown Elctrns. 213-877-3550
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NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055

Tex Garland, Kierulff-Dallas, 2815 National Dr. 214-271-2472

Wash Seattle, Kierulff - Seattle, 5940 6th Ave. S. 206-763-1550

MOTORESEARCH MFG. CO., 1600 Junction Ave., Racine, Wisc., 53403, Tel: 414-632-5131; Sls. Mgr: W.H. Cooper

MOTOROLA INC., Component Products Dept., 4545 W. Augusta Blvd., Chicago, Ill., 60651, Tel: 312-772-6500, TWX: 910-221-5565; Mktg. Mgr: C. Chopp ....Vol 2•429

Local Sales Offices & Reps.

Ariz Scottsdale, F. Board Assocs. (602)994-9388

Cal Brea, R. E. Isles Assoc. 714-533-1120

Cal San Carlos, Kottmeier Assoc. 415-592-8333

Colo Wheatridge, Waugaman Assocs., Inc. 303-423-1020

Fla Orlando, GRA-MAR 305-894-3351

Md Bel Air, Motorola 301-879-9335

Mass Wayland, Wayland Engrg. Sls. 617-655-6080

Mich Farmington, Sheridan Assocs. Inc. 313-447-3800

Minn St. Paul, Cahill Assoc. 612-739-8445

Mo Florissant, Sheridan Assocs. Inc. 314-837-5200

NM Albuquerque, Waugaman Assocs. Inc. 505-265-4097

NY Rockville Center, Motorola 516-678-2989

Ohio Cincinnati, Sheridan Assoc. 513-761-5432

Ohio Cleveland, Sheridan Assocs., Inc. 216-524-8210

Ohio Dayton, Sheridan Assocs. Inc. 513-277-8911

Ore Portland, Almac/Stroum Elctrns. 503-292-3534

Pa Monroeville, Sheridan Assocs. Inc. 412-373-1070

Tex Dallas, R.M. Elctrns. 214-341-7989

Tex Houston, R.M. Elctrns. 713-664-7131

Wash Seattle, Almac/Stroum Elctrns. 206-763-2300

MOTOROLA INC. Local Distributors

Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534

Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300

MOTOROLA SEMICONDUCTOR PRODS., Tech. Info. Ctr. T902, 5005 E. McDowell Rd., Phoenix, Ariz., 85008, Tel: 602-244-3464, TWX: 910-951-1334; Tech. Info. Ctr. Mgr: Lothar Stern

Local Sales Offices & Reps.

Ala Huntsville, Motorola Semiconductor Products Inc. 205-883-0950

Ariz Phoenix, Motorola Semiconductor Products Inc. 602-273-6900

Ariz Phoenix, Motorola Semiconductor Products Inc. 602-273-6364

Cal Encino, Motorola Semiconductor Products Inc. 213-986-6850

Cal La Jolla, Motorola Semiconductor Products Inc. 714-459-4217

Cal Menlo Park, Motorola Semiconductor Products Inc. 415-854-1910

Cal Santa Ana, Motorola Semiconductor Products Inc. 714-558-2601

Colo Denver, Motorola Semiconductor Products Inc. 303-770-2122

Conn Hamden, Motorola Semiconductor Products Inc. 203-288-6478

Fla Maitland, Motorola Semiconductor Products Inc. 305-644-3422

Fla Palm Beach Gardens, Motorola Semiconductor Products Inc. 305-622-2700

Fla Pinellas Park, Motorola Semiconductor Products Inc. 813-546-3538

Fla Pompano Beach, Motorola Semiconductor Products Inc. 305-782-4464

Ga Atlanta, Motorola Semiconductor Products Inc. 404-255-2043

Ill Chicago, Motorola Semiconductor Products Inc. 312-992-2320

Ill Schiller Park, Motorola Semiconductor Products Inc. 312-678-7205

Ind Ft. Wayne, Motorola Semiconductor Products Inc. 219-484-8581

Ind Lawrence, Motorola Semiconductor Products Inc. 317-897-2220

Iowa Cedar Rapids, Motorola Semiconductor Products Inc. 319-393-8632

Kans Mission, Motorola Semiconductor Products Inc. 913-384-3050

Md Hyattsville, Motorola Semiconductor Products Inc. 301-779-1100

Mass Lexington, Motorola Semiconductor Products Inc. 617-861-1350

Mich Garden City, Motorola Semiconductor Products Inc. 313-261-6200

Minn Minneapolis, Motorola Semiconductor Products Inc. 612-545-0251

NJ River Edge, Motorola Semiconductor Products Inc. 201•488-1200

NM Albuquerque, Motorola Semiconductor Products Inc. 505-299-4448

NY Fishkill, Motorola Semiconductor Products Inc. 914-896-8970

NY Hauppauge, Motorola Semiconductor Products Inc. 516-231-9000

NY Rochester, Motorola Semiconductor Products Inc. 716-381-7220

NY Syracuse, Motorola Semiconductor Products Inc. 315-454-9373

NC Raleigh, Motorola Semiconductor Products Inc. 919-782-7604

Ohio Cleveland, Motorola Semiconductor Products Inc. 216-461-3160

Ohio Dayton, Motorola Semiconductor Products Inc. 513-294-2231

Ore Portland, Motorola Semiconductor Products Inc. 503-297-2236

Pa Ft. Washington, Motorola Semiconductor Products Inc. 215-643-4500

SC Columbia, Motorola Semiconductor Products Inc. 803-788-0585

Tex Houston, Motorola Semiconductor Products Inc. 713-688-4583

Tex Richardson, Motorola Semiconductor Products Inc. 214-235-8385

Wash Bellevue, Motorola Semiconductor Products Inc. 206-455-3700

Wisc Wauwatosa, Motorola Semiconductor Products Inc. 414-476-5554

MOTOROLA SEMICONDUCTOR Local Distributors

Ala Huntsville, Hall-Mark Elctrns., Box 1133 205-539-0691

Ariz Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave. 602-269-1391

Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331

Cal Culver City, Hamilton Electro Sales 213-870-7171

Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100

Cal Hollywood, Hamilton/Avnet Elctrncs. 305-925-5401

Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525

Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611

Cal Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd. 415-961-7000

Cal Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd. 415-968-6292

Cal San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd. 714-279-1550, 279-2421

Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112

Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.

Colo Denver, Burstein-Applebee 303-244-3336

Colo Denver, Hamilton/Avnet Electronics 303-534-1212

Colo Denver, Kierulff-Denver, 10890 E. 47th Ave. 303-343-7090

Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801

Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641

Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181

Fla Hollywood, Schweber Elctrns. 305-927-0511

Fla Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214 305-894-1511

Ga Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd. 404-448-0800

Ga Atlanta, Schweber Elctrns. 404-449-9170

Ill Chicago, Burstein-Applebee 312-763-4848

Ill Chicago, Schweber Elctrns. 312-593-2740

Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000

Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500

Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.

Kans Kansas City, Burstein-Applebee 816-561-5460

Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747

Kans Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St. 913-362-3250

Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200

Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110

Md Hanover, Hamilton/Avnet Elctrns. 301-796-5000

Md Rockville, Schweber Elctrns. 301-881-2970

Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100

Mass Burlington, Hamilton/Avnet Elctrns. 617-273-2120

Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700

Mass Newton, Cramer/International, 85 Wells Ave. 617-969-7700

Mass Waltham, Schweber Elctrns. 617-890-8484

Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040

Mich Detroit, Schweber Elctrns. 313-583-9242

Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700

Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628

Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500

Minn Edina, Cramer/Bonn, 7275 Bush Lake Road 612-835-7811

Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400

Mo Hazelwood, Hamilton/Avnet Electronics 314-731-1144

Mo Kansas City, Burstein Applebee 816-561-5460

Neb Lincoln, Burstein Applebee 402-434-0678

NJ Cedar Grove, Hamilton/Avnet Elctrns. 201-239-0800

NJ Cherry Hill, Hamilton/Avnet Elctrns. 609-662-9337

NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900

NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000

NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800

NJ Somerset, Schweber Elctrns. 201-469-6008

NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055

NY East Syracuse, Cramer/Syracuse, 6716 Joy Road 315-437-6671

NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800

NY Hauppauge, Cramer/Systems, 29 Oser Ave. 516-231-5682

NY Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue 516-231-5682

NY Rochester, Cramer/Rochester, 3259 Winton Road South 716-275-0300

NY Rochester, Schweber Elctrns. 716-328-4180

NY Syracuse, Hamilton/Avnet Elctrns. 315-437-2642

NY Westbury, Hamilton-Avnet Electrns., 70 State St.

NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474

NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700

NC Raleigh, Schweber Elctrns. 919-832-8881

Ohio Beachwood, Schweber Elctrns. 216-464-2970

Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000

Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600

Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176

Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900

Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458

Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400

Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101

Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington

Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100

Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay

Utah Salt Lake City, Cramer/Utah, 391 West 2500 South 801-487-3681

Utah Salt Lake City, Hamilton/Avnet Elctrns. 801-262-8451
Wash Seattle, Hamilton/Avnet Elctrncs., 2320 6th Ave. 206-624-5930
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
Wisc Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave. 414-476-1270
For: Can., Montreal, Hamilton/Avnet Elctrns. 514-735-6393
For: Can., Ottawa, Ont., Hamilton/Avnet Elctrncs., 880 Lady Ellen Pl.
For: Can., Toronto, Ont., Hamilton/Avnet Elctrns. 416-789-1838

MPB CORP., Precision Park, Keene, N.H., 03431, Tel: 603-352-0310, TWX: 710-366-1801
MPC PRODS. CORP., 4200 W. Victoria Ave., Chicago, Ill., 60646, Tel: 312-583-5100, TWX: 910-221-2576; Dir. of Mktg: A.V. Trozzo; Section Mgr.-Sls: R.T. Roeser; Sls. Mgr: F. Choromanski
MSI ELECTRONICS, INC., 34-32 57th St., Woodside, N.Y., 11377, Tel: 212-672-6500; Pres: A. Lederman; V.P: D. Scaringella
MU-DEL ELCTRNS., 2426 Linden La., Silver Spring, Md., 20910, Tel: 301-587-6087; Pres: I. Kuzminsky; Dir., Mktg: I. Lieberman

MUELLER ELEC. CO., 1589H E. 31st St., Cleveland, Ohio, 44114, Tel: 216-771-5225; Sls. Mgr: E.H. deConingh Jr. ..... Vol 3•702,703

Local Sales Offices & Reps.
Ariz Phoenix, Maddox Sls. 602-274-3807
Cal Los Angeles, Maddox Sls. 213-269-7291
Cal San Francisco, Maddox Sls. 415-431-2953
Colo Denver, L.B. Putnam 303-825-5066
Fla Orlando, Cartwright & Bean 305-425-8284
Fla Plantation, Cartwright & Bean, Inc. 305-791-3989
Ga Atlanta, Cartwright & Bean 404-237-2273
Ill Libertyville, R. Klipp & Assoc. 312-362-4676
La Chalmette, Cartwright & Bean 504-279-4598
Md Baltimore, E-K-P Assocs. Inc. 301-788-6498
Mass Lynn, Keene Sls. Co. 617-595-2300
Mich Ferndale, Hilltronics 301-398-5556
Minn Mpls., A.S. Miller 612-866-6677
Mo Kansas City, K & M Sls. 816-471-1355
NY Buffalo, R.W. Mitscher 716-854-2517
NY Port Washington, Joseph Assocs. 516-883-7770
NC Cary, Cartwright & Bean 919-832-7128
NC Charlotte, Cartwright & Bean 704-537-7965
Ohio Columbus, Mandabach & Assocs. 614-235-0265
Ore Portland, R. Legg Co. 503-292-8824
Pa Easton, E-K-P Assocs. Inc. 215-258-6477
Tenn Memphis, Cartwright & Bean 901-276-4442
Tex Waco, Sanders-Willis Co. 817-776-1742
Utah Salt Lake City, L.B. Putnam 801-277-0375
For: Can., Toronto, Ont., W. H. Cooper & Co. 416-630-3900

MUELLER Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal Goleta, Radio Prods. Sls., 350 S. Kellogg Ave 805-964-6823
Cal Los Angeles, Radio Prods. Sls., 1501 S. Hill St. 213-748-1271
Cal San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd. 714-292-5611
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Colo Denver, Burstein-Applebee 303-244-3336
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Kansas City, Burstein-Applebee 816-561-5460
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd 314-428-8522
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Reading, Barbey Elctrn., 333 N. 4th St.,
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

MULTICORE SALES CORP., Div. Avnet, Long Island Expwy., Westbury, N.Y., 11590, Tel: 516-334-7450, TWX: 510-222-2219; Sls. Mgr: M. Baranick; Tech. Dtr: J. Tarnowsky

Local Sales Offices & Reps.
Mo Kansas City, Forristal-Young Sls. Co. 316-358-6771

MULTICORE Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
La Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094 318-423-6131
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

MULTIMETRIC INDUSTRIES, Div. Daysam Corp., 120-30 Jamaica Ave., Richmond Hill, N.Y., 11418, Tel: 212-441-4240; Sls. Mgr: R.W. Tramposch; Pres: P. Basse ..... Vol 2•576

Local Sales Offices & Reps.
Ala Huntsville, Scientific Devices, SE, Inc. 205-536-1969
Ariz Phoenix, R. A. Mayes Co. 602-279-5243
Cal Mountain View, Gado Instr. Sls. 415-961-2222
Cal Torrance, Saber Entprs. 213-534-2876
Colo Broomfield, R. A. Mayes Co. 303-466-6311
Conn Hamden, J & J Assocs. 203-624-7800
Fla Orlando, Scientific Devices, SE, Inc. 305-424-7932
Ill Schaumburg, Electronic Instrument Assocs., Inc. 312-882-7140
Ind Indianapolis, Electronic Instrument Assocs., Inc. 317-257-7231
Mass Burlington, J & J Assocs. 617-272-2606
NJ Hazlet, Mer-Mon Electronic Instrumentation 201-264-1851
NM Albuquerque, R. A. Mayes Co. 505-265-7989
NY Plainview, Eastern Metro Assocs., Inc. 516-WE-1-1414
NC Burlington, Scientific Devices, S.E., Inc. 919-584-8311
Pa Mt. Penn, Mer-Mon Electronic Instrumentation 215-779-1640
Tex Houston, R. A. Mayes Co. 713-466-8325
Tex Richardson, R. A. Mayes Co. 214-235-3043
Va Annandale, J. Hopkins Assocs. 703-280-2086
Wash Bellevue, Hudson Co. 206-455-0773
For: Can., Don Mills, Ont., Componetics, Ltd. 416-445-3230
For: Can., Montreal, Que., Componetics, Ltd. 514-342-4117

MUPAC CORP., 646 Summer St., Brockton, Mass., 02402, Tel: 617-588-6110; V.P: B. Leary; Mktg. Mgr: A. Largey
MURA CORP., 50 S. Service Rd., Jericho, N.Y., 11753, Tel: 516-334-2700, TWX: 96-7879; V.P. Sls: E. Weisl; OEM Sls: R. Lerner

MURA Local Distributors
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Cal Van Nuys, C.H. Mitchell, 14614 Raymer St. 213-994-9466
Colo Denver, Fistells Elctrn., 1001 Bannock St. 303-244-4691
Conn Hartford, Hatry Elctrn. Entpr., 500 Ledyard St. 203-527-1881
Fla Miami, Elctrn. Equip. Co., 2701 NW 42nd Ave. 305-871-3500
Ga Atlanta, Specialty Distributing, 763 Juniper St. N.W. 404-873-2521
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La Shreveport, Ind'l. Elctrn Supply, 2422 Southern Ave 318-422-9459
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Detroit, RS Elctrns., 12775 Lyndon St. 313-491-1000
Miss Jackson, Ellington Elec. Supply, 1425 Terry Rd. 601-355-0561
Mo St. Louis, Olive Ind'l Elctrns., 6662 Olive Blvd. 314-863-7800
NJ Edison, William Elctrnc. Supply, 1863 Woodbridge Ave. 201-985-3700
NY Hempstead, Elctrn. Equip., 741-757 Peninsula Blvd. 516-538-5510
NC Winston-Salem, Kirkman Elctrns., Inc., 901 W. Second St. 919-724-0541
Ohio Cleveland, RPC Elctrns., 749 Miner Rd. 216-461-4700
Ohio Fremon, J & B Elctrn., 820 E. State St. 419-332-9334
Okla Oklahoma City, Trice Wholesale Electr., 4701 No. Stiles 405-524-4411
Ore Portland, Central Dist., 955 N.E. Union 503-234-0711
Ore Portland, J W Elctrn., 2030 S.E. 7th 503-232-1104
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
SC Charleston, Wholesale Radio Supply, 515 E. Bay St. 803-722-2634
Tenn Memphis, Bluff City Distr. Co., Box 418, 234 East St. 901-725-9500
Tex Dallas, Wholeslae Elctrns., 2809 Ross Ave. 214-824-3001
Va Arlington, Arlington Elctrnc., 3636 Lee Hwy.
Wash Seattle, Western Elctrn., 717 Dexter Ave. N. 206-284-0200

MURATA CORP. OF AMERICA, 2 Westchester Plaza, Elmsford, N.Y., 10523, Tel: 914-592-9180; Sls. Mgr: J. Alterescu ..... Vol 2•434,575

MURATA MFG. CO. LTD., Nagaoka-shi, Kyoto, Japan, Tel: 075-921-9111; Mgr., Export: S. Horie Vol 2•434,575

Local Sales Offices & Reps.
NY Elmsford, Murata Corp. of America 914-592-9180

MYSTIK TAPE, DIV. BORDEN CHEM., Borden Inc., Box 189, Winnetka, Ill., 60093, Tel: 312-446-4000; Prod. Mgr: R.E. Madden; Prod. Mgr: W. Gemas
NANOTRON RELAY CO., Sub. Veradyne Corp., 330 N. Victory, Burbank, Cal., 91502, Tel: 213-849-3123; Sls. Mgr: J. Ashford
NARDA MICROWAVE CORP., Plainview, N.Y., 11803, Tel: 516-433-9000, TWX: 510-221-1867; Mgr.-Sls. Adm: R.E. Nopper

Local Sales Offices & Reps.
Cal Menlo Pk., Straube Assocs. 415-323-2476
Cal Woodland Hills, Interstate Mktg. Assocs. 213-883-7606

Fla Orlando, E.G. Holmes & Assocs. 305-894-8901
Ga Chamblee, E.G. Holmes & Assocs. 404-451-6161
Haw Honolulu, Industrial Elctrns., Inc. 533-6095
Ill Chicago, Scientific Sls. Co. 312-775-7594
Ind Indianapolis, Scientific Sls. Co. 317-253-4606
Kans Shawnee Mission, EIR Co. 913-362-0919
Md Kensington, Electronic Mktg. Assocs. 301-881-5300
Mass Burlington, Tri-Tek, Inc. 617-272-4550
Mich Detroit, Micro Sls. Corp. 313-482-1229
Minn Bloomington, Scientific Sls. Co. 612-881-3300
Mo Hazelwood, EIR Co. 314-895-4100
NJ Merchantville, Megargel/Himmelstein Assoc. 215-629-1072 & 609-662-3081
NJ Westfield, Gray & Reed Assoc., Inc. 201-233-6116
NY E. Syracuse, Ossmann Instrs., Inc. 315-437-6666
NY Huntington Sta., Gray & Reed Assoc. 516-433-3333
NY Rochester, Ossmann Instrs. 716-328-2230
NY Vestal, Ossmann Instrs., Inc. 607-785-9947
NY Wappingers Falls, Ossmann Instrs., Inc. 914-297-7777
Ohio Cleveland, Micro Sls. Corp. 216-371-0522
Ohio Dayton, Micro Sls. Corp. 513-298-3033
Okla Norman, Data Mktg. Assocs. 405-364-8320
Tex Dallas, Data Mktg. Assocs. 214-358-4643
Tex Houston, Data Mktg. Assocs. 713-686-9627
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NORTEC ELCTRNS. CORP., 3697 Tahoe Way, Santa Clara, Cal., 95051, Tel: 408-732-2204; Sls. Mgr: M. Sanjideh

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Minn	Mpls, Nortec Sls.	612-835-7414
Mo	Hazelwood, Dy-Tronix Inc.	314-731-4677
Mo	Kansas City, Dy-Tronix Inc.	816-761-6543
NJ	Livingston, A.A. Budde	201-994-1210
NY	Forest Hills, Malin Assocs.	212-268-9122
NY	Rochester, Woodams-Montbach	716-544-8721
NC	Winston-Salem, W.A. Brown Comps.	919-725-5384
Ohio	Cleveland, C. Robinson Co.	216-381-9049
Ohio	Dayton, C. Robinson Co.	513-275-2412
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Tex	Dallas, R. Kimball Co.	214-231-3447
Va	Charlottesville, L.D. Lowery	703-973-6672
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Fla	Orlando, W. Brown	305-425-5505
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NM	Albuquerque, Williams Assocs.	505-255-1638
NY	New York, Wilson Assoc.	212-889-0370
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NC	Winston-Salem, W. Brown	919-725-5384
Ohio	Cleveland, C. Robinson	216-381-9049
Ohio	Dayton, C. Robinson	513-275-2412
Pa	Ambler, G.M.C. Assocs.	215-646-7535
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Exp:	NY, N.Y., Frathom Co.	212-687-9390
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Cal	Mountain View, Scientific Devices-CA	415-964-4230
Cal	North Hollywood, North Atlantic Dist. Off.	213-982-0442
Cal	San Diego, Scientific Devices-CA	714-279-6642
Conn	Hamden, J & J Assocs.	203-624-7800
Fla	Fort Lauderdale, BCS Associates Inc.	305-735-7641
Fla	Orlando, BCS Assocs.	305-843-1510
Ga	Atlanta, BCS Assocs.	404-874-9925
Ill	Chicago, P. Lind	312-774-1246
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Md	Baltimore, Dyna Rep. Co.	301-879-2586
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Mich	Milford, Scientific Devices	313-363-2282
Minn	Circle Pines, P. Lind	612-786-5770
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Ohio	Dayton, Scientific Devices	513-298-9904
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NORTH ELECTRIC CO., Electronetics Div., Box 688, Galion, Ohio, 44833, Tel: 419-468-8100, TWX: 419-464-4860; Mktg. Analyst: K. Gregg; Mktg. Analyst: H. Sunnucks

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NJ	Cherry Hill, Benco Sls.	609-429-5515
NJ	Fair Lawn, Bixon Assoc.	201-797-5356
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Va	Oakton, Prod. Mgt. Co.	301-948-0493
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NORTH HILLS ELCTRNS., INC., Alexander Pl., Glen Cove, N.Y., 11542, Tel: 516-671-5700; Sls. Mgr: V. Macri Vol 1•366,768; Vol 2•358,359; Vol 3•533,1268

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Fla	Melbourne, Reynolds & Assocs., Inc.	305-727-3205
Md	Kensington, Aeron Assocs.	301-946-0070
Mass	Wakefield, Measurement Equip. Co.	617-245-4870
Mich	Clawson, George Instr. Co.	313-435-3400
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Ohio	Dayton, Weschler Elec. Corp.	513-274-6972
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NORTHEAST SCIENTIFIC CORP., 30 Wetherbee St., Acton, Mass., 01720, Tel: 617-263-2711; Chief Engr: Dr. C. Moritz

NORTHERN ENGRG. LABS., 357 Beloit St., Burlington, Wisc., 53105, Tel: 414-763-3591; Sls: D. Griebel Vol 2•435

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Cal	Palo Alto, R. W. Thompson Assocs.	415-493-7388
Cal	Pasadena, P. Nurches	213-796-5844
Colo	Aurora, Robbins & Assocs.	303-399-6618
Fla	Orlando, W. B. Wimberly	305-425-3083
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Kans	Overland Park, B. Rush Assocs.	913-831-4259
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NJ	Bergenfield, H. Gray	201-384-3643
NY	Syracuse, Naylor Elec. Co.	315-472-9183
Ohio	Wickliffe, W. J. Brauer	216-943-0601

NORTHERN PRECISION LABS., INC., 202 Fairfield Rd., Fairfield, N.J., 07006, Tel: 201-227-4800, TWX: 710-734-4301; Sls. Mgr: T. Monaco

NORTHFIELD PRECISION INSTR. CORP., 4400 Austin Blvd., Island Pk., N.Y., 11558, Tel: 516-431-1112; S.M: M. Farber ..... Vol 2•658

Local Sales Offices & Reps.

Cal	Mondrovia, Electro-Mechanical Instr., Inc.	213-358-1881

NORTON ASSOCS., INC., 10 Di Tomas Ct., Copiague, N.Y., 11726, Tel: 516-842-4666; Pres: R.S. Norton Vol 1•316

NORTON COATED ABRASIVE & TAPE DIVS., Dept. 7312, Troy, N.Y., 12181, Tel: 518-273-0100; Abras. Ad. Mgr: J.P. Burke; Tape Ad. Mgr: W.G. Kestner

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Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
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Md	Towson, Gawler-Knoop Co.	215-348-4646
Mass	Burlington, J & J Assocs.	617-272-2606
Minn	Minneapolis, R-J Inc.	612-992-1425
NJ	Roseland, Gawler-Knoop Co.	201-226-4545
NM	Albuquerque, A.L.S. Elctrns.	505-268-9600
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Ohio	Worthington, Ohio Instr.	614-885-0743
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NOVATRONICS, INC., Box 878, Pompano Beach, Fla., 33061, Tel: 305-942-5200, TWX: 510-956-9878; Mgr. Cust. Req: J. Cianciarulo

NU-CONCEPT COMPUTER SYS., 306 W. Logan St., Norristown, Pa., 19401, Tel: 215-275-3200; VP: J. Moretz; VP: T. Dvorak

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Wash Bellevue, C. W. Fowler Co. 206-454-8600

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OSTBY & BARTON CO., Box 6267, Providence, R.I., 02904, Tel: 401-739-7310; Sls. Mgr: W.A. Webb

Local Sales Offices & Reps.
Ill Glen Ellyn, H.F. Wilson Engrg. Co. 312-469-8473
Nev Reno, S.P. Marketing 702-329-6311
RI Providence, Market Development 401-943-2600

OTTO ENGRG. INC., 36 Main St., Carpentersville, Ill., 60110, Tel: 312-428-7171; Sls. Mgr: R.E. Sparks Vol 2•1127

Local Sales Offices & Reps.
Cal No. Los Altos, Frauman Assocs. 415-941-0660
Cal So. Alhambra, M. W. Riedel & Co. 213-283-7694
Del Lutherville, M & J Assocs. Inc. 301-828-6230
Ill Glen Ellyn, Rockford Controls Co. 312-469-6016
Ind Fort Wayne, McDonald Sls. Co. 219-747-3650
Mo Kansas City, Harris-Hanson Co. 816-444-9494
Mo St. Louis, Harris-Hanson Co. 314-962-0111
NY Great Neck, F Tylinski Co. 516-466-9070
Ohio Cleveland, A. H. Baier Co., & Assoc. 216-461-6161
Ohio Dayton, A. H. Baier Co., & Assoc. 513-276-4128
Tex Garland, Whiteside Sls. Co. 214-231-9771
Tex Houston, Whiteside Sls. Co. 713-498-2551

OTTO Local Distributors
Cal Culver City, Avnet Electrns. Div., 10916 Washington Blvd. 213-836-7200
Cal Los Angeles, ED Warburg Co., 1207 E. 8th St.
Cal Los Angeles, Electric Switch, 4111 Beverly Blvd. 213-664-1141
Cal Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way 213-685-5511
Cal Santa Clara, Fisher/Brownell, 3381 Edward Ave. 408-244-6182
Cal Sun Valley, Richey Elctrn. Inc., 10871 La Tuna Canyon Rd. 213-875-2862
Conn Hartford, GAL Electric Co., 19 Heath St.
Conn Windsor Locks, Adam's Aircraft Engrg. Co., Box 291, Bradley Int'l. Airport
Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181
Ga Atlanta, Electro Air Corp., 2270 Marietta Blvd. N.W.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Kans Wichita, Air Technics, Inc., 745 So. Emporia
Md Baltimore, ASI Elctrn./Astrex, 1728 Whitehead Rd. 301-265-5100
Md Rockville, Pioneer/Washington, 1037 Taft St. 301-427-3300
Mass Boston, Controller Serv. Sales Co., 212 Old Colony Ave.
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mich Detroit, Blackburn Don & Co., 6191 John C. Lodge Frwy.
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY New York, City Elec. Distrs., Inc., 510 W. 34th St.
NY Plainview, ACI Elctrns., 28 South Mall 516-293-6630
NY Westbury, Hamilton-Avnet Electrns., 70 State St.
NY Woodside, Durham Aircraft Serv. Inc., 56-15 Northern Blvd.
Pa Harrisburg, Pyttronic Inds. Inc., 2325 No. 7th St. 717-233-6591
Tex Arlington, ASC Industries Inc., Box 5068, 716 Ave. H. East
Tex Dallas, Assoc. Aircraft Supply Co., 5021 W. Jefferson Blvd.
Tex Dallas, Texas Instrs. Supply, 6000 Denton Dr. 214-238-6850
Tex Houston, Sterling Electronics, Box 1229 713-623-6600
Wash Bellevue, Farwest Elctrns. Co., 1240 S.E. 32nd St.
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300

OVEN INDUSTRIES, INC., Box 229, 1106 E. Simpson St., Mechanicsburg, Pa., 17055, Tel: 717-766-0721; Sls. Engr: S.A. Bashore; V.P. Sls: T.M. Nolan .....Vol 2•440

Local Sales Offices & Reps.
Ala Huntsville, Reynolds & Assocs. 205-536-1941
Ariz Scottsdale, S.C. Blaker Co. 602-948-3061
Cal Burlingame, Westronics Assoc. 415-342-1425
Cal Encino, El-Tec, Inc. 213-981-9881
Fla Melbourne, Reynolds & Assoc. 305-727-3205
Ga Atlanta, Reynolds & Assocs. 404-252-5360
Ill Skokie, Saffro & Assocs. 312-588-0905
La Baton Rouge, Covington Instr. Co. 504-924-1784
Mass Reading, Geder & Rotundi Assocs. 617-944-3105
Mo St. Peters, K.M. & B. Tech. Sls. 314-278-3159
NY Huntington, Andrews & Andrews 516-692-8686
NY Syracuse, Mike Antil 315-463-0266
NC Greensboro, Reynolds & Assocs. 919-275-3725
Ohio Medina, McShane, Inc. 216-725-4568
Pa Ambler, W & M Assocs. 215-643-4119
Tex Dallas, Bouco Sls. Assocs. 214-247-6708
Va Falls Church, Beacon Elctrn. Assoc. 703-534-1673
Exp: Pa., Lemoyne, Elctrns. Int'l. 717-737-8858
For: Can., Vancouver 9, Cal-Tron Elctrn. Sls., Ltd.

OVENAIRE, Div. Walter Kidde & Co., 706 Forrest St., Charlottesville, Va., 22901, Tel: 804-293-5148, TWX: 510-587-5461; VP Frequ. Prods: N. Broadbent; Mgr. Temp. Prods: R. VanDerveer .....Vol 2•436-439

Local Sales Offices & Reps.
Cal San Mateo, Melvin Sl. 415-349-7445
Cal Van Nuys, R.L. Assocs. 213-780-1666
Fla Maitland, Ellis & Assocs. 305-645-1101
Ill Chicago, T. Hunter 312-777-2500
Ind Fort Wayne, Scott Elctrns., Inc. 219-743-1586
Ind Indpls., Scott Elctrns. 317-635-8951
Ky Louisville, Scott Elctrns., Inc. 502-583-3220
Mass Sherborn, Naton Assocs., Inc. 617-235-1966
Mich Southfield, Scott Elctrns., Inc. 313-357-2088
Minn St. Paul, Countryman 612-645-9151
NY Buffalo, Quality Comps. 716-839-4170
NY Smithtown, TX Sls., Inc. 516-979-8750
NC Greensboro, L & D, Inc. 919-292-3201
Ohio Cincinnati, Scott Elctrns., Inc. 513-791-2513
Ohio Cleveland, Scott Elctrns. 216-291-2600
Ohio Columbus, Scott Elctrns., Inc. 614-228-2313
Ohio Dayton, Scott Elctrns. 513-223-2652
Tex Dallas, Stevens Sls. 214-350-2476
Exp: New York, N.Y., C. Tennant, Sons & Co. Electronic Div. 212-889-8530

OWATONNA TOOL CO., 395 Eisenhower Dr., Owatonna, Minn., 55060, Tel: 507-451-5310; V.P. Mktg: J.A. Mullenmaster

OXFORD INSTR. CORP., 100 Cathedral St., Annapolis, Md., 21401, Tel: 301-268-2350; G.M: J.E. Templeton

PACE DIV., Pathcom, Inc., 24049 S. Frampton, Harbor City, Calif., 90710, Tel: 213-325-1290; Mktg. Mgr: J.L. Haskins

PACE Local Distributors
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960

PACE WIRE & CABLE CORP., 3590 Oceanside Rd., Oceanside, N.Y., 11572, Tel: 516-678-2275; Sls. Mgr: S. Stadlen

PACIFIC COMMUNICATIONS, Box 10392, Santa Ana, Cal., 92711, Tel: 714-546-0147; V. P: K. Fowler; Engr: W. Cormey

PACIFIC ELECTRONIC ENTERPRISES, 2643 N. San Gabriel Blvd., Rosemead, Cal., 91770, Tel: 213-573-1686; M/M: S. Tullock .....Vol 1•780

Local Sales Offices & Reps.
Ala Huntsville, Lee Assocs. 205-883-2530
Fla Lake Park, Lee Assocs. 305-844-6730
Fla Orlando, Lee Assocs. 305-241-4445
Ga Chamblee, Lee Assocs. 404-457-7117
Ill Chicago, Carter Elctrns. 312-585-5485
Ind Indianapolis, Carter Elctrns. 317-293-0696
Mass Newtonville, H. J. Schuft Co. 617-527-5304
Minn Minneapolis, Carter Elctrns. 612-544-9393
Mo Hazelwood, Carter Elctrns. 314-731-2237
NJ Union, SBM 201-687-8737
NY Pleasantville, SBM 914-769-1811
NY Rochester, SBM 716-266-1400
NC Raleigh, Lee Assocs. 919-787-5818
Wisc Milwaukee, Carter Elctrns. 414-464-5555

PACIFIC MEAS., INC., 940 Industrial Ave., Palo Alto, Calif., 94303, Tel: 415-328-0300, TWX: 910-373-1171; Sls. Mgr: D.E. Armann; V.P. Mktg: A.D. Anderson; Pres: R.H. Rassmussen

Local Sales Offices & Reps.
Ariz Phoenix, P L S Assocs., Inc. 602-957-9110
Cal Costa Mesa, Measurement Assocs. 714-540-7160
Cal Palo Alto, Bert Oppenheim, Inc. 415-321-7323
Colo Denver, P L S Assocs., Inc. 303-771-0140
Ill Chicago, Scientific Sls. 312-775-7594
Ind Indianapolis, Scientific Sls. 317-253-4606
Kans Shawnee Mission, EIR Co. 913-362-0919
Mass Waltham, MC Bar Assocs. 617-890-0233
Minn Bloomington, Scientific Sls. 612-881-3300
Mo Hazelwood, EIR Co. 314-837-0597
NJ Ridgewood, Damon/Engel Inc. 201-444-1400
NM Albuquerque, P L S Assocs., Inc. 505-255-2330
NY Commack, Damon/Engel Inc. 212-732-0001
NY East Syracuse, Ossmann Instrus. 315-437-6666
Ohio Dayton, H. Teplitz & Co. 513-277-6531
Pa Hatboro, Damon/Engel Inc. 215-922-3270
Tex Dallas, Crockett Engrg. Co. 214-637-6120
Va Annandale, Nine Assocs. 703-256-9105

PACIFIC TECHNOLOGY, 235 Airport Way, Renton, Wash., 98055, Tel: 206-226-8350; V.P. Mktg: D.R. Hall

Local Sales Offices & Reps.
Cal El Monte, Randolph Industries, Inc. 213-283-7901
Cal Palo Alto, Coherent Mktg. Assocs. 415-327-2217
Colo Englewood, Utility Prods., Inc. 303-771-9080
Conn Glastonbury, Instrument Reps., Inc. 203-633-0777
Ga Atlanta, M. J. Fein & Co. 404-938-0190
Ill Chicago, Scientific Sls. Corp. 312-775-7594
Ind Indianapolis, Scientific Sls. Corp. 317-253-4606
Mich Ann Arbor, H. C. Heym Assocs. 313-971-6552
Mich Birmingham, H. C. Heym Assocs. 313-644-9166
Mich Lexington, Instrument Reps., Inc. 617-861-8620
Minn Bloomington, Scientific Sls. Corp. 612-881-3300
NJ Livingston, M. J. Fein & Co. 201-994-3575
NY Scarsdale, M. J. Fein & Co. 914-472-1100
NC Charlotte, J. Rudisill Assocs., Inc. 704-377-6901
Okla Tulsa, Telstar Instrument Corp. 918-628-1011
Pa Latrobe, Measurement & Control Assocs. 412-539-8200
Tex Houston, W. W. Scherwitz Co. 713-527-8866
Wash Mercer Island, Penryn Sls. & Engrg. Co. 206-232-3411
For: Can., Montreal 355, Quebec, Associated Instrumentation & Controls 514-384-7211
For: Can., Vancouver, British Columbia, T. W. MacKay & Son, Ltd. 604-731-6561

PACIFIC TRANSDUCER CORP., 2301 Federal, Los Angeles, Calif., 90064, Tel: 213-478-1134, 479-2119; Pres: G.A. Argabrite; Asst. Corp. Secty: Mrs. P. Bull

PACKAGED RESINS DIV., Bacon Inds., Inc., 192 Pleasant St., Watertown, Mass., 02172, Tel: 617-926-2550; Sls. Mgr: R.S. Cass

PACKARD INSTRUMENT CO., INC., 2200 Warrenville Rd., Downers Grove, Ill., 60515, Tel: 312-969-6000, TWX: 910-695-3220; Sls. Mgr: J. Connell

Local Sales Offices & Reps.
Ill Downers Grove, Packard Inst. Co. 312-969-6000

PAKTRON DIV., Illinois Tool Works, Inc., 900 Follin Lane, S.E., Vienna, Va., 22180, Tel: 703-281-2810, TWX: 710-833-0682; Sls. Mgr: M.J. Waters

PALL CORP., 30 Sea Cliff Ave., Glen Cove, N.Y., 11542, Tel: 516-671-4000, TWX: 510-223-0606; V.P. Mktg: N. Nickolaus

Local Sales Offices & Reps.
Cal Pasadena 213-684-2131
NJ , Pall Trincor Corp. 201-245-8400

PALL TRINITY MICRO CORP., Rte. 281, Cortland, N.Y., 13045, Tel: 607-756-7535, TWX: 510-252-0791; V.P. Mktg./Sls: A.L. Weiner

PALOMAR ENGRS., Box 455, Escondido, Cal., 92025, Tel: 714-747-3343; Ch. Eng: J. Althouse

PAMOTOR, INC., 770 Airport Blvd., Burlingame, Cal., 94010, Tel: 415-347-1203, TWX: 910-374-2353; Sls. Mgr: C. Port, Jr. .....Vol 3•1050,1051

Local Sales Offices & Reps.
Cal Burlingame, W. J. Purdy Co. 415-347-7701
Cal Los Angeles, P. F. Wiley 213-663-8028
Cal San Diego, King & Cassidy Elctrns. 714-278-7640
Colo Englewood, W. J. Purdy Co. 303-770-5311
Conn Meriden, P. R. Sturgeon 203-237-1112
Fla Orlando, Cartwright & Bean 305-425-8284
Fla Plantation, Cartwright & Bean, Inc. 305-791-3989
Ga Atlanta, Cartwright & Bean 404-237-2273
Ill Hinsdale, Hill-Gray 312-325-4810
Iowa West Des Moines, T. L. Dowell Co. 525-225-1620
Kans Overland Park, T. L. Dowell Co. 913-649-6069
La Chalmette, Cartwright & Bean, Inc. 504-279-4598
Mass Babson Park, P. R. Sturgeon Co. 617-237-3506
Mich Ferndale, Hilltronics, Inc. 313-398-5556
Minn Edina, M. Foster 612-835-2252
Mo Shrewsbury, T. L. Dowell Co., Inc. 314-647-7067
NJ Bergenfield, H. Gray Assoc. 201-384-3643
NM Albuquerque, W. J. Purdy Co. 505-266-7959
NY Syracuse, Mar-Com Assocs. 315-437-2843
NC Charlotte, Cartwright & Bean 704-333-6457
NC Raleigh, Cartwright & Bean Co. 919-832-7128
Ohio Dayton, N. Bear Corp. 513-299-3566
Ohio Richfield, N. Bear Corp. 216-659-3131
Pa Enon Valley, Nebco Assoc. 216-457-2333
Tenn Memphis, Cartwright & Bean 901-276-4422
Tex Dallas, J. Schoonmaker Co. 214-357-8481
Tex Houston, J.Y. Schoonmaker Co. 713-926-9510
For: Can., Willowdale, Ont., A. C. Simmonds & Sons 416-491-1010

PAMOTOR, Local Distributors
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave. 415-961-1500
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Conn Hamden, Connecticut Electro Sls., 1601 Dixwell Ave. 203-288-8266
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200

PAN-L-FAST, 13161 Sherman Way, N. Hollywood, Cal., 91605, Tel: 213-764-1143; Sls. Mgr: J. Eliot

PANAMETRICS INC., 221 Cresent St., Waltham, Mass., 02154, Tel: 617-899-2719

PANDUIT CORP., 17301 S. Ridgeland Ave., Tinley Pk., Ill., 60477, Tel: 312-532-1800; Sls: T. Wittert Vol 3•1408,1409; Vol 4•571*

Local Sales Offices & Reps.
Ala Montgomery, Holman-Lobsinger 205-264-8592
Alas Anchorage, H.J. Lang & Assocs. 279-5741
Ark Little Rock, Ransom Sls. Co. 501-225-7332
Cal Anaheim, Panduit Corp. 714-772-1300
Cal Los Altos, Ewing-Foley, Inc. 415-941-4525
Colo Denver, Panduit Corp. 303-756-7747
Conn Glastonbury, Barton-Caron Assocs. 203-633-9417
Fla Winter Park, Floritronics 305-886-4818
Ga Marietta, Panduit Corp. 404-971-5316
Ind Ft. Wayne, Val-Skol 219-742-9122
Ind Indpls, Val-Skol Sls. 317-926-5063
Iowa Marion, Thomas & Modrcin 319-377-6261
Kans Shawnee Mission, Thomas & Modrcin Assoc. 913-432-2131
Ky Jeffersontown, A.L. Pickens 502-267-8213
La Metaire, Case Sls. Co. 504-835-7713
Md Silver Spring, L.G. White & Co. 301-585-3141
Mass Auburndale, Barton-Caron Assocs. 617-332-2021
Mich Southfield, Panduit Corp. 313-354-1830
Minn Mpls, Elec. Comp. Sls. 612-933-2594
Mo Hazelwood, Thomas & Modrcin 314-895-4700
NJ Hackensack, Panduit Corp. 201-489-5335
NY Buffalo, R.W. Mitscher 716-633-7890
NY Fayetteville, R.W. Mitscher 315-637-9761
NY Vestal, R.W. Mitscher 607-798-0868
NC Winston-Salem, L.G. White Southern, Inc. 919-725-3612
Ohio Cincinnati, Val-Skol 513-563-6790
Ohio Cleveland Heights, Val-Skol Sls., Inc. 216-462-2822
Ohio Columbus, Val-Skol Sls. 614-291-4123
Okla Okla. City, Panduit Corp. 405-848-6916
Pa King of Prussia, White-Keystone 215-265-1817
Pa Pittsburgh, M. Smith 412-276-5363
Tenn Memphis, Ransom Sls. 901-332-0036
Tex Dallas, Panduit Corp. 214-638-7280
Tex Houston, Panduit Corp. 713-688-4568
Wash Bellevue, Panduit Corp. 206-454-7267
Wisc Appleton, Harold Mercer Co. 414-739-6223
Wisc Brookfield, Harold Mercer Co. 414-786-6431
For: Can., Markham, Ont., Panduit (Canada) Ltd. 416-499-4077

PANEL CONTROLS CORP., 1000 Mt. Elliott Ave., Detroit, Mich., 48207, Tel: 313-568-2400; Sls. Mgr: D. Miller
Local Sales Offices & Reps.
Ariz Phoenix, Davis Pack. Supp. 602-942-5484
Cal Westminster, Contronic Devices 714-897-2266
Ill Glenview, B. Castle 312-724-5939
Mass Burlington, Contact East 617-272-5051
Mich Dearborn, F. B. Wright Co. 313-843-8250
Minn Anoka, A & R Assocs. 613-421-0751
Mo Maryland Heights, Allied Assocs. 314-291-1120
NJ Mountain Lakes, Dearie & Farrell Co. 201-334-4848
NC Durham, R.H. Davis Co. 919-596-8472
Ohio Dayton, Dynel Co. 513-434-6467
Ore Portland, Commercial Prods. 503-233-8504
Tenn Chattanooga, Jackson & Assocs. 615-267-4260
Tex Dallas, W. Cannon 214-FL-7-2846
Utah Salt Lake City, American Hand. & Pack. 801-278-0532
Wash Seattle, Commercial Prods. 206-246-5330

PANELGRAPHIC CORP., P.O. Box 254, Caldwell, N.J., 07006, Tel: 201-227-1500, TWX: 710-734-4367; Sls. Mgr: E.C. Greason
Local Sales Offices & Reps.
Ala Huntsville, W.A. Brown Comps. 205-539-4411
Ariz Tempe, G.R. McKnight Co. 602-949-0809
Cal Canoga Park, M.J. Murphy 213-341-1472
Cal Menlo Park, G.R. McKnight 415-325-2844
Colo Denver, R.C. Bowen Co. 303-722-4641
Conn North Haven, Kitchen & Kutchen 203-239-0212
Fla Orlando, W.A. Brown Comps. 305-425-5505
Ill Rolling Meadows, Sumer, Inc. 312-394-4900
Mass Lexington, Kitchen & Kutchen 617-862-8230
Minn Minneapolis, Nortec Sls. 612-835-7414
Mo Kansas City, Auto, Gen. Elec. Sls. 816-333-8206
NJ Mt. Lakes, Comp. for Electronics 201-334-2921
NY Rochester, L. Hart 716-244-3253
NC Winston Salem, W.A. Brown Comp. 919-725-5384
Ohio Cleveland, Components Inc. 216-842-2737
Pa Havertown, Snyder & Massey 215-789-2320
Va Fairfax, Snyder & Massey 703-273-1413
Wash Bellevue, Hickey Eng. Sales 206-454-0460

PANELOC CORP., Front & Main Sts., Collinsville, Conn., 06022, Tel: 203-693-8363; Sls. Mgr: G.M. Williams III

PANTA-PAK PACKAGING DIV., Pantasote Co. of N.Y. Inc., 26 Jefferson St., Passaic, N.J., 07055, Tel: 201-777-8500, TWX: 710-989-7108; Mktg. Mgr: J.J. Hayman

PAR-METAL PRODS. DIV., Eon Corp., 1260 Atlantic Ave., Brooklyn, N.Y., 11216, Tel: 212-772-5800; Sales: W. Jones
Local Sales Offices & Reps.
NY New York, Miller Co. 212-263-4446
PAR-METAL Local Distributors
La Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094 318-423-6131
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370

PARABAM, INC., 3017 E. Las Hermanas St., Compton, Cal., 90221, Tel: 213-537-1771; Sls. Mgr: J.N. Day, Jr.

PARAGON ELEC. CO., Sub. AMF Inc., 1600 12th St., Two Rivers, Wisc., 54241, Tel: 414-793-1161; V.P. Mktg: R.J. Langlois

PARAMETRICS, INC., 284 Racebrook Rd., Orange, Conn., 06477, Tel: 203-799-2333; Sls. Mgr: D. Maass

PARAMETRIC INDS., INC., 742 Main St., Winchester, Mass., 01890, Tel: 617-729-7333

PARAMOUNT INDS., INC., 1430 Progress Rd., Ft. Wayne, Ind., 46808, Tel: 219-484-4111; Sls. Mgr: R.R. Weimer

PARAPLEGICS MFG., 304 N. York Rd., Bensenville, Ill., 60106, Tel: 312-625-7740; Sls. Mgr: V. Caricato

PARKER SEAL CO., 10567 Jefferson Blvd., Culver City, Calif., 90230, Tel: 213-837-5101, TWX: 910-340-6764; V.P-Mktg: F.J. Opatrny

PARKS LABORATORY HENRY FRANCIS, Box No. 15201, Seattle, Wash., 98115, Tel: 206-523-4832; Sls. Mgr: S.T. Parks

PAUL, F.H. & STEIN BROS., 235 5th Ave., New York, N.Y., 10016, Tel: 212-684-6370; Sls. Mgr: E. Stein

PCA ELCTRNS., INC., 16799 Schoenborn St., Sepulveda, Calif., 91343, Tel: 213-892-0761, TWX: 910-496-1525; Pres: Weinberg; G. M: K.H. Dendy; Chief Engr. Transformers: K.H. Dendy
Local Sales Offices & Reps.
Ariz Phoenix, Toward Engrg. Assocs., Inc. 602-955-3193
Conn North Haven, Forsberg Sls. 203-239-5111
Fla Clearwater, WMM Assocs. 813-726-8871, 72
Ill Westchester, W. G. Brouillette & Assocs., Inc. 312-345-6500
Iowa Marion, Thomas & Modrcin Assocs., Inc. 319-377-6261
Kans Shawnee Mission, Thomas & Modrcin Assocs., Inc. 913-432-2131
Md Baltimore, R. P. Luce & Co., Inc. 301-752-8200
Mass Brockton, Forsberg Sls. 617-588-6110
Mich Grand Rapids, R. P. Urban & Assocs. 616-245-0511
NJ Berkeley Heights, R. P. Luce & Co., Inc. 201-464-6400
NY New Hyde Park, R. P. Luce & Co., Inc. 516-437-4550
NY Rochester, H. C. Johnson Agencies, Inc. 716-482-3000
Ohio Cleveland, Weschler Elec. Co. 216-251-4609
Pa Philadelphia, R. P. Luce & Co., Inc. 215-884-8365
Tex Dallas, Blackburn Assocs. 214-351-9992, 93
Exp: Glenshaw, Pa., H. C. Johnson Agencies 412-961-0414
Exp: Hazelwood, Mo., Thomas & Modrcin Assocs., Inc. 314-838-6446

PCB PIEZOTRONICS, INC., 5800 Transit Rd., Depew, N.Y., 14043, Tel: 716-684-0001, TWX: 710-263-1371; Sls. Mgr: J.F. Lally R. Maines
Local Sales Offices & Reps.
Cal Santa Clara, Richards Assocs. 408-246-5860
Cal Torrance, Saber Entprs. 213-534-2876
Conn Hamden, Northeast Engrg. 203-248-4481
Fla Orlando, Physimetrics, Inc. 305-894-8081
Ga Atlanta, Physimetrics, Inc. 404-261-8720
Ill Northfield, Torkelson Assocs., Inc. 312-446-9085
Ind Indianapolis, Torkelson Assocs., Inc. 317-244-7867
Md Ellicott City, Gans-Fryling, Inc. 301-837-6311
Mass Danvers, Northeast Engrg. 617-774-3010
Mich Farmington, Carter, McCormic & Peirce, Inc. 313-477-7700
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NY	East Syracuse, Application Specialists	315-437-2813
NY	Rochester, Application Specialists	716-586-6226
Ohio	Dayton, J.C. Hofstetter Co.	513-298-0662
Ohio	Medina, J.C. Hofstetter Co.	216-241-4880
Ore	Portland, Donal Co.	503-246-3131
Pa	Pittsburgh, J.C. Hofstetter Co.	412-561-5454
Tex	Dallas, Blair Engrg. Sls. Co.	214-352-8411
Tex	Houston, Blair Engrg. Sls. Co.	713-772-0677

PLANET INSTR., 14814 S. Broadway, Gardena, Cal., 90248, Tel: 213-321-6190, 323-9860, TWX: 910-346-6310; Mktg. Mgr: J. Rusler; Sls: K. Cox; Sls: M. Lamlie

Local Sales Offices & Reps.

Ariz	Scottsdale, Mercury Eng.	602-945-1927
Colo	Littleton, Barron Farquhar	303-795-1973
Ill	Mt. Prospect, Magnuson	312-956-0700
Ind	Ft. Wayne, McDonald Sls. Co.	219-745-9214
Mass	Bedford, F.R. Lesser	617-275-7558
Minn	St. Paul, Magnuson Assocs.	612-227-8495
Mo	St. Louis, Repco	314-343-9313
NJ	Summit, R. Potter	201-277-0220
NY	Hyde Park, R.P. Kennedy Co.	914-229-2269
NY	N.Y., Haber-Ramp	212-799-4040
NY	N.Y., Metro N.Y., Corp.	212-682-5844
NY	Rochester, R. Kennedy	716-271-6322
Tex	Houston, P.J. Scanlon Co.	713-466-6897
Tex	Richardson, P. Scanlon	214-231-4661
Wash	Bellevue, Conrard	206-455-1336
Exp:	N.Y., N.Y., Technitron	212-758-2790
For:	Can., Weston, Ont., C. Pipe	416-249-1766

PLASTIC CAPACITORS, INC., 2620 N. Clybourn Ave., Chicago, Ill., 60614, Tel: 312-348-3735; Order Dept. Supervisor: B. Hain; Chief Engr: R. Langstaff

Local Sales Offices & Reps.

Ala	Huntsville, B.J.R.	205-881-3569
Cal	Los Angeles, E.E. Strassner Co.	213-666-1511
Cal	Redwood City, Logan Sls. Co.	415-369-6726
Conn	East Haven, Eagle Assocs., Inc.	203-235-9036
Fla	North Miami, L. Haas Co., Inc.	305-949-9143
Ill	Chicago, Carlson Elctrn. Sls.	312-774-4812
Ind	Ft. Wayne, W.W. Bieberich, Inc.	219-432-2537
Md	Baltimore, Component Sls., Inc.	301-484-3647
Mass	Needham, Eagle Assocs., Inc.	617-444-3446
Mo	St. Louis, Carlson Elctrn. Sls.	314-991-0262
NJ	Springfield, F.F. Sylvester Assocs.	201-376-3324
NY	Baldwinsville, Ellis Scovel	315-652-9798
NY	Rushville, Ellis Scovel	315-584-6522
NC	Raleigh, Component Sls., Inc.	919-876-5550
Ohio	Cleveland, Electro-Com	216-886-2404
Ohio	Dayton, Electro-Com	513-273-3993
Pa	Philadelphia, Eastern Components	215-927-6262
Tex	Dallas, Packard Assocs.	214-357-5713
Wisc	Milwaukee, Carlson Elctrn. Sls.	414-476-2790
Exp:	New York City, N.Y., B. Freudenberg, Inc.	212-757-9130

PLASTIGLIDE MFG. CORP., 1757 Stanford St., Santa Monica, Cal., 90404, Tel: 213-829-2661; Sls. Mgr: S. Powell

PLESSEY CERAMIC DIV., Plessey N.J. Inc., 8th & Harrison Sts., Frenchtown, N.J., 08825, Tel: 201-996-2121, TWX: 510-235-3399; Gen. Mgr: J.D. Fredericks

PLESSEY ELECTRO-PRODUCTS, 3860 Centinela Ave., Los Angeles, Cal., 90066, Tel: 213-390-3585, TWX: 910-343-6483; Dir. Sls: M. Mintz ..... Vol 2•360

PLESSEY ENVIROMENTAL SYS., 3939 Ruffin Rd., San Diego, Cal., 92112, Tel: 714-278-6500; Mktg. Mgr: E.K. Dean

PLESSEY SEMICONDUCTORS, 170 Finn Ct., Farmingdale, N.Y., 11735, Tel: 516-694-7377; Mktg. Mgr: B.R. Erde ..... Vol 2•600-604

Local Sales Offices & Reps.

Cal	Santa Ana, Plessey Memories	714-540-9945
Fla	St. Petersburg, Kirkwood Assocs.	813-894-8240
Ill	Chicago, LGS Assocs.	312-622-8183
Tex	Dallas, Thorson Co.	214-233-5744
Tex	Houston, Thorson Co.	713-771-3504

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

PLYMOUTH RUBBER CO., INC., Canton, Mass., 02021, Tel: 617-828-0220, TWX: 617-828-4546; Mgr: N.J. Lenihan

PLYMOUTH Local Distributors

Tex	Houston, Geophysical Supply Co., Box 52230	713-224-0621

PMC DESIGNING, See Proto Matic Co.

PODGOR, JOSEPH CO., 7895 Browning Rd., Pennsauken, N.J., 08109, Tel: 609-NO-3-7878; Sls. Mgr: F.C. Kline; Pres: J.E. Podgor

SELF-ORGANIZING SYS., See Cosar Corp.

POLARAD ELCTRN. INSTRS., 5 Delaware Dr., Lake Success, N.Y., 11040, Tel: 516-328-1100, TWX: 510-223-0414; V.P. Mktg: E. Feldman; Cust. Svc: A. Hartig

Local Sales Offices & Reps.

Ala	Huntsville, J. Highsmith	205-881-3294
Alas	Anchorage, Arva, Inc.	907-272-5231
Ariz	Scottsdale, Inter-Mountain Engrg. Co.	602-947-7379
Cal	Cupertino, T. Snitzer	408-257-8333
Cal	Del Mar, T. Snitzer	714-454-2191
Cal	Los Angeles, T. Snitzer	213-836-6170
Colo	Littleton, Intermountain Engrg. Co.	303-794-9111
DC	Wash., Eastern Instr.	202-333-8880
Fla	Orlando, J. Highsmith	305-293-5202
Ill	Chicago, L. Green	312-286-6824
Ind	Indpls., L. Green	317-253-2087
Kans	Prairie Vlg., Engrg. Svcs.	913-649-4000
Md	Lanham, Brimberg Assocs., Inc.	301-552-2200
Mass	Needham, Addelco Corp.	617-444-4754
Mich	Detroit, H. Teplitz	313-537-9058
Minn	Mpls., L. F. Green	612-781-1611
Mo	St. Louis, Engrg. Svcs.	314-726-2233
NM	Albuquerque, Inter-Mountain Engrg. Co.	505-344-2212
NY	Great Neck, Meas. Tech.	516-482-3500
NY	Liverpool, R&D Assocs.	315-622-2350
Ohio	Cleveland, H. Teplitz	216-371-2044
Ohio	Dayton, H. Teplitz Co.	513-277-6531
Okla	Tulsa, Data Applications Corp.	918-622-3753
Pa	Phila., East Instrumentation Phila. Inc.	215-927-7777
Tex	Houston, Data Applications	713-622-2820
Tex	Richardson, Data Applications	214-231-4846
Tex	San Antonio, Data Applications	512-732-7176
Wash	Seattle, Arva, Inc.	206-622-0177

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Local Sales Offices & Reps.

Cal	Downey, Litton Servo Components Group	213-927-3335
Conn	Stamford, Talbe, Inc.	203-322-6570
Conn	Wilton, Talbe, Inc.	203-762-0577
Fla	Orlando, Triflex, Inc.	305-841-5440
Ill	Lemont, Talbe, Inc.	312-739-7844
NC	Bethania, Candor Co.	919-924-1480
Ohio	Dayton, Talbe, Inc.	513-253-5351
Okla	Tulsa, Carey, Wolf & Assocs.	918-622-9233
Tex	Fort Worth, Carey, Wolf & Assoc.	817-738-1702
Va	Lynchburg, Candor Co.	703-239-5265

POLYGON INDS. LTD., 50 Northline Rd., Toronto 16, Ont., Canada, Tel: 416-755-3301; Exp. S/M: A.A. Jones

POLYPHASE INSTR. CO., 126 E. Fourth St., Bridgeport, Pa., 19405, Tel: 215-279-4660; V.P. Sls: R.H. Simmons

POMONA ELCTRNS. CO., INC., 1500 E. 9th St., Pomona, Cal., 91766, Tel: 714-623-3463, TWX: 910-581-3822; Sls. Mgr: C.W. Musarra ..... Vol 3•710-765

Local Sales Offices & Reps.

Ala	Huntsville, South Eastern Assoc.	205-539-9816
Ariz	Phoenix, H.A. Moore Sls. Co.	602-CR-4-0060
Ariz	Scottsdale, DeAngelo, Rothman & Cheever, Inc.	602-947-8626
Cal	Beverly Hills, Intercontinental Aviation	213-274-7578
Cal	Culver City, DeAngelo,Rothman	213-398-6239
Cal	La Selva Bch., Belchamber & French	408-722-0444
Cal	Palo Alto, Engineering Assoc.	415-DA-6-7842
Cal	Pasadena, P. Nurches	213-681-8957
Colo	Aurora, AES, Inc.	303-EM-6-0208
Fla	No. Miami, L. Haas	305-949-9143
Ill	Lincolnwood, W.M. Linz	312-677-2000
Ind	Indianapolis, Blind & Assoc., Inc.	317-251-1249
Mass	Sharon, A Appell Assoc.	617-SU-4-3439
Mich	Kentwood, C. Geer	616-534-9449
Minn	Mpls., Northern States	612-866-3468
Mo	Crestwood, NEVCO	314-843-7406
Mo	Kansas City, NEVCO, Inc.	816-421-1751
NY	Flushing, Tobias	212-886-2020
Ohio	Cleveland, P. Lohse	216-381-4424
Pa	Philadelphia, D.S. Linz	215-ES-9-0734
SC	Greenville, H. C. Norman	803-244-6254
Tex	Dallas, Techno Assocs.	214-FL-7-9213
Wash	Seattle, R.K. Squibb	206-632-2450
For:	Can., Downsview, Ont., Electronetic Sys.	416-661-3673
For:	Can., Montreal, Que., Electronetic Sys.	514-342-4112
For:	Can., Ottawa, Ont., Electronetic Sys.	613-733-3781
For:	Can., Vancouver, B.C., A Deskin Sls. Corp.	604-324-6331

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Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr.	415-964-0820
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Diego, Shanks and Wright Inc., 2045 Kettner Blvd.	714-239-0176
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Md	Beltsville, Powell Elctrns/Washington, 10728 Hanna St.	301-937-4030
Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NJ	Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys.	609-662-4000
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Farmingdale, Harrison Elctnc., 20 Smith St.	516-293-7990
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ore	Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd	503-292-3534
Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA-9-1880
Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500

PORTER, H.K., INC., 74 Foley St., Somerville, Mass., 02143, Tel: 617-776-8200; V.P-Mktg: H.M. Webster

POSITRONIC INDS., 1906 S. Stewart, Springfield, Mo., 65804, Tel: 417-883-3434; Sls. Mgr: J.T. Gentry Vol 3•766

Local Sales Offices & Reps.

Ariz	Phoenix, Hecht, Henschen	602-275-4411
Cal	Canoga Park, Balzer/Wolf Assocs. Inc.	213-888-7432
Cal	Mountain View, G. Woempner Co.	415-964-5454
Conn	Fairfield, Schumacher & Yarrington	203-259-0772
Fla	Miami Beach, Geartner Assocs.	305-861-3661
Ill	Evanston, Rendell Sls. Co.	312-866-8060
Md	Baltimore, W. S. Warrington & Assoc.	301-823-8759
Mich	Warren, DEM Elctrn. Sls.	313-755-6660
Minn	Mpls., Furber	612-861-1518
Mo	Weldon Springs Hghts., Buckman Assocs.	314-623-4766
NJ	E. Orange, Masin-Esco, Inc.	201-674-6505
NJ	Moorestown, C & B Assocs.	609-546-4787
NY	Syosset, Masin-Esco, Inc.	516-364-0310
Ohio	Dayton, Myers Assoc.	513-435-1309
RI	Warwick, Schumacher & Yarrington	401-884-5671
Tex	Richardson, Zonk Engrg. Co.	214-238-7651

POSSIS CORP., 825 Rhode Island Ave., S., Minneapolis, Minn., 55426, Tel: 612-545-1471; Div. Mgr: G.H. Baillie

POTTER & BRUMFIELD, Div. AMF Inc., 1200 E. Broadway, Princeton, Ind., 47670, Tel: 812-385-5251, TWX: 812-291-4125; Sls. Mgr: D. Morrow Vol 2•845-869,Back Cover Vol 2

Local Sales Offices & Reps.

Ariz	Phoenix, Howe & Howe	602-264-7971
Cal	Los Altos, Recht	415-941-0336
Cal	Los Angeles, Black, Ekizian, Strong, Inc.	213-870-9191
Cal	San Diego, Black, Ekizian, Strong, Inc.	714-278-2150
Cal	San Juan Capistrano, Potter & Brumfield	714-493-4507
Colo	Littleton, Simpson Assocs.	303-798-8439
Conn	Canaan, G. M. Hathaway Elctrns.	800-225-1293
Fla	N. Miami Beach, Irby & Connolly	305-949-5197
Fla	Orlando, Irby & Connolly, Inc.	305-894-8471
Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Chicago, Balhorn & Welch, Inc.	312-889-5011
Ill	LaGrange Pk., Bierhaus Sls.	312-354-5100
Ind	Ft. Wayne, R. O. Whitesell	219-432-5591
Ind	Indpls, R. O. Whitesell	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assoc., Inc.	317-453-6868
Kans	Overland Park, Penzner-Mankus Assocs.	913-381-0004
Kans	Wichita, Penzner-Mankus Assocs.	316-522-4101
Ky	Louisville, R. O. Whitesell	502-893-7303
La	Chalmette, Cartwright & Bean, Inc. of Tenn.	504-279-4598
Mass	Arlington, Hathaway Elctrns.	617-646-1380
Mich	Detroit, Hilltronics	313-398-5556
Mich	St. Joseph, R. O. Whitesell & Assoc., Inc.	616-983-7337
Minn	Edina, Mel Foster	612-835-2255
Miss	Jackson, Cartwright & Bean, Inc.	601-354-1368
Mo	Hazelwood, Penzner-Mankus Assocs.	314-731-4334
NJ	Cherry Hill, J. McCoy	HA 8-3444
NM	Albuquerque, C. Carlberg	505-265-1579
NY	Buffalo, Ossmann Component Sls.	716-832-4271
NY	Garden Cy, Comtronic	516-PI-1-8966
NY	Kingston, Ossmann Comp. Sls.	914-338-5505
NY	Rochester, Ossmann Comp. Sls.	716-442-3290
NY	Syracuse, Ossmann Comp. Sls.	315-454-4477
NY	Vestal, Ossmann Comp. Sls. Corp.	607-785-9949
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Cincinnati, R. Whitesell	513-521-2290
Ohio	Cleveland, Scott Elctrns.	216-291-2600
Ohio	Columbus, Scott Elctrns.	614-236-8619
Ohio	Dayton, R. Whitesell	513-298-9546
Okla	Tulsa, Comps., Inc.	918-LU-3-9149
Pa	Camp Hill, Beil & Whittaker, Inc.	717-233-1254
Pa	Harrisburg, Beil & Whittaker	717-652-0184
Pa	Philadelphia, J. W. McCoy, Inc.	215-WA-2-7333
Pa	Pittsburgh, Scott Elctrns.	412-781-3112
Pa	Reading, Beil & Whittaker, Inc.	215-779-2610
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Tex	Houston, J. B. Guenther, Inc.	713-468-0232
Utah	Salt Lake City, Simpson Assocs.	801-521-3622
Va	Alexandria, Potomac Elctrns., Inc.	836-1630
Va	Richmond, Potomac Elctrns.	703-270-3682
Wash	Seattle, R. Johnston	206-524-5170
Wisc	Milwaukee, E. Dickinson	414-264-1080
For:	Can., Downsview, Ont., F. Eakin Ltd.	416-638-0451
For:	Can., Guelph, Ont., Potter & Brumfield	519-822-0390
For:	Can., Montreal, Que., Braydon Electro, Ltd.	514-341-3330
For:	Can., No. Vancouver, B.C., C. L. Thompson Ltd.	604-987-9388
For:	Can., Winnipeg, Manitoba, C. L. Thompson Ltd.	204-783-0848

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Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
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Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Hollywood, Hamilton/Avnet Elctrncs.	305-925-5401
Cal	Irvine, Cramer/L. A., 17201 Daimler St.	714-979-3000
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd.	415-961-7000
Cal	San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd.	714-279-1550, 279-2421
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Cal	Sunnyvale, Cramer/San Fran., 720 Palomar Ave.	408-739-3011
Colo	Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave.	303-287-9611
Colo	Denver, Burstein-Applebee	303-244-3336
Colo	Denver, Hamilton/Avnet Electronics	303-534-1212
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Fla	Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue	305-923-8181
Fla	Hollywood, Schweber Elctrns.	305-927-0511
Fla	Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214	305-894-1511

Ga Atlanta, Cramer/Atlanta, 3923 Oakcliff Industrial Court 404-448-9050
Ga Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd. 404-448-0800
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Chicago, Schweber Elctrns. 312-593-2740
Ill Mt Prospect, Cramer/Chicago, 1911 South Busse Road 312-593-8230
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Kansas City, Burstein-Applebee 816-561-5460
Kans Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St. 913-362-3250
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La Lafayette, Ralph's Inc., 3004 Cameron St. 318-234-4507
La New Orleans, Ralph's, Inc., 4334 Stemway Dr. 504-242-2731
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110
Md Hanover, Hamilton/Avnet Elctrns. 301-796-5000
Md Rockville, Schweber Elctrns. 301-881-2970
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Mich Detroit, Schweber Elctrns. 313-583-9242
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Ann, Interstate Ind Elctrn, 10525 St. Charles Rock Rd 314-428-8522
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Clifton, Eastern Radio, 312 Clifton Ave. 201-471-6600
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NJ Somerset, Schweber Elctrns. 201-469-6008
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY East Syracuse, Cramer/Syracuse, 6716 Joy Road 315-437-6671
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Hauppauge, Cramer/Systems, 29 Oser Ave. 516-231-5682
NY Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue 516-231-5682
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
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Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
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RCA SOLID STATE DIV., Thyristors & Rectifiers, Rte. 202, Somerville, N. J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Eng. Ldr., Thyr. Appl: T. McNulty; Mktg. Mgr: W.E. Wagner ..... Vol 4•436*

RCA SOLID STATE DIV., Transistors, Rte. 202, Somerville, N. J., 08876, Tel: 201-722-3200, TWX: 710-480-9333; Mgr. Pwr. Trans. Appl: D. Baugher; Consumer: P.R. Thomas; Ind'l: G. Scholes
Vol 4•436*

RCA Local Distributors
Kans Kansas City, Burstein-Applebee 816-561-5460

RCA SERVICE CO., Tech. Prods. Svc. Div. RCA Corp., Bldg. 204-2, Cherry Hill, Camden, N.J., 08101, Tel: 609-963-8000, TWX: 710-892-0905; Sls. Mgr: B.L. Grossman

RCL ELCTRNS., INC., 700 S. 21st St., Irvington, N.J., 07111, Tel: 201-374-3311, TWX: 710-999-5511; Sls. Coord: G.W. Zabel
Vol 2•1128-1131; Vol 3•1002,1003,1163-1167

Local Sales Offices & Reps.
Ala Huntsville, Interep 205-881-3677
Ariz Phoenix, Gramer & Co. 602-279-1231
Cal Torrance, O'Donnell Assocs. 213-323-9243
Colo Wheatridge, Waugaman 303-423-1020
Conn No. Haven, Kitchen & Kutchin 203-239-0212
Fla Altamonte Springs, Semtronic Assocs. 305-831-8233
Fla Ft. Lauderdale, Semtronic Assocs. 305-566-9917
Fla Tampa, Semtronic 813-886-4825
Ill Chicago, Gassner & Clark 312-764-6121
Ind Indianapolis, L. DeVoe 317-257-1227
Iowa Hiawatha, Gassner & Clark 312-764-6121
Kans Overland Park, Ensco-Rep 913-381-7557
Md Baltimore, Burgin-Kreh 301-788-5200
Mass Lexington, Kitchen & Kutchin 617-862-8230
Mich Farmington, Davis-Martenson 313-474-8300
Minn Minnetonka, T. Ayre 612-474-4125
Mo St. Louis, Ensco-Rep 314-543-3935
NJ Haddonfield, T.A.I. 609-854-3011
NJ Irvington, MGI 201-399-4350
NY Rochester, W. Zimmerman 716-586-4450
NY Syracuse, W.H. Zimmerman 315-474-4889
NC Winston Salem, Burgen-Kreh 919-768-4174
Ohio Cleveland, KW Elctrn. Sls. 216-831-8292
Ohio Dayton, KW Elctrn. Sls. 513-890-2150
Okla Oklahoma City, Ammon & Rizos 405-947-1051
Ore Portland, Almac/Stroum 503-292-3534
Pa Waterford, KW Elctrn. Sls. 814-796-6714
Tex Dallas, Ammon & Rizos 214-233-5591
Tex Houston, Ammon & Rizos 713-729-1233
Va Lynchburg, Burgin-Kreh 703-845-5600
Wash Seattle, Almac/Stroum 206-763-2300
For: Alaska, Almac Stroum 206-232-8228
For: Can., Brit. Ca., Almac/Stroum (Portland) 503-292-3534
For: Can., Malton, Ont., S. Hooker 416-677-3554
For: Can., Montreal, Que., S. Hooker 514-487-5151

RCL Local Distributors
Cal Hollywood, Hamilton/Avnet Elctrncs. 305-925-5401
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300

RDF CORP., 23 Elm Ave., Hudson, N.H., 03051, Tel: 603-882-5195, TWX: 710-228-1882; Sls. Mgr: R.S. Warnick; Mgr. Spec. Prod: D.J. O'Connor

RE-EL CIRCUITS, INC., 520 Victor Street, Saddle Brook, N.J., 07662, Tel: 201-843-3738; V.P. Sls: G. Snedecor
Vol 1•320

Local Sales Offices & Reps.
NY E. Northport, Jarms Assoc. 516-368-4096

RECORDER SYSTEMS DIV., Gulton Inds., Inc., Gulton Industrial Park, E. Greenwich, R.I., 02818, Tel: 401-884-6800, TWX: 710-387-1500; Sls. Mgr: T. Tuccillo Vol 1•541

RECORDER Local Distributors

Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400

RECTIFIER COMPS. CORP., 1112 Lousons Rd., Union, N.J., 07083, Tel: 201-687-5410; Sls. Mgr: E.H. Pollacek Vol 2•925; Vol 4•527*

Local Sales Offices & Reps.

Ill	Chicago, Lightner	312-SP-4-1500
Ill	Chicago, M & S Sls.	312-992-1053
Md	Phoenix, Cunningham & Assoc.	301-823-4220
Mass	Needham Hgts., Todino Engrg.	617-HI-4-7925
Mich	Detroit, A. Blumenberg	313-557-1934
NJ	Haddonfield, Gray Assoc.	609-429-5300
NJ	Ridgewood, Ballou	201-444-6990
NY	Syracuse, N. Matchuk	315-488-3251
Wash	Seattle, W. Spaulding Co.	206-282-9173

RED POINT CORP., 105 W. Spazier, Burbank, Calif., 91503, Tel: 213-842-4895; Sls. Mgr: R.P. Craig

REDACTRON CORP., 100 Parkway Dr. S., Hauppauge, N.Y., 11787, Tel: 516-543-8700; OEM Sls. Mgr: T. Reantillo; OEM: S. Glasser

REDINGTON COUNTERS, INC., 130 Addison Rd., Windsor, Conn., 06095, Tel: 203-688-6207; Sls. Mgr: T. Nelson

REED DEVICES, INC., 21 W. 183 Hill Ave., Glen Ellyn, Ill., 60137, Tel: 312-858-2050; Sls. Mgr: H.J. Roeser Vol 3•769

Local Sales Offices & Reps.

Ariz	Tempe, G. R. McKnight Co.	602-949-0809
Ark	Little Rock, Ransom Sls. Co.	501-225-7332
Cal	Menlo Park, G. R. McKnight Co.	415-325-2844
Cal	Woodland Hills, Cummings	213-340-6035
Fla	Tampa, S. K. Wallace Assoc.	813-932-3568
Ga	Atlanta, A. Brown Assoc.	404-457-6381
Ill	Glen Ellyn, Rockford Controls	312-469-6016
Kans	Wichita, Avionics	316-264-6201
Mich	Brighton, H. H. Barnum Co.	313-229-2961
Mich	Lowell, H. H. Barnum Co.	616-897-9686
Minn	Minneapolis, Automated Controls	612-377-7727
Miss	Jackson, Ransom Sls. Co.	601-353-0707
Mo	St. Louis, Miller Assocs.	314-355-1642
NH	Nashua, Bell Controls	603-882-6984
NJ	Clifton, Grimm, Siegel Assoc.	201-546-5010
NY	Buffalo, H.C. Johnson Ags.	716-632-7880
NY	Fayetteville, H.C. Johnson Ags.	315-637-9383
NY	Guilderland, H.C. Johnson Ags.	518-456-9681
NY	Plainview, Grimm, Siegel Assoc.	516-938-9721
NY	Rochester, H.C. Johnson Ags.	716-482-3000
NC	Greensboro, S. K. Wallace Assoc.	919-292-0487
Ohio	Columbus, Rockford Controls Ohio	614-231-5890
Ohio	Dayton, Rockford Controls Ohio	513-278-7362
Ohio	Euclid, Rockford Controls Ohio	216-731-5250
Pa	Elkins Park, K. B. Erdman Co.	215-224-1833
Tenn	Memphis, Ransom	901-332-0036
Tex	Dallas, Carey & Assoc.	214-363-7813
Tex	Houston, Carey & Assoc.	713-869-3623
Utah	Salt Lake City, D. W. Stuart & Co.	801-466-8605
Wash	Seattle, R. Johnston & Co.	206-524-5170

REED Local Distributors

Ark	Little Rock, Carlton-Bates Co., 6821 Scott Hamilton Dr	501-562-9100
Cal	Los Angeles, Electro Component Dist., 122 S. Mission Blvd	213-264-7100
Colo	Denver, Mundix Co., 5495 Marion	303-893-2390
Conn	Hartford, Hartford Elec. Supply Co., 571 New Park Ave	203-233-3694
Fla	Davie, Newark Elctrns, 7200 Griffin Rd.	305-587-2372
Ga	Macon, Wilson Elec. Co., 557 Pine	912-746-5654
Ill	Chicago, Newark Elctrns, 500 N. Pulaski Rd.	312-638-4411
Ill	Chicago, Revere Elec. Supply Co., 2501 W. Washington Blvd	312-738-3636
Ill	Peoria, Klaus Radio & Elec. Co., 8400 N. Pioneer Pkwy	309-691-4840
Ill	Rockford, Mid-West Associated, 225 S. 6th St	315-964-4657
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Iowa	Moline, Otis, Jim & Assocs. Inc., 4520 River Dr.	309-762-9311
Kans	Wichita, Interstate Elec. Supply Co., Box 2018, 230 IDA	316-264-6317
La	Shreveport, Ind'l. Elctrn Supply, 2422 Southern Ave	318-422-9459
Mass	Cambridge, Apollo Elctrns, Inc., 101 Binney St	617-868-3120
Mich	Augusta, Great Lakes Elctrns, Box 217	616-731-4156
Mich	Oak Park, Newark-Detroit Elec., Inc., 20700 Hubbell Ave.	313-548-0250
Minn	Minneapolis, Control Design, Inc., 3433 E. 25 St	612-721-1629
Mo	Kansas City, Barr-Thorpe, 2601 Madison Ave	816-531-8840
Mo	St. Louis, Olive Ind'l Elctrns Inc, 6662 Olive Blvd	314-863-7800
Neb	Lincoln, Scott Elctrn Supply Corp., 4040 Adams St	403-434-8308
NJ	Jersey City, Cuny-Guerber, Inc., 3468 Kennedy Blvd	201-227-7722
NJ	So. Plainfield, Brownell-Electro Inc., 500 Hadley Rd. & Durham Ave	201-753-4600
NY	No. Syracuse, Control Comps., 401 Fay Rd.	315-458-6709
NY	Rochester, Requa Elec Supply Co., 2005 Brighton Henrietta	716-442-2020
NY	Schenectady, Adirondack Elctrns Inc., Box 147, Brandywine Sta.	518-346-4717
NC	Winston-Salem, Kirkman Elctrns., Inc., 901 W. Second St.	919-724-0541
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Cincinnati, Mytronics, 1843 N. Reading Rd	513-733-1661
Ohio	Columbus, E/M Equipment Co., 3492 E. Fulton St	614-236-0880
Ohio	Dayton, ESCO, 221 Crane St.	513-224-9192
Ohio	Dayton, J. A. Becker Co., 1341 E. 4th St.	513-224-1071
Ohio	Dayton, Stotts-Friedman Co., 108 N. Jefferson St	513-224-1111
Ohio	Solon, REPCO, 6835 Cochran Rd.	216-248-8900
Okla	Tulsa, Radio Inc., 1000 S. Main St.	918-587-9123
Ore	Eugene, Vitus Elec. Supply Co., 140 E. Fifth Ave	503-345-4377
Ore	Portland, Consolidated Elec Distr., Inc., 2053 NW Upshur	503-224-3200
Ore	Portland, Platt Elec. Supply Co., 1305 N.W. Davis	503-222-9633
Tex	Dallas, All State OEM, 510 S. Good Latimer	214-651-0242
Tex	Denison, Denison Radio Supply, 310 W. Woodard St	214-465-2336
Tex	Houston, Lenert Co., Box 2184	713-225-1465
Tex	Houston, Nunn Elec Supply, 2221 Canada Dry	713-928-5511
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Utah	Salt Lake City, Stuart Elec Supply Co., 2999 South 2nd W	801-466-8605
Wash	Seattle, Radar Electric Co., 168 Western Ave., W.	206-282-2511
Wash	Spokane, Industrial Instr. Supply, E. 2121 Riverside	509-534-9353
WVa	So. Charleston, Allied Controls Co., 4842 Mac Corcle Ave. SW	304-768-7313
Wisc	Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd.	414-545-6500
Wisc	Milwaukee, Parts Mart, 1314 N. 7th	414-276-4160

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

REED SWITCH DEV. CO., 34 Lincoln Ave., Greenwich, Conn., 06830, Tel: 203-661-9410; Pres: J.S. Hammond

REEVES-HOFFMAN DIV., Dynamics Corp. of Amer., 400 W. North St., Carlisle, Pa., 17013, Tel: 717-243-5929, TWX: 510-650-3510; VP Sls: J.D. Harlin Vol 2•444,445

Local Sales Offices & Reps.

Cal	Hollywood, Westaironics	714-831-2369
Cal	Santa Clara, L & M Assocs.	408-243-2891
Fla	Winter Park, Semtronics Assocs.	
Ill	Deerfield, Hutchinson Assocs.	
Iowa	Cedar Rapids, Seltec Sls.	
Md	Baltimore, R. F. Assocs.	
Mass	Wakefield, H. Jappe Co.	
Mich	Farmington, W. R. Hummon & Assoc.	
Mo	St. Louis, Engrg. Svcs. Co.	
NJ	Ridgefield, G. M. Moch Co.	
NY	E Aurora, E.A. Kershaw & Co.	
NC	Bethania, Candor Co.	
Ohio	Cincinnati, Tri-State Mktg.	
Pa	Philadelphia, C.H. Newson & Assoc.	
Tex	Dallas, G. Weinreich & Assoc.	

REGENCY ELCTRNS., INC., 7707 Records St., Indianapolis, Ind., 46226, Tel: 317-547-3581; V.P. Sls. Mgr: A. Harling

REGENCY Local Distributors

Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565

RELAY SERVICE CO., 1310 N. Pulaski Rd., Chicago, Ill., 60651, Tel: 312-AL-2-2700; Sls. Mgr: C. H. Badger

RELAY SPECIALTIES INC., 1300 Plaza Rd., Fair Lawn, N.J., 07410, Tel: 201-797-3313; Adv. Mgr: J.G. Sauer; Sls. Mgr: S. Gershberg

RELCO PRODS., 5594 E. Jefferson Ave., Denver, Colo., 80237, Tel: 303-756-1143; Pres: R.A. Ruehle

RELCOM (DIV. WATKINS-JOHNSON), 3333 Hillview Ave., Palo Alto, Calif., 94304, Tel: 415-326-8830, TWX: 910-379-6979; Sls. Mgr: J.B. Cochrane

Local Sales Offices & Reps.

Cal	Los Angeles, Cain & Co.	213-476-2251
Va	Fairfax, Schibley Assocs.	703-591-3008

RELIANCE ELEC. CO., 24701 Euclid Ave., Cleveland, Ohio, 44117, Tel: 216-266-7000, TWX: 216-486-5630; Advtg. Mgr: A.G. Conway

REMEX, Ex-Cell-O Corp., 1733 Alton St., Santa Ana, Cal., 92705, Tel: 714-557-6860, TWX: 910-595-1715; Gen. Sls. Mgr: W.E. Walker

Local Sales Offices & Reps.

Ala	Huntsville, Gentry	205-536-5306
Ariz	Scottsdale, BFA Corporation of Arizona	602-946-4215
Cal	Irvine, Moxon, Inc.	714-833-2000
Colo	Denver, BFA Corp. of Ariz.	303-744-3301
Conn	Hartford, Victor Assoc.	203-246-5643
Fla	Orlando, Gentry Assocs.	305-894-4401
Ill	Chicago, SEA, Inc.	312-282-6694
Ind	Carmel, SEA, Inc.	317-846-2593
Kans	Leavenworth, Midwest Mktg. Assoc.	913-651-2929
Md	Silver Spring, Ron Davies Assoc.	301-587-3910
Mass	Framingham, Victor Assoc.	617-879-5710
Mich	Livonia, Dietrich & Assocs.	313-961-4540
Minn	Mpls., SEA, Inc.	612-425-4455
Mo	Florissant, Midwest Mktg. Assoc.	314-831-0342
NJ	Ridgewood, Hansen Assocs.	201-652-7055
NM	Las Cruces, BFA Corp. of Arizona	505-523-0601
NY	New York, Hansen Assocs.	212-947-0379
NY	Ogdensburg, Whittaker Elctrns., Ltd.	315-393-0710
NY	Rochester, Ossmann Instrs.	716-328-2230
NY	Syracuse, Ossmann Instr.	315-437-6666
NY	Vestal, Ossman Instrs.	607-785-9947
NY	Wappinger Falls, Ossmann Instr.	914-297-7777
Ohio	Cleveland, Dietrich & Assocs.	216-781-1885
Ohio	Dayton, Dietrich & Assocs.	513-223-6042
Pa	Pittsburgh, Dietrich & Assocs.	412-892-2992
Pa	Wayne, Emlen-Peterson	215-687-3535
Tex	Dallas, Data Mktg.	214-358-4646
Tex	Houston, Data Mktg.	713-686-9627
Tex	San Antonio, Data Mktg.	512-344-3993
Utah	Denver, BFA Corp. of Ariz.	303-744-3301
Wash	Seattle, R. Drake	206-763-2755
Wisc	Waukesha, S-E-A, Inc.	414-547-6637
For:	Can., Downsview, Ont., Whittaker Elctrns.	416-247-7454
For:	Can., Ottawa 5, Ont., Whittaker Elctrns	613-224-1221
For:	Can., Roxboro, Que., Whittaker Elctrns.	514-683-3621
For:	Can., W. Vancouver, B.C., Whittaker Elctrns., Ltd.	604-926-3411

RENBRANDT, INC., 6 Parmelee St., Boston, Mass., 02118, Tel: 617-445-8910; Sls. Mgr: M. Rogers

RENCO CORP., 26 Coromar Ave., Goleta, Cal., 93017, Tel: 805-968-1525, TWX: 910-334-1180; Mktg. Mgr: R. Hotchin ..... Vol 1•370

Local Sales Offices & Reps.

Ala	Huntsville, Technical Sls.	205-881-1750
Cal	Concord, Dunfred Tech. Prods.	415-682-5038
Cal	Sante Fe Sps., Sls. Engrs.	213-921-4337
Ill	Chicago, Electro Tech Mktg. Assoc.	312-588-4535
Ind	Ft. Wayne, McDonald Sls.	219-745-9214
Ind	Indpls., Holsapple & Assoc.	317-894-0513
Mass	Andover, Mech-Tron Co.	617-475-1766
Mich	Detroit, Ridgway East	313-538-3940
Ohio	Chagrin Falls, Ridgway East	216-247-4845
Ohio	Loveland, Ridgway East	513-683-4350
Tex	Dallas, IBL Engrg. & Sls.	214-363-2921
Wash	Seattle, Thorson Co.	206-632-0710
Exp:	Schenectady, NY, EMB Elctrns.	518-372-5841

REON RESISTOR CORP., 420 Lincoln Highway, Frazer, Pa., 19355, Tel: 215-647-5420, TWX: 510-668-8463; Prod. Sls. Mgr: N. Lukens; Tech. Oper: J. Mulqueen; Nat'l. Sls. Mgr: Edw. L. Beaudry ..... Vol 4•503*

Local Sales Offices & Reps.

Cal	Culver City, DeAngelo & Rothman	213-398-6239
Fla	Ft. Lauderdale, G. F. Bohman Assoc.	305-564-3081
Fla	Orlando, G. F. Bohman Assoc.	305-855-0274
Ill	Des Plaines, Coombs Assoc., Inc.	312-298-4830
Ind	Ft. Wayne, Coombs Assoc.	219-747-0402
Iowa	Cedar Rapids, Reid Assoc., Inc.	319-362-6302
Md	Towsen, J. A. Dougherty	301-823-0431
Mass	Canton, New England Elctrn. Sls.	617-828-4835
Mo	St. Louis, Coombs Assoc.	314-567-3399

NJ Englewood Cliffs, Sprung/Nussbaum 201-947-6767
NM Albuquerque, C. T. Carlberg Assoc. 505-265-1579
NC Winston-Salem, L. G. White Southern, Inc. 919-725-3612
Ohio Cincinnati, Components, Inc. 513-721-2997
Ohio Cleveland, Components, Inc. 216-842-2737
Ore Portland, J. V. BeLusko Co. 503-222-4279
Pa Phila., PSA 215-722-8222
Tex Dallas, Stasco 214-239-5054
For: Can., Etobicoke, Space Elctrns. 416-677-5172
For: Can., Montreal, Space Elctrns. 514-735-1108
For: Can., Montreal, Que., Space Elctrns. 514-735-1108
For: Can., Ottowa, Space Elctrns. 613-745-6300

REON Local Distributors
Md Hanover, Hamilton/Avnet Elctrns. 301-796-5000

REPUBLIC ADVANCED SYSTEM TECHNOLOGY GROUP, 9754 Deering St., Chatsworth, Calif., 91311, Tel: 213-341-9200; Sls. Mgr: W. Morgan

REPUBLIC ELCTRNS. CORP., 176 E. 7th St., Paterson, N.J., 07524, Tel: 201-279-0300, TWX: 710-988-5908; Sls. Mgr: G. Wolter ..... Vol 3•495

Local Sales Offices & Reps.
Cal Los Angeles, Trepco 213-641-7411
Cal Mount View, Melchior/Wesley Assoc. 415-964-2321
Cal Santee, Advanced Tech. Sls. 714-448-8986
Fla Miami Beach, Geartner 305-861-3661
Fla Orlando, Geartner 305-299-1000
Ill Chicago, Ropek & Cahill 312-287-7292
Ind LaFontaine, Kirsch Sls. 317-981-2801
Iowa Cedar Rapids, J.R. Sales Engrg. 319-377-8211
Kans Leawood, Vasen Sls. 913-649-0679
Md Bethesda, W. Mount Co. 301-657-9312
Mass Cambridge, Vector Sls. 617-491-5700
Minn Hopkins, Grayden & Flemmer 612-941-1120
NJ Paterson, Mucon Corp. 201-279-0300
NJ Wallington, Comp-Tech Sls. 201-935-5454
NY Liverpool, J.L. Semple Assoc. 315-457-1188
NY New Hyde Park, Comp-Tech. Sls. 516-593-2628
NY Rochester, J.L.Semple Assoc. 716-342-1413
NC Charlotte, J. Rudisill Assocs. 704-377-6901
Ohio Columbus, T. Mulligan & Assoc. 614-457-2242
Okla Tulsa, H.J. Daly Co. 918-627-4159
Pa Ardmore, Rothenheber & Wurts 215-649-6300
Wash Seattle, Blum & Assoc. 206-782-1600

REPUBLIC Local Distributors
Cal No. Hollywood, Distro Inc., 12517 Burbank Blvd. 213-980-8888

RESDEL CORP., Bldg. #22-County Airport, Rio Grande, N.J., 08242, Tel: 609-886-1111; Pres: W. Taylor

RESDEL ENGRG. CORP., 300 E. Live Oak Ave., Arcadia, Cal., 91006, Tel: 213-684-2600, TWX: 910-582-3219; Sls. Mgr: W.C. Neil, Jr.

RESEARCH DEVICES, 616 Springfield Ave., Berkeley Heights, N.J., 07922, Tel: 201-464-0668; Sls. Mgr: B.G. Cohen

RESEARCH, INC., Box 24064, Minneapolis, Minn., 55424, Tel: 612-941-3300, TWX: 612-292-4066; Sls. Mgr: J.M. Law

RESEARCH PRODS. CORP., 1015 E Washington Ave., Madison, Wisc, 53701, Tel: 608-257-8801; Sls. Mgr: V.J. Hellenbrand

RESISTANCE PRODS., 914 S. 13th St., Harrisburg, Pa., 17104, Tel: 717-236-5081, TWX: 510-650-4920; Ch. Eng: G. Wachtman; Prod. Eng: G. Schmutz Vol 3•1160-1162

Local Sales Offices & Reps.
Ariz Scottsdale, Fred Board Assocs. 602-949-9561
Cal Mountain View, G.C. Woempner 415-964-5454
Cal San Marino, Van Gott & Assoc. 213-282-1125
Colo Denver, Walter Engrg. Assoc. 303-777-5585
Ill Bellwood, Fiat Engrg. Assoc. 312-547-6200
Ind So Bend, Valentine-Schillinger Co. 219-291-6258
Kans Leawood, Vasen Sls. Co. 913-649-0679
Mass Canton, New England Elec. Sls. Co. 617-828-4835
Minn St. Paul, Furber Sales 612-861-1518
Mo St. Louis, Vasen Sls. Co. 314-725-5219
NY Floral Park, Mos Assocs. 516-694-5923
NY Syracuse, C. W. Floring & Assoc., Inc. 315-478-2149
Ohio Wickliffe, D. Steffen Assocs. 216-944-8080
Pa Flourtown, Avenir 215-836-4400
Tex Dallas, MMS Comps. 214-357-6893
Wash Seattle, D. Smith Sls. Co. 206-633-3160
Exp: N.Y., Westbury, Minthorne Int'l. Co., Inc. 516-334-3303
For: Can., Markham, Ont., Wilson Enterprises 416-231-7536
For: Can., Roxboro, Que., Wilson Ent. 514-684-0383

RESISTORS, INC., 5226 W. 26th St., Chicago, Ill., 60650, Tel: 312-652-7555 ..... Vol 3•1168

Local Sales Offices & Reps.
Cal Los Angeles, W. S. Harmon Co. 213-937-1460
Cal Palo Alto, W. Tompkins 415-DA-6-7940
Conn Berlin, White Sls. Co. 203-224-0423
Ill Chicago, L-Tec, Inc. 286-1500
Iowa Cedar Rapids, J.R. Sls. Engrg. 319-EM-5-2864
Kans Overland, Penzner Assocs., Inc. 913-DE-1-0004
Mass Needham, White Sls. Co. 617-444-3676
NJ Moorestown, A. Foley Assocs. 609-663-4545
NY Buffalo, J.J. Glass 716-TL-6-9272
NY N.Y., Symon Assocs. 212-PL-7-3638
Ohio Vandalia., W. Brauer & Assocs. 513-898-1224
Ohio Wickliffe, W. Brauer & Assocs. 216-943-0601
Pa Pittsburgh, W. Brauer & Assocs. 412-921-3213
Tex Garland, Whiteside Sls. Co. 214-BR-6-8382
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REVERE ELCTRN. DIV., Neptune Meter Co., 845 N. Colony Rd., Wallingford, Conn., 06492, Tel: 203-269-7701, TWX: 710-476-3197; V. P: G.W. Grace

REYNOLDS INDS., INC., Box 1170, Marina Del Rey, Cal., 90291, Tel: 213-823-5491; Salesman: J. Densmore; Salesman: J. Spratt; Salesman: J. Korbel

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NJ Moorestown 609-234-0613
Tex Dallas, Elcom Co. 214-352-5006

REYNOLDS METALS CO., Box 27003, Richmond, Va., 23261, Tel: 703-282-2311, TWX: 710-956-0112; Mkt. Mgr: G.E. Lennox; Prod. Dir: G.J. Wirth

RF INTERONICS, 100 Pine Aire Dr., Bay Shore, N.Y., 11706, Tel: 516-231-6400, TWX: 510-227-6233; Sls. Adm: R.W. Fitzpatrick ..... Vol 2•578

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Cal Alhambra, M.W. Riedel & Co. 213-283-7694
Cal San Mateo, Melvin Sls. 415-349-7444
Colo Denver, Williams-Assocs. 303-343-2911
Fla Hollywood, Tech-Rep Assocs. 305-962-8860
Fla Indian Rocks Bch., Tech-Rep. 813-595-2834
Fla Melbourne, Tech-Rep. Assoc. 305-723-9140
Ga Huntsville, Tech-Rep Assocs. 205-881-5925
Ill Oak Park, J. Popp Sls. Co. 312-626-3711
Ind Ft. Wayne, Ryan Sls. 219-483-9567
Kans Overland Pk., ENSCO-REP 913-381-7557
Md Rockville, Mechtronics 301-340-2130
Mass Wakefield, Measurement Equip. Co. 617-245-4870
Mich Cleveland, Forrest G. Mahannah 216-561-3024
Mo St. Louis, ENSCO-REP 314-542-3935
NJ Cherry Hill, H. J. White Co. 609-428-4544
NM Albuquerque, Williams-Assocs. 505-255-1638
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Ohio Tipp City, TEC-COM 513-667-1216
Tex Richardson, The Mero Corp. 214-234-3365
Exp: New York, N.Y., Ad. Auriema, Inc. 212-466-2516

RF SYSTEMS, INC., 155 King St., Cohasset, Mass., 02025, Tel: 617-383-1200; V. Pres.-Sls: J.E. Hayes; V. Pres. Adm: R.E. Gallinger

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Ariz Scottsdale, Williams 602-947-4297
Cal San Pedro, IFM Inc. 213-547-0829
Colo Denver, Williams Assocs. 303-388-4391
Fla Ft. Lauderdale, Lee Assocs. 305-771-3761
Fla Orlando, Lee Assocs. 305-241-4445
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Haw Honolulu, Aloha Assocs. 808-941-1574
Ill Des Plaines, Marsland 312-298-2620
Ind Indpls, Marsland 317-924-3568
Mass Needham Hgts., Cowperthwait & Brodhead 617-444-9410
Mich Farmington, Carter, McCormic & Pierce, Inc. 313-477-7700
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NJ Bordentown, Dyna Rep Co. 609-298-6700
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NY Latham, L-Tron Corp. 518-785-5032
NY Tonawanda, L-Tron 716-691-8887
NC Raleigh, Lee Assocs. 919-787-5818
Ohio Cleveland, Carter, McCormic & Pierce 216-333-5650
Ohio Dayton, Carter, McCormic & Pierce 513-278-5873
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Cal San Pedro, IFM Inc. 213-547-0829
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Ga Atlanta, Brownell Electro Inc., 3026 Commerce Way 404-762-5181
Mass Boston, Sager Elec. Sup. Co., 172 High St. 617-542-2281
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Mass Needham Heights, Instruments Inc., 570 Hillside Ave. 617-444-9410
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Cal San Diego, Cain 714-461-1033
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Ind Indianapolis, RF Spl. 317-783-7630
Md Annapolis, Hayden Assoc. 202-296-6059
Mass Reading, Geder & Rotundi Assoc. 617-944-3105

NJ Livingston, G & A 201-992-3087
NJ Moorestown, M. Lader 609-234-0661
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NY Rochester, KLM Assocs. 716-442-0820
NY Syracuse, KLM Assocs. 315-458-6214
NC Burlington, Gentry 919-227-2581
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Mass S. Chelmsford, I M R 617-256-8251
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NJ Plainview, Central Assoc. 516-433-0808
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Cal So. San Francisco, Robertshaw Controls 415-871-7767
Cal Taft, Oilfield Controls, Inc. 805-763-1561
Colo Denver, Peterson Co. 303-388-6322
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Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

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Mass Woburn, Jalco Assocs. 617-227-1515
NY Lynbrook, H.B. Heft Assocs. 516-599-3351
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Ill Chicago, Carter Elctrns. 312-585-5485
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Mass Newton, Instrument Conslts. 617-969-9881
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Minn Minneapolis, Carter Elctrns. 612-544-9393
Mo Hazelwood, Carter Elctrns. 314-731-2237
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NY Syracuse, Scientific Devices 315-457-7420
Ohio Cleveland, WKM Assocs. 216-267-0445
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Tex Dallas, Data Mktg. Assoc. 214-358-4643
Tex Houston, Data Mktg. 713-686-9627
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NJ Springfield, F. F. Sylvester Assoc. 201-376-3324
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Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
Mo	Kansas City, Burstein Applebee	816-561-5460
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
Neb	Lincoln, Burstein Applebee	402-434-0678
NJ	Moorestown, Arrow Elctrns., Pleasant Valley Rd.	609-235-1900
NJ	Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys.	609-662-4000
NJ	Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave.	201-797-5800
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110	516-694-6800
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Cleveland, Arrow Elctrns., 23945 Merchantile Rd.	216-464-2000
Ohio	Cleveland, Pattison Supply Co., 4550 Willow Pkwy.	216-441-3000
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Dayton, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Ohio	Solon, REPCO, 6835 Cochran Rd.	216-248-8900
Okla	Tulsa, Oil Capitol Elec., 708 S. Sheridan	918-836-2541
Pa	Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave	
Pa	Erie, Mace Elctrn., 2631 W. 8th St.	814-838-3544
Pa	Philadelphia, Simco Inc., 3907-11 N. Broad St.	215-BA-9-1880
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St	817-335-6521
Tex	Houston, Geophysical Supply Co., Box 52230	713-224-0621
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
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Ohio	Cleveland, Component/Insulation

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Local Sales Offices & Reps.

Ariz	Phoenix, Hytronics Measurements, Inc.	602-253-6104
Cal	Inglewood, J. Berman Co.	213-678-1281
Cal	Oakland, Moulthrop Sls. Inc.	415-261-7676
Colo	Denver, Hytronic Measurements, Inc.	303-388-4081
Fla	Orlando, Cartwright & Bean	305-896-2031
Fla	Plantation, Cartwright & Bean	305-791-3989
Ga	Atlanta, Cartwright & Bean	404-237-2273
Ill	Chicago, GNB Assocs., Inc.	312-673-4050
Ill	Chicago, Sola Electric	312-439-2800
Ind	Fort Wayne, Baehr, Greenleaf & Assoc. Inc.	219-483-6864
La	Chalmette, Cartwright & Bean	504-279-4598
Md	Silver Spring, NKA, Inc.	301-585-6141
Mass	Norwood, JMG, Inc.	617-762-5333
Mich	Detroit, R.C. Merchant & Co., Inc.	313-535-6000
Mich	St. Joseph, R. C. Merchant & Co.	616-983-7378
Minn	Minneapolis, Stack-Johnson	612-925-2111
Miss	Jackson, Cartwright & Bean, Inc.	601-354-1368
Mo	Kansas City, Forristal-Young Sls. Co.	816-358-6771
Mo	St. Louis, Forristal-Young Sls. Co.	314-645-2360
NJ	Cherry Hill, Trinkle Sls.	609-667-3500
NM	Albuquerque, Hytronic Measurements, Inc.	505-268-3941
NY	Mineola, Willco Sls.	516-294-9840
NY	Rochester, L-Mar Assocs.	716-328-5240
NY	Rochester, Sola Electric	716-288-2230
NC	Charlotte, Cartwright & Bean	704-333-6457
NC	Raleigh, Cartwright & Bean	919-832-7128
Ohio	Cincinnati, Baehr, Greenleaf & Assoc. Inc.	513-891-3826
Ohio	Cleveland, Sola Electric	216-521-8038
Ohio	Columbus, Baehr, Greenleaf & Assoc. Inc.	614-486-4046
Ohio	Lakewood, Baehr, Greenleaf & Assoc. Inc.	216-221-9030
Ore	Portland, Earl & Brown Co.	503-292-9145
Tenn	Memphis, Cartwright & Bean	901-276-4442
Tex	Dallas, R.E. Nesbitt Co.	214-357-4601
Tex	Houston, R. E. Nesbitt Co.	713-224-3633
Utah	Salt Lake City, Hytronics Measurements, Inc.	801-466-4924
Wash	Seattle, Earl & Brown Co.	206-284-1121

SOLA Local Distributors

Ala	Birmingham, J.W. Clary Co., 1713 Second Ave. S.	205-322-2488
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
Ill	Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.	
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Kans	Kansas City, Burstein-Applebee	816-561-5460
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	Lafayette, Ralph's Inc., 3004 Cameron St.	318-234-4507
Md	Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd.	301-823-0070
Mass	Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy.	617-491-3300
Mich	Muskegon, Western Elctrn Supply, 1781 5th St	616-722-7628
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
Mo	Kansas City, Burstein Applebee	816-561-5460
Neb	Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St.	402-341-7700
NJ	Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22	201-376-8900
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd.	716-328-3230
Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Ohio	Akron, Sun Radio Co., 110 E. Market St.	216-HE-4-2171
Ohio	Cincinnati, United Radio Co., Summit & Reinhold Dr.	800-582-7080
Ohio	Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St.	216587-3600
Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900
Ohio	Solon, REPCO, 6835 Cochran Rd.	216-248-8900
Ohio	Warren, REM Elctrns. Supply Co., 264 W. Market St.	216-399-2777
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Houston, Harrison Equip. Co. Inc., 1616 McGowen St.	713-224-9131
Utah	Salt Lake City, Standard Supply Co., 225 E. 6th So.	801-355-2971
Va	Norfolk, Priest Elctrn., 6431 Tidewater Dr.	703-855-2021
Wash	Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S.	206-763-2300
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Ariz	Phoenix, Maddox Sls. Co.	602-274-3807
Cal	Los Angeles, Maddox Sls. Co.	415-431-2953
Cal	San Francisco, Maddox Sls. Co.	213-269-7291
Ill	Chicago, Cumming & Foley Sls. Co.	312-725-8110
Kans	Shawnee Mission, M. E. Bettis Co.	913-362-0772
Md	Phoenix, REBCO Sls.	301-592-8907
Mass	Wayland, Ellingwood, Inc.	617-265-6400
NJ	River Edge, Meg Electronic Sls.	201-265-9887
NM	Albuquerque, Maddox Sls. Co.	505-298-2422
Ohio	Cleveland, J. O. Olsen Co.	216-752-5444
Tex	Dallas, G. Weinreich & Assoc.	214-321-2800
Wisc	Milwaukee, Cumming & Foley Sls. Co.	414-372-7650

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Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401

SOLID STATE DEVICES, INC., 14830 Valley View Ave., La Mirada, Cal., 90638, Tel: 213-921-9660, TWX: 910-586-1881; Sls. Mgr: M. Rican **Vol 1•597; Vol 2•941**

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Ala	Mt. Brook, Beatty Co.	205-879-3774
Cal	Norwalk, Bertrand-Zoolalian	213-921-9791
Cal	Oakland, Moulthrop Sls., Inc.	415-261-7676
Colo	Boulder, H. Bass	303-449-7509
Fla	Maitland, Beacon	305-647-3498
Fla	Palm Beach Gardens, Beacon Elctrns.	305-622-2770
Ga	Atlanta, Beacon	404-351-3654
Ill	Chicago, TechRep	312-761-0548
Kans	Overland Park, Dy-Tronix	816-931-3030
Mass	Brookline, Tech. Prods.	617-731-0858
Mich	Warner, DEM Elctrn. Sls.	313-755-6660
Minn	Minneapolis, Bitronics Sls. Co.	612-866-3035
Mo	Hazelwood, Dy-Tronix	314-731-5799
NJ	Wallington, Comp-Tech Sls.	201-935-5454
NM	Albuquerque, J. Smith	505-255-2111
NY	Liverpool, BCS Assocs.	315-458-4774
NY	New Hyde Park, Comp-Tech	516-593-2628
Pa	Phila., Schibley	215-676-9885
SC	Spartanburg, Beacon	803-576-7462
Tex	Addison, Campion Sls. Co.	214-239-9196
Va	Fairfax, Schibley	703-591-3008
Va	Falls Church, Beacon	703-534-1868
Wash	Seattle, Underwood & Underwood	206-243-2133

SOLID STATE ELCTRNS. CORP., 15321 Rayen St., Sepulveda, Cal., 91343, Tel: 213-894-2271; Sls. Mgr: E. Politi ..... Vol 1•937

SOLID STATE EQUIPMENT CORP., 430 Delaware Drive, Fort Washington, Pa., 19034, Tel: 215-643-7900, TWX: 510-661-0197; Pres: R.D. Richardson; V. P: V.J. Green

SOLID STATE SCIENTIFIC, Montgomeryville Ind'l. Pk., Montgomeryville, Pa., 18936, Tel: 215-855-8400, TWX: 510-661-7267; Appl. Mgr: W. Kajin; Mkt. Adm: R. Mason **Vol 2•606,944**

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Ariz	Phoenix, Moltronics, Inc., 2746 W. Palm LA.	602-272-7951
Cal	Chatsworth, Westates Elctrns. Corp., 20151 Bahama St.	213-341-4411
Cal	San Diego, Moltronics, Inc., 7969 Engineer Rd.	714-278-5020
Cal	Santa Clara, Moltronics, Inc., 337 Mathews St.	408-244-7600
Cal	South Gate, Moltronics, Inc., 5610 E. Imperial Hwy.	213-773-6521
Mich	Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza	313-729-8500
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Ohio	Dayton, Pioneer/Dayton, 1900 Troy St.	513-236-9900

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SOLIDSTATE CONTROLS, INC., 600 Oakland Park Ave., Columbus, Ohio, 43214, Tel: 614-263-1886; Sls. Mgr: J.N. Holscher

SOLITRON DEVICES, 8808 Balboa Ave., San Diego, Cal., 92123, Tel: 714-278-8780, TWX: 910-335-1221; Mkt. Mgr: J. McNeal ..... Vol 2•942,943

SOLITRON Local Distributors

Ala	Huntsville, Hall-Mark Elctrns., Box 1133	205-539-0691
Ariz	Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave.	602-269-1391
Ariz	Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd.	602-273-7331
Cal	Culver City, Avnet Electrns. Div., 10916 Washington Blvd.	213-836-7200
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
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Cal	San Diego, Kierulff-San Diego, 8797 Balboa Ave.	714-278-2112
Cal	Santa Ana, Intermark, 2920 W. Warner St.	714-540-1322
Colo	Denver, Intermark, 2600 W. Second St.	303-936-8284
Colo	Denver, Kierulff-Denver, 10890 E. 47th Ave.	303-343-7090
Fla	Clearwater, Southland Elctrncs., 1771 N. Hercules	813-443-4514
Fla	Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr.	305-855-4020
Ill	Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave	312-437-8800
Ill	Elk Grove Village, Lakeland Elctrns., 2451 Brickvale Dr.	312-595-1000
Md	Baltimore, RESCO, 1026 Cromwell Bridge Rd.	301-823-0070
Md	Hanover, Hamilton/Avnet Elctrns.	301-796-5000
Md	Savage, Pyttronic Ind., 8200 Wellmoor Ct.	
Mass	Boston, De Mambro Elctrns, 1095 Commonwealth Ave.	617-787-1200
Mass	Needham Hgts., Kierulff - Boston, 14 Charles St.	617-449-3600
Mich	Detroit, RS Elctrns., 12775 Lyndon St.	313-491-1000
Mich	Farmington, Northland Elctrns., Inc., 32708 W. Eight Mile Rd.	313-477-3200
Minn	Minneapolis, ICI-Industrial Comps. Inc., 612-927-9991	77-3200
Mo	No. Kansas City, LCOMP-Kan City, 1520 Taney St.	910-221-2400
Mo	St. Louis, LCOMP-St. Louis Inc., 2605 S. Hanley Rd.	314-647-5505
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NM	Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E.	505-247-1055
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Ohio	Dayton, Kierulff - Dayton, 2030 Drill Ave.	513-278-9411
Ohio	Highland Heights, Radio Parts Corp., 749 Miner Rd.	216-461-2280
Ohio	Kettering, Arrow Elctrns., 3100 Plainfield Rd.	513-253-9176
Pa	Erie, Erie Corporate Contrs., 1938 Buffalo Rd.	814-455-8110
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Ala	Huntsville, W.A. Brown Comps.	205-539-4411
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Cal	Canoga Pk., Solitron Devices, Inc.	213-883-3822
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Colo	Denver, Daniels-Padgett Assoc.	303-433-7181
Fla	Ft. Lauderdale, W.A. Brown Comps.	305-564-8000
Fla	Orlando, W.A. Brown Comps.	305-425-5505
Fla	Palm Beach Gardens, Beacon	
Fla	Port Salerno, Solitron Microwave	305-746-8931
Ill	Chicago, D. Dolin Sls. Co.	312-286-6200
Ill	Des Plaines, Solitron Devices	312-824-8127
Ind	Indianapolis, Sukup & Cox Inc.	317-257-8436
Kans	Overland Park, Ensco-Rep.	913-381-7557
Md	Towson, Solitron Devices	301-821-1282
Mass	Lexington, Circuit Sls. Co.	617-861-0567
Mass	Needham, Solitron Devices, Inc.	617-444-1152
Mich	Dearborn, Pitcher-Poulin	313-582-5450
Minn	St. Paul, Wagner Consits.	612-698-0331
Mo	Saint Louis, Ensco-Rep	314-542-3935
NY	Jamaica, S & J Sls. Assocs.	212-291-3232
NY	Syracuse, Nycom, Inc.	315-437-8343
NY	Tappan, Solitron Devices, Inc.	914-359-5050
NY	West Nyack, R. Rubin Sls.	914-623-9237
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Ohio	Cleveland, Luebbe Sls.	216-333-0425
Ohio	Dayton, Luebbe Sls.	513-294-0426
Pa	Delmont, Luebbe Sls. Co.	412-468-4019
Pa	Havertown, Massey Assoc.	215-789-2320
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Mich	Farmington, Northland Elctrns., Inc., 32708 W. Eight Mile Rd.	313-477-3200
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Mo	St. Louis, LCOMP-St. Louis Inc., 2605 S. Hanley Rd.	314-647-5505
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NY	Hauppauge, Time Elctrncs., 70 Marcus Blvd.	516-273-0100
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NY	New Hyde Park, Lafayette Ind'l. Elctrns., Inc., 1327 Second Ave.	516-488-6600
NY	New York, Calvert Elctrns. Int'l., 220 E. 23 St.	212-679-1340

NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rockville Center, All American Transistor, 100 N. Village Ave. 516-534-7141
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Ohio Dayton, ESCO, 221 Crane St. 513-224-9192
Ohio Dayton, Kierulff - Dayton, 2030 Drill Ave. 513-278-9411
Ohio Kettering, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Pa Erie, Erie Corporate Contrs., 1938 Buffalo Rd. 814-455-8110
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
Tex Dallas, Component Specialties Inc., 2560 Electronic La. 214-357-4576
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Component Specialties, 7315 Ashcroft 713-771-7237
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Alta-Land Elctrns., Inc., 2280 S. Main St. 801-486-7227
Wash Bellevue, Farwest Elctrns. Co., 1240 S.E. 32nd St.
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NJ Haddonfield, Mesa Tech. Assocs. 609-429-9531
NM Albuquerque, Intermountain Eng. 505-344-2212
NY Camillus, C.P. Dixon Co. 315-471-6663
NY Springfield, F.F. Sylvester Assoc. 212-944-6964
Ohio Cincinnati, Luebbe Sls. 513-871-4211
Ohio Cleveland, Luebbe Sls. Co. 216-333-0425

Ohio Dayton, Luebbe Sls. Co. 513-294-0426
Pa Delmont, Luebbe Sls. Co. 412-468-4019
SC Greenville, Egan Assocs. 803-288-4450
Tex Dallas, D.G. Neely Assocs. 214-241-6741
Va Fairfax, Shibley Assocs. 703-591-3008
Wash Mercer Is., Northwest Mfrs. Agts. 206-284-7002
SPEED DETECTORS, 32 W. Monroe St., Bedford, Ohio, 44146, Tel: 216-232-1880; Sls. Mgr: A. Bletcher

SPELLMAN HIGH VOLTAGE ELCTRNS. CORP., 1930 Adee Ave., Bronx, N.Y., 10469, Tel: 212-671-0300, TWX: 710-593-4135; V.P./Eng: S.H. Glassman; Sls. Mgr: M.A. Civin; Pres: S.M. Skeist ..... Vol 1•887-891

Local Sales Offices & Reps.
Cal Menlo Park, Long Assocs. 415-327-1300
Cal Pasadena, A-F Sls. Engrg. 213-681-5631
Colo Arvada, Cleveland Entprs., Inc. 303-423-3707
Conn Glastonbury, Instrument Representatives 203-633-0777
Mass Lexington, Instrument Representatives 617-861-8620
NM Albuquerque, Cleveland Entprs. 505-298-7671
Tex Houston, Engrg. Assocs. 713-644-5397
For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)
SPERRY ELCTRN. TUBE, Sperry Rand, Gainesville, Fla., 32601, Tel: 904-372-0411

SPERRY INFORMATION DISPLAYS DIV., Box 3579, Scottsdale, Ariz., 85257, Tel: 602-947-8371, TWX: 667-498; Sls. Mgr: R.A. Kuntz; Mktg. Mgr: L.L. Pond, Jr. Vol 2•533

Local Sales Offices & Reps.
Ariz Phoenix, Elcom, Inc. 602-267-1348
Cal Los Angeles, M.A. Stolaroff Co. 213-295-7781
Cal Mt. View, Quad Rep, Inc. 415-964-3532
Colo Denver, Elcom, Inc. 303-771-6200
Conn Hartford, Measurement Equip. Co. 203-528-8192
Fla Orlando, Gra-Mar, Inc. 305-894-3351
Ill Chicago, Gassner & Clark 312-764-6121
Ind Indianapolis, Sheridan Assocs., Inc. 317-542-0661
Iowa Hiawatha, Gassner & Clark 319-393-5763
Md Silver Spring, QED Elctrns. 301-588-8134
Mass Wakefield, Measurement Equip. Co. 617-245-4870
Mich Farmington, Sheridan Assocs. Inc. 313-477-3800
Mo Florissant, Sheridan Assocs. Inc. 314-837-5200
NJ Camden, QED Elctrns. 215-925-8711
NM Albuquerque, A.Q. Elctrns. 505-255-8701
NY Mt. Vernon, QED Elctrns. 914-664-0080
Ohio Cleveland, Sheridan Assocs., Inc. 216-524-8120
Ohio Dayton, Sheridan Assocs., Inc. 513-277-8911
Ore Portland, J.J. Backer Co. 503-297-3776
Pa Monroeville, Sheridan Assocs., Inc. 412-373-1070
Tex Dallas, Allied Comps. Inc. 214-348-6660
Tex Houston, Allied Comps., Inc. 713-782-5406
Wash Seattle, J.J. Backer Co. 206-285-1300
Exp: Scottsdale, Ariz., Sperry Information Displays 602-947-8371

SPERRY Local Distributors
Ala Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr. 205-539-2731
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Fla Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave 305-885-8761
Fla Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way 305-859-1450
Md Beltsville, Powell Elctrns/Washington, 10728 Hanna St. 301-937-4030
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
NJ Clifton, Eastern Radio, 312 Clifton Ave. 201-471-6600
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave 215-365-1900
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)
SPRAGUE ELEC. CO., 481 Marshall St., No. Adams, Mass., 01247, Tel: 413-664-4411, TWX: 710-369-1360; Dir. Adv. & Sls. Prom: S.L. Chertok

Local Sales Offices & Reps.
Ala Huntsville, Elctrn. Mktg. Assocs. 205-852-2660
Ala Huntsville, Sprague Elefc. Co. 205-883-0520
Ariz Tempe, Sprague Elec. Co. 602-279-5435
Cal Burlingame, W. J. Purdy Co. 414-347-7701
Cal Inglewood, Sprague Elec. Co. 213-649-2600
Cal Los Angeles, KCE Corp. 213-649-2622
Cal San Diego, KCE Corp. 714-278-7640
Colo Denver, K-C Marketers Inc. 303-733-5561
Colo Denver, Sprague Elec. Co. 303-756-3611
Conn Trumbull, Sprague Elec. Co. 203-261-2551
DC Washington, Sprague Elec. Co. 202-244-6026
Fla Longwood, Sprague Elec. Co. 305-831-3636
Ill Schiller Park, Sprague Elec. Co. 312-678-2262
Ill St. Ann, Sprague Elec. Co. 314-291-2500
Ind Indianapolis, Sprague Elec. Co. 317-253-4247
Mass North Adams, Sprague Elec. Co. 413-664-4411
Mass Waltham, Sprague Elec. Co. 617-899-9100
Mich Jackson, Sprague Elec. Co. 517-787-3934
Minn Minneapolis, HMR, Inc. 612-920-8200
Mo St. Ann, Sprague Elec. Co. 314-291-2500
NJ Cherry Hill, Sprague Elec. Co. 609-667-4444
NJ Cherry Hill, Trinkle Sls. Inc. 609-667-3500
NJ Wayne, Sprague Elec. Co. 201-696-8200
NM Albuquerque, W. J. Purdy Co. 505-266-7959
NY Mamaroneck, W. Rutt, Inc. 914-698-8600
NY Melville, Sprague Elec. Co. 516-549-4141
NY Syracuse, Mar-Com Assocs. 315-437-2843
NY Syracuse, Sprague Elec. Co. 315-437-7311
NC Winson-Salem, Electronic Mktg. Assocs. 919-722-5151
Ohio Chagrin Falls, Sprague Elec. Co. 216-247-6488
Ohio Dayton, Sprague Elec. Co. 513-278-0781
Tex Richardson, Sprague Elec. Co. 214-235-1256
Va Lexington, Sprague Elec. Co. 703-463-9161
Wash Seattle, Sprague Elec. Co. 206-632-7761
For: Can., Toronto 15, Ont., Sprague Elec. of Can., Ltd. 416-766-6123
For: Can., Ville St. Laurent 9, P.Q., Sprague Elec. of Can., Ltd. 514-747-7811

SPRAGUE Local Distributors
Ala Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr. 205-539-2731
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Ariz Phoenix, Moltronics, Inc., 2746 W. Palm LA. 602-272-7951
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal Irvine, Cramer/L. A., 17201 Daimler St. 714-979-3000
Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525
Cal Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave. 415-961-1500
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr. 415-964-0820
Cal Palo Alto, WESCO Elctns.-Palo Alto, 3973 E. Bayshore Rd. 415-968-3475
Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112
Cal San Diego, Moltronics, Inc., 7969 Engineer Rd. 714-278-5020
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Cal Santa Clara, Moltronics, Inc., 337 Mathews St. 408-244-7600
Cal South Gate, Moltronics, Inc., 5610 E. Imperial Hwy. 213-773-6521
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Colo Denver, Kierulff-Denver, 10890 E. 47th Ave. 303-343-7090
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641
Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181
Fla Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave 305-885-8761
Fla Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way 305-859-1450
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ill Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave. 312-282-5400
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Kans Kansas City, Burstein-Applebee 816-561-5460
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Beltsville, Powell Elctrns/Washington, 10728 Hanna St. 301-937-4030
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Needham Hgts., Kierulff - Boston, 14 Charles St. 617-449-3600
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Neb Lincoln, Scott Elctrn Supply Corp., 4040 Adams St 403-434-8308
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave. 212-492-9590
NY Buffalo, Genesee Radio & Parts Co., 2550 Delaware Ave. 716-873-9661
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Elmsford, Melville Radio, 1 Nepperham Ave. 914-592-7100
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue 516-231-5682
NY Hicksville, Kierulff - Hicksville, 49 Bethpage Rd. 516-433-5530
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Cincinnati, Cramer/Tri-States, 666 Redna Terr. 513-771-6441
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Kierulff - Dayton, 2030 Drill Ave. 513-278-9411
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave 215-365-1900
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Garland, Kierulff-Dallas, 2815 National Dr. 214-271-2472
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Wash Seattle, Kierulff - Seattle, 5940 6th Ave. S. 206-763-1550
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200

Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

SPRAGUE-GOODMAN ELECTRONICS, INC., 371 Willis Ave., Mineola, N.Y., 11501, Tel: 516-746-1385; Pres: J. Goodman; V. Pres: H. Fried

SPRAYON PRODS., INC., Ind'l. Supply Div., 26300 Fargo Ave., Bedford Hgts., Ohio, 44146, Tel: 216-292-7400; V.P: D.B. Powers

SPRENGNETHER, W.F. INSTR. CO., INC., 4567 Swan St., St. Louis, Mo., 63110, Tel: 314-535-1682; Sls. Mgr: K.D. Scott

SQUARE D CO., Executive Plaza, Park Ridge, Ill., 60068, Tel: 312-774-9200; Comm. V.P. Sls: L.J. Murrans Vol 2•367,875

SRC DIV., Moxon, Inc., 2222 Michelson Dr., Newport Bch., Cal., 92664, Tel: 714-833-2000, TWX: 910-596-1362; Sls. Mgr: D.J. Romrell; Mktg. Mgr: J. Heyer; Mktg: J. Haas ..... Vol 2•1178

Local Sales Offices & Reps.
Ala Huntsville, International Scientific Instrs. 205-837-1601
Ariz Phoenix, Moxon Elctrns. 602-273-7363
Cal Irvine, Moxon Elctrns. 714-833-2000
Cal San Diego, Moxon 714-292-4820
Cal Sunnyvale, Moxon 408-734-4352
Cdlo Denver, PLS Assoc. 303-771-0140
Fla Orlando, Truex Assocs. Inc. 305-859-2160
Ill Des Plaines, Cozzens & Cudahy 312-298-3600
Ind Indianapolis, Cozzens & Cudahy 317-244-2456
Md Rockville, Farrell 301-424-9460
Mass Cambridge, Ken Corp. 617-491-5700
Mich Farmington, Carter, McCormic & Pierce 313-477-7700
Minn Mpls., Cozzens & Cudahy 612-884-4336
Mo Edmundson, Cozzens & Cudahy 314-423-1234
NJ Union, SBM Reps. 201-687-8737
NM Albuquerque, PLS Assocs. 505-255-2330
NY Endicott, SBM Reps. 607-754-1334
NY Pleasant Ville, SBM Reps. 914-769-1811
NY Rochester, SBM Repres. 716-266-1400
NC Winston Salem, International Scientific Instrs. 919-722-1783
Ohio Dayton, Carter, McCormic & Peirce 513-278-5873
Pa Pittsburgh, Carter, McCormic & Peirce 412-824-3760
Tex Dallas, A. Barnes Co. 214-235-4541
Tex Houston, A. Barnes Co. 713-523-7333
Utah Salt Lake City, PLS Assoc. 801-272-3681
Wash Seattle, R. Drake 206-763-2755

SSR INSTRS. CO., 1001 Colorado Ave., Santa Monica, Cal., 90401, Tel: 213-451-8701; Product Line Mgr: J. Barrett

STA-WARM ELEC. CO., 116 N. Chestnut St., Ravenna, Ohio, 44266, Tel: 216-296-6461; Sls. Mgr: E. Littrell

STACKBIN CORP., Box 434, Pawtucket, R.I., 02862, Tel: 401-722-1600; Sls. Mgr: J.J. Patterson

STACKPOLE CARBON CO., CARBON DIV., Stackpole St., St. Marys, Pa., 15857, Tel: 814-781-1234, TWX: 510-693-4511; Sls. Mgr: G. Pauline

STACKPOLE CARBON CO., Elctrn. Comps. Div.-Fixed Comp. Resistors, Kane, Pa., 16735, Tel: 814-837-7000, TWX: 510-695-8404; Sls. Mgr: J.S. Sennett

STACKPOLE Local Distributors
Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331
Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525
Cal Palo Alto, WESCO Elctns.-Palo Alto, 3973 E. Bayshore Rd. 415-968-3475
Conn Fairfield, Utronic Inc., 273 Linwood Ave. 203-255-4521
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Mass Needham Hgts., Kierulff - Boston, 14 Charles St. 617-449-3600
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
NY Hicksville, Kierulff - Hicksville, 49 Bethpage Rd. 516-433-5530
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Wisc Milwaukee, Electronic Expeditors, Inc., 6045 N. Green Bay Ave. 414-228-8100

STACKPOLE CARBON CO., Elctrn. Comp. Div.-Soft Ferrites/Special Resistors, St. Marys, Pa., 15857, Tel: 814-781-1234, TWX: 510-693-4511; Sls. Mgr: D. Almquist

Refer to STACKPOLE CARBON CO. Elctrn. Comps. Div. Fixed Composition Resistors/Capacitors For Sales Office Information.

STACKPOLE Local Distributors
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121

STACKPOLE CARBON CO., Magnet Div., Kane, Pa., 16735, Tel: 814-837-7000, TWX: 510-695-8360; Sls Mgr: V.D. Benigni

STACKPOLE COMPS. CO., Box 14466, Raleigh, N.C., 27610, Tel: 919-828-6201, TWX: 510-928-0520; Sls. Mgr: C.F. Robison ..... Vol 2•1136,1137

Local Sales Offices & Reps.
Ariz Phoenix, Dorton Enterprises 602-263-0414
Cal Los Angeles, Black, Ekizion & Strong Inc. 213-870-9191
Cal Mt. View, Melchior Assocs. 415-964-2321
Cal San Diego, Black, Ekizion & Strong Inc. S. 714-278-2150
Colo Denver, Parker Webster Co. 303-770-1972
Conn Plantsville, R. J. Pisaneschi 203-628-9505
Ga Peachtree City, J.A. Creighton 404-461-9836
Ill Chicago, A.A. Woods 312-283-7400
Ind Bloomington, R. E. Riggs 812-339-6166
La Baton Rouge, R.F. Gallagher 504-924-4995
Md Baltimore, Stemler Assoc., Inc. 301-944-8262
Mass Bedford, Deco Co. 617-275-1860
Mich Birmingham, J. E. Vollmer, Jr. 313-644-3571
Minn Minneapolis, HMR, Inc. 612-920-8200
Mo Kansas, Ensco-Rep. Inc. 913-381-7557
Mo St. Louis, Ensco-Rep. Inc. 314-456-3935
NJ Englewood Cliffs, Sprung/Nussbaum, Inc. 201-947-6767
NY Buffalo, R. W. Mitscher Co. 716-854-2517
NY Fayetteville, R.W. Mitscher 315-637-9575
NC Raleigh, R.W. Mitscher 919-828-0575
Ohio Hudson, D. J. Mohr 216-653-2255
Pa Oreland, Brown-Oberlies Inc. 215-887-1325
Pa Pittsburgh, H. S. Swoyer 412-256-2538
Tenn Shelbyville, R. W. Mitscher 615-684-4544
Tex Dallas, M. N. Herbst 214-239-2497
Va Virginia Beach, R.W. Mitscher 703-464-0500
Wash Bellevue, Vantage Corp. 206-455-3460
Exp: N.Y., N.Y., Ad Auriema 212-349-8220
For: Can., Toronto, Ont., Canadian Stackpole Ltd. 416-255-2373

STACO, INC., 2240 E. 3rd St., Dayton, Ohio, 45403, Tel: 513-253-1191, TWX: 810-459-1798; Sls. Mgr: D. James; V.P. Eng: H.G. Zambell ..... Vol 3•1288,1289

Local Sales Offices & Reps.
Ark Little Rock, Electra-Tech Midsouth, Inc. 501-562-4090
Cal Los Angeles, E. Strassner 213-666-1511
Cal Santa Clara, Thomas-Hartman Assocs. 408-247-1252
Conn Hamden, Impact Sls. 203-248-9368
Fla North Miami, Winfield Elctrn. Sls. 305-945-6544
Ga Atlanta, Millar Elctrns. 404-261-6160
Ill Skokie, Saffro & Assocs. 312-JU-8-0905
Ind Indpls, Southern Sls. 317-253-3359
Kans Shawnee Mission, Kathrinus-Kelly Co. 913-722-0000
Ky Louisville, Southern 502-583-6902
Md Lanham, Eastern Comps., Inc. 301-794-8610
Mass Waltham, Impact Sls. 617-893-2850
Mich Ferndale, Shalco, Inc. 313-547-4771
Minn Mpls, C. Gibb Co. 612-FR-7-1200
Mo St. Louis, Kathrinus-Kelly Co. 314-968-3800
NY Buffalo, R.F. Lamb Co. 716-874-4900
NY Kingston, R.F. Lamb Co. 914-338-8833
NY Rochester, R.F. Lamb Co. 716-544-5580
NY Syracuse, R.F. Lamb Co. 315-454-2469
NY Valley Stream, Levison Sls. Co. 516-LO-1-9696
NC Raleigh, Millar Elctrns. 919-787-9564
Ohio Cleveland, Marlow 216-381-4500
Pa Phila, Eastern Comps. 215-WA-7-6362
Pa York, Eastern Comps. 717-764-3114
Tex Bellaire, Brice Co. 713-666-1788
Tex Richardson, Brice Co. 214-235-7281
Wash Seattle, R.K. Squibb, Inc. 206-632-2450

STACO, Local Distributors
Ala Birmingham, J.W. Clary Co., 1713 Second Ave. S. 205-322-2488
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Conn Fairfield, Utronic Inc., 273 Linwood Ave. 203-255-4521
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Pa Philadelphia, Arch Electronics, 1318 Arch St
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Tenn Chattanooga, Curle Elctrns., 1813-S. Market
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

STACOSWITCH, INC., 1139 Baker St., Costa Mesa, Cal., 92626, Tel: 714-549-3041, TWX: 910-595-1507; Sls. Adm: K. Johnson; Sls. Admn: G. Slouka

STAINLESS, INC., 3rd St., N. Wales, Pa., 19454, Tel: 215-699-4871, TWX: 510-661-8097; Sls. Mgr: J.C. Rodriguez

STAKE FASTENER CO., 9835 Dupree St., S. El Monte, Calif., 91733, Tel: 213-442-4700; Sales: J.D. Pon

STANCOR, Essex Int'l., Inc., 3501 W. Addison St., Chicago, Ill., 60618, Tel: 312-463-7400, TWX: 910-221-5466; Sls. Eng: J. Ewing; Ch. Eng: E. Kelly; Sls: N. Eichenberger

STANCOR Local Distributors
Ala Birmingham, J.W. Clary Co., 1713 Second Ave. S. 205-322-2488
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
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Ohio	Akron, Akron Elctrn. Supply, 107 S. Arlington St	216-762-8818
Pa	Pittsburgh, Cameradio Co., 2801 Liberty Ave.	412-391-7400
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401

STURDILITE SCI. FURNITURE SYS., 100 Acorn St., Plainwell, Mich, 49080, Tel: 616-685-6400; Sls. Mgr: B. Taugner

SUFFOLK ETCHED PRODS., INC., Div. Suffolk Photo-Etched, 300 Pleasure Dr. Dept. E, Riverhead, N.Y., 11901, Tel: 516-727-8860; Pres: J.M. Pufahl

SUMMIT ENGRG. CORP., Box 938, 1820 S. 7th Ave., Bozeman, Mont., 59715, Tel: 406-587-0636, TWX: 910-975-1950; VP Mktg: R.A. Hall

SUNSHINE SCI. INSTRS., INC., 1810 Grant Ave., Philadelphia, Pa., 19115, Tel: 215-OR-3-5600; Sls. Mgr: A. Stiles

Local Sales Offices & Reps.

Cal	LaMirada, P. H. DuBois	714-521-1481
Md	Elkridge, Sunshine Scientific	301-796-5600

SUPERIOR CABLE DIV., Box 489, Hickory, N.C., 28601, Tel: 704-328-2171, TWX: 510-934-1204; Gen. Mgr: J.L. Reece; Gen. Sls. Mgr: J.W. English

SUPERIOR CARBON PRODS., INC., 9115 George Ave., Cleveland, Ohio, 44105, Tel: 216-883-4880; Pres: E. Hastings-Salter

SUPERIOR ELEC., 1000 Middle St., Bristol, Conn., 06010, Tel: 203-582-9561, TWX: 710-454-0682; Media Mgr: F.A. Leachman; Mktg. Mgr. Corps: K.E. Meissner Vol 1*676; Vol 2*662,663; Vol 3*643,1290,1291

Local Sales Offices & Reps.

Cal	Redwood City	415-369-8203
Cal	Van Nuys	213-786-3626
Ill	Glen Ellyn	312-858-2960
Md	College Pk.	301-277-3235
Mass	Wellesley Hills	617-237-0750
Mich	Detroit	313-543-3450
NY	Elmsford	914-592-7980
NY	Rochester	716-381-9210
NC	Charlotte	704-535-5846
Ohio	Medina	216-723-1515
Pa	Ft. Washington	215-248-3537
Tex	Dallas	214-368-4688
For:	Can., Toronto, Ont., American Superior Elec. Co., Ltd.	416-255-2318

SUPERIOR FLUX & MFG., 1536 St. Clair Ave., Cleveland, Ohio, 44114, Tel: 216-781-9373; Pres: B.J. Garfinkel

SUPERIOR MFG. & INSTRUMENT CORP., 19-36 38th St., Long Island City, N.Y., 11105, Tel: 212-932-1800, TWX: 710-582-2626; Sls. Mgr: C. Muscietta; Contracts Mgr: A.D. Metsch

SWITCHCRAFT, INC., 5555 N. Elston Ave., Chicago, Ill., 60630, Tel: 312-792-2700, TWX: 910-221-5199; V.P. Mktg: C.J. Schultz; Dist. Sls. Mgr: L. Erickson

Local Sales Offices & Reps.

Fla	Orlando, Cartwright & Bean	305-896-2031
NM	Albuquerque, G. Moss Elctrns., Inc.	505-898-6072
NC	Charlotte, Cartwright & Bean	704-333-6457
Pa	Enon Valley, NEbco Assocs.	216-457-2333
Tenn	Metairie, Cartwright & Bean	504-887-5225
Tex	Richardson, J.R. Lavender & Co.	214-231-9011

SWITCHCRAFT, Local Distributors

Ala	Birmingham, J.W. Clary Co., 1713 Second Ave. S.	205-322-2488
Ariz	Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway	
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way	213-685-5511
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Diego, Shanks and Wright Inc., 2045 Kettner Blvd.	714-239-0176
Cal	San Diego, Western Radio, 1415 India St.	714-235-6571
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Colo	Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave.	303-287-9611
Colo	Denver, Burstein-Applebee	303-244-3336
Conn	Fairfield, Utronic Inc., 273 Linwood Ave.	203-255-4521
Conn	Hamden, Arrow Elctrncs., 295 Treadwell St.	203-248-3801
Ga	Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW	404-355-2223
Ill	Chicago, Burstein-Applebee	312-763-4848
Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ind	South Bend, Radio Distr Co Inc, 1212 High St	219-287-2911
Iowa	Cedar Rapids, Iowa Radio Supply Co. Inc., 719 Center Point Rd. NE	319-364-6154
Kans	Kansas City, Burstein-Applebee	816-561-5460

Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Burlington, Arrow Elctrns., 15 A Street 617-273-0100
Mass Cambridge, Wilshire Elctrns./New England, 205 Alewife Brook Pkwy. 617-491-3300
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Saddlebrook, Arrow Elctrns. Inc., 285 Midland Ave. 201-797-5800
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Brooklyn, LACO Ind'l. Elctrns. Corp., 4924 4th Ave. 212-492-9590
NY Buffalo, Radio Equip. Corp., 196 Vulcan St 716-874-2690
NY Farmingdale, Arrow Elctrns., Inc., 900 Broad Hollow Rd., Rte. 110 516-694-6800
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
NY Woodbury, Harvey Radio, 60 Crossways Park W. 516-921-8700
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ohio Cleveland, Arrow Elctrns., 23945 Merchantile Rd. 216-464-2000
Ohio Cleveland, Farr Elctrns, 5403 Prospect Ave. 216-881-7403
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Arrow Elctrns., 3100 Plainfield Rd. 513-253-9176
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tenn Chattanooga, Curle Elctrns., 1813-S. Market
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Va Roanoke, Peoples Radio & Tv Supply Co., 1015 Moorman Rd
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

SWS SILICONES DIV., Stauffer Chemical Co., Sutton Rd., Adrian, Mich., 49221, Tel: 313-263-5711, TWX: 510-450-2606; Natl. Sls. Mgr., Fluid Prods: R.C. Flewwelling; Natl. Sls. Mgr., RTV - Elastomers: J.D. Acker; Natl. Sls. Mgr., Heat Curable Rubber: R.L. Harden

SYNCHRO-START PRODS., 8151 N. Ridgeway, Skokie, Ill., 60076, Tel: 312-267-1730; Sls. Mgr: A.F. Barrett; Mktg. Mgr: G.A. Soule

SYNTHANE TAYLOR CORP., An Alco Standard Corporate Partner, Valley Forge, Pa., 19481, Tel: 215-666-0300; V.P. Mktg: R.L. Smith

SYNTRONIC INSTRS., INC., 100 Industrial Rd., Addison, Ill., 60101, Tel: 312-543-6444, TWX: 910-651-2191; Chf. Sls. Eng: P. Evans .....Vol 3•535

Local Sales Offices & Reps.
Cal Arcadia, Ash M. Wood Co. 213-447-3511
Cal Los Altos, Frauman Assocs. 415-941-0660
Colo Wheatridge, Waugaman Assocs., Inc. 303-423-1020
Conn New Canaan, W. Couch 203-966-4630
Ill Northfield, Torkelson 312-446-9085
Ind Indianapolis, Torkelson 317-244-7867
Md Reisterstown, Massey Assocs. 301-833-2039
Mass Norwood, S. Pierce, Inc. 617-762-3164
Minn Mpls., Torkelson 612-835-2414
NJ Fairlawn, G. D. Harris Assoc. 201-796-5200
Pa Havertown, Snyder & Massey 215-789-2320
Tex Irving, Space Elctrns. 214-251-2261
Exp: N.Y., N.Y., Sylvan Ginsbury 212-689-5212

SYRACUSE ELCTRNS. CORP., Box 566, Syracuse, N.Y., 13201, Tel: 315-488-4911; Sls. Mgr: C.N. Benoit

Local Sales Offices & Reps.
Cal San Rafael, Wells Assocs. 415-454-5730
Cal Sherman Oaks, Gee Assocs. 213-788-5961
Fla Seminole, G. W. Fenton 813-393-5803
Ill Chicago, Automation Equip. 312-631-9673
Ind Angola, Southern Sls. 219-665-3961
Ind Indianapolis, Southern Sls. 317-253-3359
Mass Waltham, Electro Prods. 617-899-1570
Mich Dearborn, Pitcher-Poulin 313-582-5450
Minn Minneapolis, K. C. Brooks 612-544-3179
Mo St. Louis, Elec. Controls 314-645-2400
NJ Ridgewood, Ballou 212-964-4640
NY Baldwinsville, Scibetta Reps. 315-622-3993
Ohio Cleveland, Marlow Assocs. 216-381-4500
Pa Ardmore, Rothenheber 215-642-6911
Pa Pittsburgh, Trymac Co. 412-823-8400
Tenn Memphis, R. Jordan Assocs. 901-452-7441
Wisc Cedarburg, Automation Equip. 414-242-1520

SYRACUSE Local Distributors
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400

SYSCON INT'L., INC., 205 Sycamore St., So. Bend, Ind., 46622, Tel: 219-287-5916; Sls. Mgr: R.E. Haggerson; Dir. of Engr: Dr. D.E. Brown

SYSTEMS INSTRS. RESCH., INC., 331 Luckie St., N.W., Atlanta, Ga., 30313, Tel: 404-525-2434; Mktg: J.M. Pensinger

SYSTONICS, INC., Box 121, Winchester, Mass., 01890, Tel: 617-729-4439; Pres: R.C. Thomas

SYSTRON-DONNER CORP., One Systron Dr., Concord, Cal., 94520, Tel: 415-682-6161, TWX: 910-481-9472; Mktg. Dir: J.E. Niebuhr .....Vol 1•508-511

Local Sales Offices & Reps.
Ala Huntsville, Sci. Devices-S.E. 205-536-1969
Ariz Mesa, Scl. Devices 602-834-1682
Cal Los Angeles, Sci. Devices-Cal. 213-641-4800
Cal Mountain View, Sci. Devices-Cal. 415-964-4230
Cal San Diego, Sci. Devices-Cal. 714-279-6642
Colo Denver, Sci. Devices-S.W. 303-573-9466
Conn Hamden, Sci. Devices-N.E. 203-248-9361
Fla Ft. Lauderdale, Sci. Devices-S.E. 305-721-4260
Fla Orlando, Sci. Devices-S.E. 305-424-7932
Haw Honolulu, Aloha Assoc. 808-941-1574
Ill Des Plaines, Sci. Devices-Midwest 312-297-5240
Kans Lenexa, Sci. Devices-S.W. 913-631-3818
Mass Waltham, Sci. Devices-N.E. 617-894-5637
Mich Franklin, Sci. Devices-Midwest 313-363-2282
Minn Minneapolis, Sci. Devices-Midwest 612-544-1616
NJ Palisades Pk., Sci. Devices-E. 201-871-3916
NM Albuquerque, Sci. Devices-S.W. 505-268-6729
NY Liverpool, Sci. Devices-N.Y. 315-457-7420
NY Rochester, Sci. Devices 716-334-2445
NC Burlington, Sci. Devices-S.E. 919-228-6279
Ohio Cleveland, Sci. Devices-Midwest 216-261-2000
Ohio Dayton, Sci. Devices-Midwest 513-298-9904
Pa Plymouth Meeting, Sci. Devices-Phil. 215-825-9515
Tex Houston, Sci. Devices-S.W. 713-623-4250
Tex Richardson, Sci. Devices-S.W. 214-231-8106
Tex San Antonio, Sci. Devices-S.W. 512-694-6251
Va Norfolk, Sci. Devices 703-499-8133
Va Springfield, Sci. Devices-Wash., D.C. 703-451-6500
Wash Bellevue, Sci. Devices-N.W. 206-454-0900
For: Can., Calgary, Alb., Canadian Dynamics 403-269-2202
For: Can., Montreal, Que., Baytronix 514-342-4281
For: Can., Ottawa, Ont., Baytronix 613-728-0113
For: Can., Vancouver, B.C., Canadian Dynamics 604-325-3201

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

SYSTRON DONNER COMPUTER SYSTEMS DIV., 10 Systron Dr., Concord, Cal., 94518, Tel: 415-682-6161, TWX: 910-481-9479; Sls. Mgr: J. Cunningham

SYSTRON-DONNER CONCORD INSTR. DIV., 10 Systron Dr., Concord, Cal., 94518, Tel: 415-682-6161, TWX: 910-481-9479; Mktg. Mgr: N. Kelley .....Vol 1•508-511

Refer to Systron-Donner Corp. for sales office information.

SYSTRON-DONNER DATAPULSE DIV., 10150 Jefferson Blvd., Culver City, Cal., 90230, Tel: 213-836-6100 Ext: 268, TWX: 910-340-6766; Mktg. Mgr: H. Mette .....Vol 1•510

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SYSTRON-DONNER INERTIAL DIVISION, 200 San Miguel Rd., Concord, Cal., 94518, Tel: 415-682-6161, TWX: 910-481-9478; Sls. Mgr: B. Sage

SYSTRON-DONNER KRUSE ELCTRNS. SUB., 735 Palomar Ave., Sunnyvale, Cal., 94086, Tel: 408-735-9660, TWX: 910-339-9309; Mktg. Mgr: J. Johnson .....Vol 1•510

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SYSTRON-DONNER MICROWAVE DIV., 14844 Oxnard St., Van Nuys, Cal., 91409, Tel: 213-786-1760, TWX: 910-495-1786; Mktg. Mgr: T. Anderson .....Vol 1•510

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SYSTRON DONNER TRYGON ELCTRNS. SUB., 1200 Shames Dr., Westbury, N.Y., 11590, Tel: 516-997-6200, TWX: 510-222-0492 .....Vol 1•913-917

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T-BAR INC., 141 Danbury Rd., Wilton, Conn., 06897, Tel: 203-762-8351; Sls. Mgr: A.H. Morgan; Comp. Sls. Mgr: W.R. Jonsson; Data Sys. Sls. Mgr: J.E. Gaffney Vol 2•889,1139

Local Sales Offices & Reps.
Cal Palo Alto, Engineering Assocs. 415-326-7842
Cal San Marino, Van Gott & Assocs. 213-282-1125
Colo Golden, J. F. Hurlbut Co. 303-279-7138
Conn Wilton, T-Bar Inc. 203-762-8351
Fla Orlando, Geartner Assocs. 305-299-1000
Ill Chicago, R. M. Weisz Assocs. 312-637-9117
Mass Needham, A & M Electronic Reps Inc. 617-444-8170
Mich Dearborn, Villani-Pitcher, Inc. 313-271-4600
Minn St. Paul, Northport Engrg. 612-698-3841
NJ Fort Lee, Tecnimat 201-461-8686
NY New Hartford, KLM Assocs. 315-735-8525
Ohio Centerville, EMA Inc. 513-433-2800
Pa Ambler, Wyncote Instrumentation 215-643-2440
Tex Dallas, R. R. Thomas Co. 214-363-8591
Tex Houston, Unidyne 713-782-0218
Va McLean, Carwithen Assocs. 703-821-3131
Wash Seattle, D. Smith Sls. Co. 206-633-3160
Exp: Wimborne, Dorset, FR Elex, Flight Refuelling Ltd. Wimborne 2121

T-BAR Local Distributors
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565

T-F ELECTRONICS, INC., 1701 Evergreen St., Austin, Tex., 78704, Tel: 512-444-9674; Sls. Mgr: G.L. Barr Vol 2•452

T-M VACUUM PRODS., Warrington & Rowland, Riverton, N.J., 08077, Tel: 609-829-2000; Sls. Mgr: H.O. Walp, Jr.

TA MFG. CORP., Viking Inds. Co., 4607 Alger St., Los Angeles, Cal., 90039, Tel: 213-240-4600, TWX: 910-497-2065; Dir. of Mktg: A. Siebrandt

Local Sales Offices & Reps.
Ariz Phoenix, Henry Sls. 602-275-5411
Cal Los Angeles, TA Mfg. Corp. 213-240-4600
Cal Mountain View, Connolly & Co. 415-967-6988
Cal San Diego, Wm. Gibson 714-223-6120
Colo Denver, Omega Ltd. 303-758-1508
Conn Trumbull, Pfannkuch & Co. 203-268-4590

Ga Atlanta, Electro-Mech 404-435-0079
Ill Chicago, Cumming & Foley 312-725-8110
Iowa Cedar Rapids, J-R Sls. Engr. 319-377-8211
Kans Wichita, D-O Engr. 316-264-7358
Md Lutherville, Milan Assocs. 301-825-1120
Mass Southboro, Pfannkuch & Co. 617-481-1769
Mich Southfield, Representative Elect. Products 313-354-9066
Minn Minneapolis, Nortec Sales, Inc. 612-835-7414
Mo St. Louis, Industrial Metal Working 314-739-3947
NJ Belleville, Andrews & Andrews 201-569-8800
NM Albuquerque, Crown Engr. 505-265-2066
NY Huntington, Andrews & Andrews 516-692-8686
Ohio Cincinnati, F.D. Borchelt 513-851-7586
Tex Fort Worth, John H. Smith Co. 817-267-1202
Wisc Milwaukee, Cumming & Foley 414-228-8740
For: Can., Ontario, International Fasteners 416-749-0070

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Cal Oakland, Moulthrop Sls., Inc. 415-261-7676
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Fla Tampa, S. K. Wallace Assoc. 813-932-3568
Ill Chicago, D. Hale Darnold 312-631-6532
Ind Indianapolis, R. Milsk Co. 317-546-5468
Iowa Atlantic, Kimiam Sls., Inc. 712-243-1626
Kans Overland Park, Kimiam Sls., Inc. 913-648-5191
Mass Needham, Coakley, Boyd & Abbett, Inc. 617-444-5470
Mich Detroit, R. Milsk Co. 313-342-6660
Minn Minneapolis, Northern States Sls. Co. 612-866-3468
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Ohio North Olmsted, Avcom, Inc. 216-777-2060
Pa Pittsburgh, Tanner Co. 412-561-4687
Tex Houston, M. F. Klicpera Co. 713-747-3868
Exp: Chicago, Ill., Ortiz Bros. Int. 312-478-3685

TANSITOR ELCTRNS., Div. Aerotron, West Rd., Bennington, Vt., 05201, Tel: 802-442-5473, TWX: 710-360-1782; Sls. Mgr: F.H. O'Neil

Local Sales Offices & Reps.
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Ariz Scottsdale, Piper Sls. Co. 602-946-4437
Cal Pico Rivera, Westrep 213-949-2551
Cal Santa Clara, Richards Assoc. 408-246-5860
Colo Denver, Walker Assoc. 303-623-8713
Conn North Haven, J. E. Boeing Co. 203-488-8301
Fla Oviedo, Conley & Assoc. 305-365-3283
Ga Atlanta, Rep, Inc. 404-876-1591
Ill Chicago, L-Tec, Inc. 312-286-1500
Iowa Cedar Rapids, J.R. Sls. Engrg., Inc. 319-377-8211
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Mo Raytown, Cen Tech 816-358-8100
NJ Haddonfield, Sunday-O'Brien 609-429-4013
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NY Leonia, Kohl-Camber 201-944-6488
NC Smithfield, Byrd & Barbour Sls. 919-934-8136
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Ohio Dayton, Augnat Assoc. 513-223-5002
Ore Portland, R. Legg Co. 503-292-8824
Tex Dallas, United Comps. 214-324-1448
For: Can., Ontario, Kaytronics, Ltd. 416-638-5511
For: Can., Quebec, Kaytronics, Ltd. 514-487-3434

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NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370

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TAU-TRON, INC., 685 Lawrence St., Lowell, Mass., 01852, Tel: 617-458-6871, TWX: 710-343-6447; Sls. Mgr: J.J. Slomski

TAURUS CORP., Academy Hill, Lambertville, N.J., 08530, Tel: 609-397-2390; Sls. Mgr: J.D. Kreuter Vol 1•375

Local Sales Offices & Reps.
Cal Los Angeles, R. Sweet 213-477-4517
Cal Pasadena, Sci. Sls. SY 1-3778
Conn New Haven, Forsberg Sls. 203-239-5111
Fla Clearwator, Brennan Assoc. 813-446-5006
Ind Ft. Wayne, Hoeming Sls. 219-483-6913
Mass Brockton, Forsberg Sls. 617-522-6300
NJ Cherry Hill, H.S. Bancroft 609-UL-4-8000
NJ Ft. Lee, K. Hughes 201-944-1600
NY New York, K. Huges 212-695-0082
Ohio Wickliffe, W.J. Brauer 216-943-0601
Pa Pittsburgh, W.J. Brauer 412-921-3213

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TDC, DIV. FREQ. TECHNOLOGY INC., Box 365, Littleton, Mass., 01460, Tel: 617-456-3374

TDK ELECTRONICS CO., LTD., 14-6 2-Chome, Uchikanda, Chiyoda-ku, Tokyo 101, Japan, Tel: (03) 256-6111; Dir: Y. Nakamura; Mgr: M. Kurihara Vol 3•536,537

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Ill Chicago, TDK Elctrns. Corp. 312-973-1222

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Kans Merriam, Tech. Reps. 913-432-4110
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Pa Ambler, W. M. Assocs. 215-643-4119
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Ohio Cleveland, Midwest Sls. 216-234-9200
Pa Pittsburgh, Waggoner-VerHill Assoc. 412-241-5202
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TECH SERV., INC., Box 125, Fogelsville, Pa., 18051, Tel: 215-285-4211, TWX: 510 651 2802; Sls. Mgr: P.D. Donahue

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Fla Fort Walton Beach, W. A. Brown Instru. 904-243-6424
Fla Orlando, W. A. Brown Instrus. 305-425-5505
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TELEDYNE MICRONETICS, 7155 Mission Gorge Rd., San Diego, Calif., 92120, Tel: 714-583-3525, TWX: 910-335-2085; Chief Scientist: S. Weisbrod; Chief Engr: A.J. Hannum

TELEDYNE MICROWAVE, 1290 Terra Bella Ave., Mountain View, Cal., 94040, Tel: 415-968-2211, TWX: 910-379-6939; Mktg. Mgr: K.W. Mills

TELEDYNE PENN-UNION ELEC., Box 723, Edinboro, Pa., 16412, Tel: 814-734-1631, TWX: 91-4490; Sls. Mgr. O.E.M. Div: J. Russ; Sls. Mgr. Distr. Div: P.F. Amann

TELEDYNE PHILBRICK, Allied Dr. at Rte. 128, Dedham, Mass., 02026, Tel: 617-329-1600, TWX: 710-348-6726; Appl. Eng: F. Goodenough; Prod. Mgr: W. Patstone

Local Sales Offices & Reps.
Ala Huntsville, W.A. Brown Instrus. 205-539-4411
Cal Burbank, Tech-Ser 213-846-9631
Cal Canoga Park, Teledyne Philbrick 213-887-8873
Cal Mountainview, Tech-Ser 415-969-9020
Cal San Diego, Tech-Ser 714-222-1121
Fla Ft. Lauderdale, W.A. Brown Instrus. 305-564-8000
Fla Ft. Walton Beach, W.A. Brown Instrs. 904-243-6424
Fla Orlando, W.A. Brown Instrus. 305-425-5505
Ga Tucker, W.A. Brown Instrs. 404-939-1674
Haw Kailua, Oahu, Lanikai Elctrns. 808-262-6286
Ill Chicago, Data Elctrns. Co. 312-283-0300
Kans Leavenworth, McGraw Engrg. 913-651-2929
La Gretna, W.A. Brown Instrus. 504-366-5766
Md Kensington, Elctrn. Mktg. Assoc. 301-881-5300
Mich Farmington, Carter, McCormic & Peirce 313-477-7700
Minn Minneapolis, Data Elctrns. Co. 612-786-9666
Mo Florissant, McGraw Engrg. 314-831-0342
NY Elmont, Crane & Egert Corp. 516-488-2100
NY New Hartford, KLM Assocs. 315-735-8525
NY North Syracuse, KLM Assocs. 315-458-6214
NY Rochester, KLM Assocs. 716-442-0820
NC Research Triangle Park, W.A. Brown Instrs. 919-489-1546
NC Winston-Salem, W.A. Brown Instrs. 919-768-3600
Ohio Cleveland, Carter, McCormic & Peirce 216-333-5650
Ohio Dayton, Carter, McCormic & Peirce 513-278-5873
Ore Beaverton, Seatronics 503-640-1152
Pa King of Prussia, Elctrn. Mktg. Assocs. 215-265-1600
Pa Pittsburgh, Carter, McCormic & Pierce 412-824-3760
Tex Dallas, Data Mktg. Assocs. 214-358-4643
Tex Houston, Data Mktg. Assocs. 713-686-9627
Tex San Antonio, Data Mktg. Assocs. 512-828-0937
Wash Seattle, Seatronics 206-767-4330

TELEDYNE POSITIVE CONNECTOR, 6488 River Rd., Ansonia, Conn., 06401, Tel: 203-735-7831; G.M: R.F. Fiorino

TELEDYNE RELAYS, 3155 W. El Segundo Blvd., Hawthorne, Cal., 90250, Tel: 213-679-2205, TWX: 910-325-6600; Mkt. Mgr: C.D. Stalker; Sls. Mgr: N. Lewis; West. Reg. Mgr: H. Laner ..... Vol 2•890-894

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Ariz Phoenix, Sales Engineering, Inc. 602-945-5781
Cal Foster City, Teledyne Relays NORCAL 415-574-1915
Colo Denver, Todd Assocs. 303-744-2313
Conn Stratford, G. Rosen Co. 203-375-5456
Fla Melbourne, Reynolds & Assocs. 305-727-3205
Ill Skokie, Mar-Con Assocs. 312-675-6450
Ind Indpls., R.F. Specialists 317-783-7630
Kans Mission, Mid America Elctrns. 913-236-4800
Md Silver Springs, Rep-tron 301-593-4844
Mass Natick, G. Rosen Co. 617-644-2211
Mich Birmingham, J.C. Hofstetter Co. 313-643-7203
Minn Minneapolis, S. Clothier Co. 612-869-3231
NJ Eatontown, Teledyne Relays Eastern Regional Office 201-542-6884
NM Albuquerque, A. Q. Elctrns. 505-255-8701
NY Mount Vernon, Friedman-Smith Elctrns. 914-664-4866
NY Syracuse, I.A. Hotze Co. 315-479-6641
NC Raleigh, R.W. Mitscher Co. 919-828-0575
Ohio Dayton, J.C. Hofstetter Co. 513-298-0662
Ohio Medina, J.C. Hofstetter Co. 216-241-4880
Okla Tulsa, Vista Assocs. 918-627-7557
Pa Pittsburgh, J.C. Hofstetter Co. 412-561-5454
Tenn Shelbyville, R. W. Mitscher Co. 615-684-4544
Tex Richardson, Vista Engrg. 214-235-4547
Wash Bellevue, Western Tech. Sls. 206-454-3906

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Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331
Ariz Phoenix, Liberty Electrns., 3612 N. 16th St. 602-264-4438
Cal El Segundo, Liberty Elctrns., 124 Maryland St. 213-322-8100
Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Cal Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd. 415-968-6292
Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Colo Denver, Kierulff-Denver, 10890 E. 47th Ave. 303-343-7090
Md Hyattsville, Milgray/Washington, 5405 Lafayette Pl. 301-864-1111
Mass Boston, De Mambro Elctrns, 1095 Commonwealth Ave. 617-787-1200
Mass Burlington, Milgray/New England, 79 Terrace Hall Ave 617-272-6800
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
NJ Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd. 609-424-1300
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Pa Philadelphia, Milgray/Delaware Valley 215-228-2000
Wash Seattle, Kierulff - Seattle, 5940 6th Ave. S. 206-763-1550
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200

For Local Source Data Call Toll-Free 800-645-9200 (In N.Y. State Call 516-294-0990 Collect)

TELEDYNE ROTOLITE, Dept. EEM, 328 Essex St., Stirling, N.J., 07980, Tel: 201-647-1040; Sls. Mgr: L. Ariyan

TELEDYNE SEMICONDUCTOR, 1300 Terra Bella Ave., Mountain View, Cal., 94040; Dir. Mktg: R.F. Graham

TELEDYNE SEMICONDUCTOR Local Distributors
Ala Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr. 205-539-2731
Cal Chatsworth, Westates Elctrns. Corp., 20151 Bahama St. 213-341-4411
Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525
Cal Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr 415-323-9431
Cal Palo Alto, WESCO Elctns.-Palo Alto, 3973 E. Bayshore Rd. 415-968-3475
Cal San Diego, Kierulff-San Diego, 8797 Balboa Ave. 714-278-2112
Cal Sepulveda, Milgray/California, 8718 Woodley Ave 213-894-4011
Colo Denver, Kierulff-Denver, 10890 E. 47th Ave. 303-343-7090
Fla Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave 305-885-8761
Fla Orlando, Milgray/Florida, 5400 Diplomat Circle 305-647-5747
Fla Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way 305-859-1450
Ill Rosemont, Kierulff - Chicago, 9340 William St. 312-678-8560
Md Beltsville, Powell Elctrns/Washington, 10728 Hanna St. 301-937-4030
Md Hyattsville, Milgray/Washington, 5405 Lafayette Pl. 301-864-1111
Mass Burlington, Milgray/New England, 79 Terrace Hall Ave 617-272-6800
Minn Minneapolis, ICI-Industrial Comps. Inc., 612-927-9991
NJ Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd. 609-424-1300
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Freeport, Milgray/Int'l, 191 Hanse Ave 516-546-6000
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
NY New Hyde Park, Lafayette Ind'l. Elctrns., Inc., 1327 Second Ave. 516-488-6600
Ohio Cleveland, Milgray/Cleveland, 1821 E. 40th ST. 216-881-8800
Pa Philadelphia, Milgray/Delaware Valley 215-228-2000
Pa Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave 215-365-1900
Tex Houston, Lenert Co., Box 2184 713-225-1465
Wash Seattle, Kierulff - Seattle, 5940 6th Ave. S. 206-763-1550

TELEDYNE TABER, 455 Bryant St., No. Tonawanda, N.Y., 14120, Tel: 716-694-4000, TWX: 710-262-1264; Sls. Mgr: D. Flavin

TELEDYNE WESTERN WIRE & CABLE, 2425 E. 30th St., Los Angeles, Cal., 90051, Tel: 213-587-7103; V.P: S.M. Johns; Gen. Sls. Mgr: C. Hoyt

TELESCIENCES, See Automatic Production Systems Inc.

TELETYPE CORP., 5555 Touhy Ave., Skokie, Ill., 60076, Tel: 312-982-2000, TWX: 910-223-3611; Dir. Mktg: D.F. Corkle

TELEVISION MICROTIME, INC., 1280 Blue Hills Ave., Bloomfield, Conn., 06002, Tel: 203-242-0761, TWX: 710-425-2390; Sls. Mgr: R. Paulson; Mktg. Dir: R. McLean

Local Sales Offices & Reps.
Cal Los Angeles, Camera Sys. Intern'l., Inc. 213-748-8925
Cal San Diego, Recording Center, Inc. 714-295-3194
Cal Santa Clara, Tel Alpha - Audio/Video Sys. 408-247-0911
Fla Orlando, J.D. Ivey 305-423-8281
Ill Franklin Park, Rich Inc. 312-678-3100
Mass Newton, Lake Sys. Corp. 617-244-6881
Mich Ferndale, Gen. Television Network 313-548-2500
Minn Minneapolis, Intern'l. Communication Services 612-544-8931
NY New York City, The Harvey Group, Inc. 212-832-8675
NC Winston-Salem, Kirkman Elctrns. Inc. 919-724-0541
Ohio Cleveland, Elctrn. Prods. Corp. 216-692-3050
Ore Portland, Oregon Audio/Video Sys. Co. 503-224-4313
Pa Philadelphia, Marco Video Sys. Inc. 215-849-9501
Wash Seattle, Aero Marc, Inc. 206-725-1400
Exp: Can., Toronto 18, Ont., Applied Elctrns. Ltd. 416-252-3761

TELEX COMM. DIV., 9600 Aldrich Ave., S., Minneapolis, Minn., 55420, Tel: 612-884-4051, TWX: 29-7053; Nat'l. Sales Mgr: Heinz Lambrecht; Sales Administration: Art Bruns ..... Vol 1•376

Local Sales Offices & Reps.
Cal Burbank 213-849-5716
Cal Burlingame 415-697-6575
Cal Los Angeles
Colo Denver 303-756-1589
DC Washington 202-785-0885
Fla Miami 305-754-5475
Ill Chicago 312-286-6824
Md Baltimore 301-764-7189
Mass Framingham 617-875-5396
Mass Wellesley Hills 617-235-0102
Mich Detroit 313-838-9100
Minn Minneapolis 612-884-4051
NY Flushing 212-969-7600
NY Rochester 716-442-9700

Ohio Cleveland 216-382-9090
Pa Newton Square 215-353-2241
Tex Dallas 214-357-8481
For: Can., Scarborough 416-291-2501

TELEX Local Distributors
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700

TELMAR, INC., 1150 W. Third Ave., Columbus, Ohio, 43212, Tel: 614-299-2165; Dir. of Mktg: J.A. Mohrman

TELONIC INDS., INC., Box 277, Laguna Beach, Calif., 92652, Tel: 714-494-9401, TWX: 910-596-1320; Prod. Mgr: W. Anthony; Sls/Mktg. Mgr: J.R. Smith

Local Sales Offices & Reps.
Ala Huntsville, Gentry Assocs. 205-534-9771
Ariz Scottsdale, J. Smith Assocs. 602-943-4131
Cal Cupertino, T. L. Snitzer Co. 408-257-8333
Cal Del Mar, T. L. Snitzer Co. 714-454-2191
Cal Los Angeles, T. L. Snitzer Co. 213-836-6170
Fla Orlando, Gentry Assocs. 305-894-4401
Haw Honolulu, Harkon Hawaii 808-538-7178
Ill Northfield, Torkelson Assocs. 312-446-9085
Ind Indianapolis, Torkelson Assocs. 317-244-7867
Kans Lenexa, S. Sterling Co. 913-888-2995
Md Lanham, Brimberg Assocs. 301-552-2200
Mass Needham, Addelco Corp. 617-444-4754
Mich Detroit, S. Sterling Co. 313-255-1970
Minn Minneapolis, Torkelson Assocs. 612-835-2414
Mo St. Louis, S. Sterling Co. 314-542-3636
NM Albuquerque, J. Smith Assocs. 505-255-2111
NY Albany, J. A. Reagan Co. 518-489-4777
NY Flushing, F & F Associates 516-334-1160
NC Burlington, Gentry Assocs., Inc. 919-227-3639
Ohio Cleveland, S. Sterling Co. 215-442-8080
Pa Ambler, WM Assocs. 215-643-4119
Tex Dallas, Texas Avionics Co. 214-368-3566

TELREX LABS., Asbury Park, N.J., 07712, Tel: 201-775-7252; Sls. Mgr: C. Ercolino

TELVAC INSTR. CO., 14614 Raymer St., Van Nuys, Cal., 91405, Tel: 213-994-9471; Sls. Mgr: J. Gaumer

Local Sales Offices & Reps.
Md Baltimore, Milan Assoc., Inc.
Mass Babson Park, P.R. Sturgeon Co., Inc.
NY Syracuse, E. Dutcher

TELVAC Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565

TEMPIL DIV., Hamilton Blvd., So. Plainfield, N.J., 07080, Tel: 201-757-8300, TWX: 138662; Genl. Mgr: A.F. Fleury

TEMPLEMAN, D.R. CO., 8 Park St., Plainville, Conn., 06062, Tel: 203-747-2709; Sls. Mgr: O.W. Bray

TEMPO INSTRUMENT, INC., 51 E. Bethpage Rd., Plainview, N.Y., 11803, Tel: 516-694-4400, TWX: 510-224-6421; Reg. Sales: R. Reed; Reg. Sales: H. White; Liaison Mgr: R. Egyud

Local Sales Offices & Reps.
Industrial Prods. Group
Cal City of Commerce, Pacific Scientific Co. 213-927-5333
Cal San Carlos, Pacific Scientific Co. 415-592-6300
Md Baltimore, Stemler 301-944-8262
Mich Farmington, Electro-Matic Co. 313-477-7270
Minn Minnetonka, T.H. Ayres 612-935-2191
NJ Barrington, Stemler Assocs. 609-546-6238
NJ Hohokus, Alto 201-447-1770
NY Rochester, H.C. Johnson 716-482-3000
Ohio Cincinnati, Luebbe Sls. Co. 513-871-4211
Pa Paoli, Stemler Assocs. 215-644-3477
Va Alexandria, Stemler 301-255-7485
Military Prods. Group
Cal Chatsworth, Tempo 213-993-1311
Cal Mountain View, Western Sls. Assoc. 415-967-5913
Cal Van Nuys, Cardinal Assoc. 213-787-5511
Conn Essex, Lafage Assocs. 203-767-0465
Md Baltimore, Stemler 301-944-8262
Mass Waltham, Russell Assocs. 617-890-4570
Mich Southfield, Luebbe Sls. Co. 313-357-0355
Mo Kansas City, PEM Sls. Co. 816-333-6012
Mo St. Louis, PEM Sls. Co. 314-434-4425
NJ Cherry Hill, Stemler Assoc. 609-966-4070
NJ Clifton, Avionics Equip. Inc. 201-772-1956
NY Brightwaters, Russell Assocs. 516-666-6500
Ohio Cincinnati, Luebbe Sls. Co. 513-871-4211
Ohio Dayton, Luebbe Sls. Co. 513-294-0426
Tex Richardson, P.J. Scanlon Co. 214-231-4661
Va Alexandria, Stemler 703-548-7818
Exp: NYC, Aero-Spectrum Inc. 212-752-4770

TEMPTRONIX INC., 40 Glen Ave., Newton, Mass., 02159, Tel: 617-965-3420; Mgr. Mktg. & Appl: T.G. Gerendas; Appl. Eng: Dr. H. Lyden

Local Sales Offices & Reps.
Ariz Scottsdale, Allen Assocs. 602-946-4903
Cal Palo Alto, Coherent Mktg. Assocs. 415-327-2217
Fla Longwood, Lenz Engrg. Co. 305-831-9797
Ill Des Plaines (Chicago), Cozzens & Cudahy, Inc. 312-298-3600
Ind Indianapolis, Cozzens & Cudahy, Inc. 317-244-2456
Minn Minneapolis, Cozzens & Cudahy, Inc. 612-884-4336/7
Mo St. Louis, Cozzens & Cudahy, Inc. 314-423-1234
NY Elmont, Crane & Egert Corp. 516-488-2100

TENNEY ENGRG., INC., 11000 Springfield Rd., Union, N.J., 07083, Tel: 201-686-7870, TWX: 710-985-4725; Mktg. Mgr: R.S. Schiffman

Local Sales Offices & Reps.
Ala Huntsville, FM Assocs. 205-536-9990
Ariz Scottsdale, Allen Assocs. 602-946-4903
Cal Belmont, Fisher Assocs. 408-245-0986
Cal Paramount, Tenney Engrg. 213-634-8232
Colo Denver, Williams Assoc. 303-343-2911
Conn Hamden, Equipment Sls. Co. 203-248-5581
Fla Lake Worth, R.H. Brown 305-655-3392
Fla Orlando, FM Assocs. 305-851-5710
Ill Des Plaines, Marsland Assocs. 312-298-2620
Ind Indianapolis, Marsland Assocs. 317-924-3568
Md Lanham, Brimberg Assocs. 301-552-2200
Mass Chelmsford, Equip. Sls. 617-256-6547
Mich Farmington, Anderson Elctrns. 313-476-9161
Minn Minneapolis, Marsland Assocs. 612-545-4481
Mo St. Peters, Marsland Assocs. 314-278-6949
NJ Moorestown, Salem Scientific 609-235-4565
NM Albuquerque, Williams Assoc. 505-255-1638
NY Fayetteville, M.P. Andrews 315-637-3144
NC Greensboro, FM Assocs. 919-294-2754
Ohio Cleveland, Dietrich & Assocs. 216-781-1855
Ohio Dayton, Dietrich & Assocs. 513-223-2992
Okla Tulsa, Carey, Wolf & Assoc. 918-622-9233
Pa Pittsburgh, Dietrich & Assocs. 412-892-2992
Tex Austin, Carey, Wolf & Assoc. 512-345-0876
Tex Ft. Worth, Carey, Wolf & Assoc. 817-738-1996
Tex Houston, Carey, Wolf & Assoc. 713-643-2114
Utah Salt Lake City, Haskel Engrg. & Supply 801-487-2238
Wash Seattle, Showalter-Judd, Inc. 206-762-2310

TENOR CO., INC., 17020 W. Rogers Dr., New Berlin, Wisc., 53151, Tel: 414-782-3800; Sls. Mgr: R. Turnbull

TENSOLITE, Div. Carlisle Corp., W. Main St., Tarrytown, N.Y., 10591, Tel: 914-631-2300, TWX: 710-567-1202

Local Sales Offices & Reps.
Ariz Scottsdale, Piper Sls. Co. 602-946-4437
Cal Monterey Park, Aero-K.A.P. 213-573-5313
Colo Denver, Todd Assocs. 303-777-4381
Conn Canaan, Hathaway Elctrns. 617-646-1380
Fla W. Palm Beach, Kinnally 305-967-3541
Ill Chicago, J. Golten 312-725-7870
Ind Greenwood, V. Schillinger Co. 317-888-2260
Mass Arlington, Hathaway Elctrns. 617-646-1380
Minn St. Paul, Cahill Assocs. 612-739-8445
Mo St. Charles, Buse Sls. Co. 314-946-6430
NY Penfield, J. Lazor Assoc., Inc. 716-473-8337
NY Tarrytown, F. Wroblewski 914-631-2300
Pa Paoli, Stitzer Assocs. 215-644-5500
Tenn Oak Ridge, G. K. Bickford
Tex Dallas, Blackburn Assocs. 214-FL-1-9991
Va Fairfax, Snyder & Massey Assocs. 703-273-1413
Wash Seattle, Barrett Sls. Co. 206-885-6991

TERADO CORP., 1068 Raymond Ave., St. Paul, Minn., 55108, Tel: 612-646-2868; Sls. Engr: W.M. Sorenson Vol 1•906,907

Local Sales Offices & Reps.
Cal Redwood City, Sinai-Johnson, Inc. 415-363-6263
Cal Torrance, Barstow & Doran, Inc. 213-325-4140, 325-2240
Ga Atlanta, J.E. Joyner & Assocs. 404-758-7496
Ill Chicago, R. M. Weisz Assocs. 312-637-9117
Mass Northboro, W. B. Pray Sls., Inc. 617-393-3434
Minn St. Paul, W. Engelbretson 612-222-2338
NJ Caldwell, A. Cerf & Co. 201-226-2263
Tex Dallas, Maynard-Gunn Sls. Co. 214-742-2384

TERADO Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000

TERADYNE, INC., 183 Essex St., Boston, Mass., 02111, Tel: 617-482-2700, TWX: 710-321-1055; V.P. Sls: J. Prestridge

TERADYNE COMPONENTS, 900 Lawrence St., Lowell, Mass., 01852, Tel: 617-454-9195, TWX: 710-343-1758; V.P. Marketing: T. Neavitt

TEST & MEASURING INSTRS. INC., North American Philips Co., 224 Duffy Ave., Hicksville, N.Y., 11802, Tel: 516-433-8800, TWX: 510-221-1839; VP & GM: A. Katz; Prod. Mgr: A. Van Kranenburg ..... Vol 4•422-425*

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Ala Huntsville, E.G. Holmes 205-837-6900
Ariz Phoenix, Cleveland Entprs. 602-938-4620
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Cal Santa Clara, L & M Engrg. 408-243-2891
Fla Orlando, E.G. Holmes 305-241-2128
Ga Chamblee, E.G. Holmes 404-451-6161
Ill Des Plaines, Marsland Assocs. 312-298-2620
Ind Indianapolis, Marsland Assocs. 317-924-3568
Kans Merriam, Tech. Rep. Inc. 913-432-4110
Md Baltimore, Dynarep Co. 301-539-5148
Mass Waltham, Test & Measuring Instr. 617-890-0588
Minn Minneapolis, Marsland Assocs. 612-545-4481
Mo Hazelwood, Tech. Rep. Inc. 314-524-6900
NJ Cherry Hill, Test & Measuring Instr. 609-667-7711
NM Albuquerque, Cleveland Entprs. 505-298-7671
NY Hicksville, Test & Measuring Instr. 516-433-8800
NY Syracuse, Tesco Assocs. 315-463-4566
Ohio Worthington, Ohio Instrs. 614-885-0743
Tex Austin, Crockett Engrg. 516-476-6801
Tex Dallas, Crockett Engrg. 214-637-6120
Va Springfield, Dyna Rep. Co. 703-321-8630
Va Virginia Beach, E.G. Holmes 703-340-6556
Wash Seattle, Comptronics 206-284-4842
Exp: Santurce, Puerto Rico, Philips Elctrns. Inc. 809-725-4645

TESTEX INC., See Automedia Inc.

TEXAS CAPACITOR CO., INC., 7830 Westglen Dr., Houston, Tex., 77042, Tel: 713-782-9232; Sls. Mgr: R. Redding

TEXAS Local Distributors
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131

TEXAS INSTRUMENTS, Components Grp., Box 5012, Dallas, Tex., 75222, Tel: 214-238-2011, TWX: 910-867-4702; Sls. Mgr: C.M. Clough

TEXAS Local Distributors
Ala Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave.SW 205-539-5722
Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331
Cal Goleta, Radio Prods. Sls., 350 S. Kellogg Ave 805-964-6823
Cal Irvine, Cramer/L. A., 17201 Daimler St. 714-979-3000
Cal Los Angeles, Radio Prods. Sls., 1501 S. Hill St. 213-748-1271
Cal Palo Alto, Kierulff-Palo Alto, 3969 E. Bayshore Rd. 415-968-6292
Cal San Diego, Radio Prods. Sls., 7869 Clairemont Mesa Blvd. 714-292-5611
Conn Hamden, Arrow Elctrncs., 295 Treadwell St. 203-248-3801
Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641
Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181
Fla Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214 305-894-1511
Ga Atlanta, Cramer/Atlanta, 3923 Oakcliff Industrial Court 404-448-9050
Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000
Ill Mt Prospect, Cramer/Chicago, 1911 South Busse Road 312-593-8230
Md Baltimore, Arrow Elctrns., 5207 E. Drive 301-247-5200
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Kans Wichita, Penzner-Mankus Assoc. 316-782-3684
Md Towson, J-H Elctrn. Sls. 301-VA-5-4440
Mass Clinton, F. J. Coleman & Co. 617-894-1855
Mich Southfield, J. L. Montgomery, Inc. 313-358-2616
Mo Hazelwood, Penzner 314-731-4334
NM Albuquerque, Elctrn. Comp. Sls. 505-256-9831
NC Charlotte, D. G. W., Inc. 704-334-7090
NC Winston-Salem, D.G.W., Inc. 919-768-7166
Ohio Cincinnati, Giesting Assocs. 513-931-0812
Okla Okla. Cy., Ammon & Champion 405-947-1051
Ore Beaverton, Seatronics 503-640-1152
Pa Glenside, Precision Elctrns. 215-MI-6-8383
Tex Dallas, Ammon & Champion 214-233-5591
Tex Houston, Ammon & Champion 713-PA-9-1233

Utah Salt Lake Cy., Elctrn. Comp. 801-486-2317
Wash Seattle, Seatronics 206-767-4330
Exp: N.Y., N.Y., Tennant & Sons 212-889-8530
For: Can., Malton, Ont., A. Deskin Sls. Corp. 416-677-5517
For: Can., Vancouver, B.C., A. Deskin Sls. Corp. 604-253-6396
For: Can., W. Montreal, Que., A. Deskin Sls. Corp. 514-384-1420

TIMES Local Distributors
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230

TITAN TOOL SUPPLY CO., INC., 68 Comet, Buffalo, N.Y., 14216, Tel: 716-873-9907; Sls. Mgr: T. Kahn

TITCHENER, E.H. & CO., 8 Titchener Pl., Binghamton, N.Y., 13902, Tel: 607-772-1161, TWX: 510-252-1985; Sls. Mgr: R.D. Lindridge

TMC SYSTEMS (ARIZ.), 930 West 23rd St., Unit 26, Tempe, Ariz., 85282, Tel: 602-967-7874, TWX: 910-950-1943; V.P. & S.M: D.R. Robinson Vol 2•450,451

Local Sales Offices & Reps.
Cal Hawthorne, WCV Co. 213-772-4479
Cal Los Altos, IFM-North 415-961-2828
Conn New Canaan, R.H. Sturdy 203-966-2580
Fla St. Petersburg, Lynch-Gentry 813-347-5131
Fla Winter Park, Lynch-Gentry 305-671-7649
Ill Chicago, Gassner & Clark 312-764-6121
Md Baltimore, J. R. Daniel Co., Inc. 301-825-3330
Mass Wellesley Hills, R. Sturdy 617-235-2330
NY Syracuse, Naylor Elec. 315-472-9183
Pa Willow Grove, J. R. Daniel Co., Inc. 215-674-3850
Tex Dallas, Blackburn Assocs. 214-351-9991
Wash Seattle, Underwood & Underwood 206-243-2133

TOBE DEUTSCHMANN LABS., INC., Box 74, Canton, Mass., 02021, Tel: 617-828-3366; VP: T. Deutschmann Jr.

TODD PRODUCTS CORP., 123 Milbar Blvd., Farmingdale, N.Y., 11735, Tel: 516-293-3440, TWX: 510-224-6584; Sls. Mgr: P. Todd .....Vol 1•897-899

Local Sales Offices & Reps.
Ariz Scottsdale, J. Smith Assocs. 602-943-4131
Cal Fullerton, Product Data Co. 714-870-9151
Cal Los Altos, Product Data Co. 415-941-4410
Colo Boulder, J. Smith Assocs. 303-449-7509
Ill Chicago, SEA Inc. 312-282-6694
Ind Carmel, SEA Inc. 317-846-2593
Mass Braintree, Bordewieck Engrg. 617-843-0845
Mich Southfield, DATA-TRON 313-354-6421
Minn Minneapolis, SEA Inc. 612-425-4455
Mo Kansas City, Harris-Hanson Co. 816-444-9494
Mo St. Louis, Harris-Hanson Co. 314-432-3611
NJ Cherry Hill, Williams Assocs. 609-424-4110
NJ Woodcliff Lake, F&F Assocs. 201-778-6767
NM Albuquerque, J. Smith Assocs. 505-255-2111
NY Flushing, F&F Assocs. 516-334-1160
NY Guilderland, Electro-Modular Sys. 518-456-2665
Ohio Dayton, DATA-TRON 513-223-8421
Ohio Wickliffe, DATA-TRON 216-585-8421
Tex Dallas, Dwayne Clement & Assoc. 214-239-6105
Wash Seattle, R. S. Drake Assocs. 206-763-2755
Wisc Milwaukee, Sea Inc. 414-547-6637

TODD SYSTEMS, 4 Radford Pl., Yonkers, N.Y., 10701, Tel: 914-963-3400; Sls. Mgr: S. Edwards

TOHOKU METAL INDS., LTD., No 13-10, 7 chome, Ginza, Chuo-ku, Tokyo, Japan, Tel: Tokyo 542-6171; Sls. Mgr: K. Suzuki

TOLEDO SCALE, Div. Reliance Elect. Co., 5225 Telegraph Rd., Toledo, Ohio, 43612, Tel: 419-478-5811

TOPAZ ELECTRONICS, 3855 Ruffin Rd., San Diego, Cal., 92123, Tel: 714-279-0111, TWX: 910-335-1526; Mktg. Mgr: L. Towle; Sls. Mgr: J. Reed Vol 1•909-911; Vol 2•582

Local Sales Offices & Reps.
Ala Huntsville, F-M Assocs. 205-536-9990
Ariz Scottsdale, J. Smith Assocs. 602-943-4131
Cal Anaheim, Topaz Elec. 714-279-0831
Cal Los Angeles, Topaz Elec. 714-279-0831
Cal Mountain View, Topaz Elctrns. 415-968-3773
Colo Boulder, J. Smith & Assocs. 303-499-7509
Conn W. Hartford, Instr. Assocs. 203-525-9367
Fla Orlando, F-M Assocs. 305-851-5710
Ill Chicago, Sumer Inc. 312-394-4900
Ind Indianapolis, Mktg. Engrs. 317-546-1524
Iowa Cedar Rapids, Palatine Engrg. Sls. 319-365-8071
Kans Andover, Palatine Engrg. Sls. 316-613-7512
Kans Overland Park, Palatine Engrg. Sls. 913-262-5643
Md Bethesda, Bartlett Assocs. 301-656-3061
Mass Bedford, Instr. Assocs. 617-275-0700
Mich Royal Oak, Satullo 313-549-3910
Minn Hopkins, Waytek Co. 612-935-5243
Mo St. Louis, Palatine Engrg. Sls. 314-426-7055
NM Albuquerque, J. Smith & Assocs. 505-255-2111
NY White Plains, Bartlett 914-949-6476
NC Greensboro, F-M Assocs. 919-294-2754
Ohio Cleveland, Satullo Co. 216-831-6904
Ohio Dayton, Satullo Co. 513-434-9541
Ore Portland, Arnett Sls. 503-292-9746
Pa Wayne, Bartlett 215-688-7325
Tex Houston, Palatine Engrg. Sls. 713-748-4076
Tex Richardson, Palatine Engr. Sls. 214-231-9489

TOPFLIGHT CORP., 160 East 9th Ave., York, Pa., 17404, Tel: 717-843-9901, TWX: 510-657-4849; Mktg. Dir: G.A. Conover; V.P. Gen. Mgr: P.F. Masterson

TORIN CORP., Kennedy Dr., Torrington, Conn., 06790, Tel: 203-482-4422, TWX: 710-439-2343; Mktg. Svcs. Adm: E. Myers .....Vol 3•1052-1055

Local Sales Offices & Reps.
Cal Van Nuys, Torin Corp. 213-892-0741
Conn West Hartford, Torin Corp. 203-568-3790
Ill Arlington Heights, Torin Corp. 312-593-0660
Ill Elgin, Cole Dynamics 312-742-3000
Minn St. Paul, Hultgren & Strutzel Inc. 612-645-9121
NY Binghamton, Torin Corp. 607-797-7389
NY Rochester, Torin Corp. 716-586-8750
Tex Dallas, Torin Corp. 214-942-8822

TORIT CORP., 1133 Rankin St. (P.O. Box 3217), St. Paul, Minn., 55165, Tel: 612-698-0391; V.P. Sls./Mktg: T.G. Ranheim

TOROTEL, INC., 13402 S. 71 Hwy., Grandview, Mo., 64030, Tel: 816-761-6314, TWX: 910-777-7037; Sls. Mgr: H. Foland; Cust. Svc. Mgr: B. Bradshaw Vol 2•453; Vol 3•538-541,1304,1305

Local Sales Offices & Reps.
Ariz Scottsdale, Gassner & Clark 602-945-7979
Cal Los Altos, Parsons Co. 415-941-4745
Cal Los Angeles, El-Com Sls. 213-223-1351
Fla Pompano Beach, Varrelman-Gorman 305-941-5544
Fla Winter Park, Varrelman-Gorman 305-831-8688
Ill Chicago, Gassner & Clark 312-764-6121
Kans Shawnee Mission, Florence & Meyer 913-722-5210
Md Silver Sps., Mechtronics 301-622-2420
Mass Weston, J.J. Goode 617-235-3900
Minn St. Paul, H.A. Cullen 612-646-7371
NY Manhasset, Win-Cor Elctrn. 516-627-9474
NY Syracuse, T2 Elctrns. 315-463-8592
NC Charlotte, A.E. Over 704-366-8601
Ohio Cleveland, H. Teplitz 216-371-2044
Ohio Dayton, H. Teplitz 513-277-6531
Pa Birchrunville, Jadelectronics 215-647-5151
Tex Dallas, Norvell Assocs. 214-FL-7-6451
Tex Houston, Norvell 713-774-2568
Wash Bellevue, Western Tech. Sls. 206-454-3906
For: Can., Toronto, Ont., Wilson Entprs. 416-231-7536

TOROTRON, 255 Washington St., Mt. Vernon, N.Y., 10553, Tel: 914-664-2050; Ch. Eng: O. Zanger; Sls. Eng: M. Frank

Local Sales Offices & Reps.
NY Glen Cove, S. Glassman Assocs. 516-676-1039

TORQUE SYSTEMS, 225 Crescent St., Waltham, Mass., 02154, Tel: 617-891-0230; Mktg. Mgr: A.W. Siff Vol 2•322,668,991

TORR LABS., 2228 Cotner Ave., Los Angeles, Cal., 90064, Tel: 213-477-1224; Sls. Mgr: W. Shellhammer

Local Sales Offices & Reps.
Cal Palo Alto, Engrg. Assocs. 415-326-7842
Colo Greeley, G. Moss Elctrns. 303-353-1452
Ill Chicago, J. Popp Sls. Co. 312-626-3711
Iowa Cedar Rapids, J.R. Sales Engrg. 319-377-8211
NJ Haddonfield, M & S Assocs. 609-429-7055
Ohio Cincinnati, Giesting & Assocs. 513-931-0812
Tex Dallas, Evans-McDowell 214-238-7157
Wash Seattle, R.K. Squibb, Inc. 206-632-2450

TORWICO ELCTRNS., INC., Rte. 70, Lakewood, N.J., 08701, Tel: 201-364-1800, TWX: 201-363-1611; Sls. Mgr: S. Karr .....Vol 3•1307

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Cal Tarzana, R. Capell 213-987-2233
Conn Middletown, N.E. Reps., Inc. 203-344-3273
Fla Orlando, Gra-Mar, Inc. 305-894-3351
Ill Deerfield, W. Krueger 312-945-3720
Md Baltimore, W.S. Warrington & Assoc. 301-823-8759
Mass Needham Hgts., N.E. Reps., Inc. 617-449-3093
Mo St. Charles, Buse Sls. 314-946-6430
NJ Haddonfield, TAI Assocs. 609-854-3011
NY Fayetteville, H.C. Johnson 315-NE-7-9383
NY Great Neck, Trionic 516-466-2300
NY Guiderland, H.C. Johnson Agencies 518-456-9681
NY Rochester, H.C.Johnson 716-482-3000
NY Williamsville, H.C. Johnson 716-632-7880
Ohio Kent, Norco Ind'l 216-678-8462
Pa Glenshaw, H.C. Johnson Agencies 412-961-0414
Tex Fort Worth, W. Pat Fralia Co., Inc. 817-738-2394

TRA-CON, INC., 55 North St., Medford, Mass., 02155, Tel: 617-391-5550; Sls. Mgr: A. Swartz

Local Sales Offices & Reps.
Cal Mountain View, K. Anderson Co. 415-961-6007
NY Irvington, H. Shprentz Co. 914-591-7970

TRACOR, INC., 6500 Tracor La., Austin, Tex., 78721, Tel: 512-926-2800, TWX: 910-874-1372; Sls. Mgr: K.O. Mahler; Sls. Mgr: E.L. Friedrich; Sls. Mgr: H.L. Thomas

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Analytical Sales
Cal Danville, Western Scien. Assocs.
Ga Atlanta, Tracor, Inc.
Ga Chamblee, Southern Analytical Co.
Haw Kailua, W. L. Yauger
Ill Chicago, J & E Assocs.
Ind Indianapolis, Tech Sls. & Mktg.
La Baton Rouge, Tek Lab
Md Rockville, Analytical Assistance Dev.
NJ Union, Tracor Analytical Instrs.
Tex Austin, Targa Analytical Sys. Devices
Tex Austin, Tracor

Industrial Sales
Ala Huntsville, BCS Assocs.
Ariz Scottsdale, BFA Corp.
Cal N. Hollywood, M. Shovlowsky
Colo Denver, BFA Corp.
Colo Denver, Didier Denver
Fla Orlando, BCS Assocs.
Fla Plantation, BCS Assocs.
Ill Chicago, Midwest Microwave
Md Rockville, T. E. Corp.
Mass Waltham, Technical Entprs.
Mich Milford, H. M. Dyer Elctrns.
NM Albuquerque, BFA Corp.
NM Las Cruces, BFA Corp.
NY Garden City, PM Elctrns.
NC Greensboro, BCS Assocs.
Tex Euless, Data-Aids
Tex Houston, Data-Aids
Wash Seattle, Showalter-Judd

Medical Sales
Cal Oakland, J. Taylor & Assocs.
Cal Santa Fe Springs, AudioMed
Cal Whittier, Electro Medical Instrtn.
Colo Arvada, Tracoustics
Fla Orlando, Lee Assocs.
Ga Atlanta, Tracor, Inc.
Ill Chicago, Audiological Svc. & Supply
Md Frederick, D. B. Creighton Assocs.
Md Rockville, Tracor
Mass Lawrence, Medical Engrg. Assocs.
Minn New Brighton, Tracoustics
Miss Jackson, Sound & Communications
Mo St. Louis, EMI Labs.
NJ Cherry Hill, N. J. Auditory Test. & Equip.
NY New York, Madsen Electromedics
NY Staten Island, Medacoustics
Ohio Cleveland, Environmental Technology
Okla Oklahoma City, Oklahoma Audiometer Svc. Co.
Ore Portland, Sanderson Safety Supply
SC Greenville, Safeco Equip.
Tenn Chattanooga, Audio & Video Elctrn.
Tenn Kingsport, Safeco Equip.
Tex Austin, Audio-Medical Sys.
Tex Austin, Tracoustics
Tex Houston, Audio Elctrns.
Wash Seattle, Safety & Supply
For: Can., Oakville, Ont., Madsen Elctrns. Ltd.

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Cal Palo Alto, RF Assocs. 415-327-5531
Ill Highland Park, Feller Assocs. 312-433-3651
Ind Rochester, Feller Assocs. 219-223-2377
Mass Wayland, Wayland Engrg. Sls. 617-653-5256
NM Albuquerque, Premmco 505-265-9629
NY Hicksville, Salsbury Assocs. 516-938-1080
NY Skaneateles 513-252-9981
Pa Lafayette Hill, M. Lader 215-825-3177
Tex Dallas, Cain & Co. 214-369-2897
Va Woodbridge, M. Lader Co. 703-494-4731

TRANS-MET ENGRG., 601 S. Palm St., La Habra, Cal., 90631, Tel: 213-691-2266; V. P. Mktg: D.R. Hornbaker; Gen. Mgr: D. Rall

TRANS-SONICS, INC., P.O. Box 326, Lexington, Mass., 02173, Tel: 617-272-1000, TWX: 710-332-1635; Dir. of Mktg: J.P. Phillips

TRAN-TEC CORP., Box 1022, Columbus, Neb., 68601, Tel: 402-564-2748; V.P: S. Zwick

TRANS-TECH, 12 Meem Ave., Gaithersburg, Md., 20760, Tel: 301-948-3800, TWX: 710-828-0549; Sls. Mgr: E.T. Fleming

TRANSCO PRODS., INC., 4241 Glencoe Ave., Venice, Cal., 90291, Tel: 213-821-7911, TWX: 910-343-6469; Sls. Mgr: W. Schoenberger

Local Sales Offices & Reps.
Ariz Phoenix, PLS Assocs., Inc. 602-957-9110
Cal Los Altos, Jay Stone & Assocs. 415-948-4563
Colo Denver, PLS Assocs., Inc. 303-771-0140
Fla Clearwater, Southeastern Component Sls., Inc.
Ga Doraville, Transco Prods., Inc. 404-436-7544
Ill Park Ridge, RF Specialists 312-698-2044
Kans Wichita, Eugene Carbiener Assocs. 316-682-5782
Md Conowingo, Transco Prods., Inc. 301-378-3344
Md Ellicott City, VPI, Inc. 301-465-4060
Mass Brookline, L-K/Harman Assocs. 617-232-6687
Mass Easthampton, L-K/Harman Assocs. 413-527-4620
Mass Haverhill, L-K/Harman Assoc. 617-373-1313
NM Albuquerque, PLS Assocs., Inc. 505-255-2330
NY Great Neck, R.L. Diamond Inc. 516-482-8387
NY Utica, B. D. Hummel Co. 315-736-7821
NC Charlotte, Jake Rudisill Assocs. 704-377-6901
Ohio Middletown, Transco Prods., Inc. 513-423-0332
Pa Montgomeryville, VPI, Inc. 215-474-3200
Tex Ft. Worth, Carey, Wolf & Assocs. 817-738-1996
Tex Houston, Carey, Wolf & Assocs. 713-MI-3-2114
Utah Salt Lake City, PLS Assocs., Inc. 801-272-3681
Exp: Los Angeles, Tel Aviation Inc.

TRANSCON MFG. CO., 2655 Perth St. Box 20825, Dallas, Tex., 75220, Tel: 214-357-8301; Sls. Mgr: J. Clifford; Pres: D.C. Packard .....Vol 3•1412

Local Sales Offices & Reps.
Cal Inglewood, V & L 213-671-7688
Ill Chicago, Ropek-Cahill 312-287-7292
Md Phoenix, Cunningham & Assocs. 301-823-4220
Mass Lynn, Manford Sls. Co. 617-598-9119
NY Forest Hills, The Miller Co. 212-263-4446
Ohio Cleveland, Loesch Assocs. 216-241-4581
Ore Portland, J. BeLusko 503-222-4279

TRANSDUCER CONTROLS CORP., 737 N. Dodsworth, Covina, Calif., 91722, Tel: 213-331-0917; Mktg. Mgr: A.A. Isford

TRANSDUCERS, INC., 12140 E. Rivera Rd., Whittier, Ca., 90606, Tel: 213-693-2711, TWX: 910-586-1899; Vice Pres.-Mktg: H. Nielsen

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Ariz Scottsdale, Inter-Mountain Engrg. Co. 602-947-7379
Cal San Diego, L.L. Stoakes, Inc. 714-274-6281
Cal Santa Clara, Richards Associates 408-246-5860
Cal Whittier, Transducers, Inc. 213-945-3741
Colo Littleton, Eissler Sls. & Service 303-794-1779
Ga Atlanta, Technical Prods., Inc. 404-252-6745
Ill Chicago, SEA, Inc. 312-282-6694
Ind Carmel, SEA, Inc. 317-846-2593
Kans Merriam, Tech Representatives, Inc. 913-432-4110
La Harvey, SECO 504-347-4646
Md Kensington, Kinney Techn. Prod., Inc. 301-942-2226
Mich Farmington, Carter McCormic & Peirce, Inc. 313-477-7700
Minn Minneapolis, SEA, Inc. 612-425-4455
Mo Hazelwood, Tech Representatives 314-524-6900
NM Albuquerque, Inter-Mountain Engrg. Co. 505-344-2212
NY Binghamton, Labtronics, Inc. 607-775-2875
NY Depew, Labtronics, Inc. 716-685-4111
NY Syracuse, Labtronics, Inc. 315-454-9314
NY Ulster Park, Labtronics, Inc. 518-372-6649
Ohio Chagrin Falls, Transducers, Inc. 216-247-5257
Ohio Cleveland, Carter, McCormic & Peirce, Inc. 216-333-5650
Ohio Dayton, Carter, McCormic & Peirce, Inc. 513-278-5873
Ohio Worthington, Carter, McCormic & Peirce, Inc. 614-888-4466
Ore Portland, Brett Associates, Inc. 503-232-4184
Pa Abington, Bach-Stewart Assocs. 215-885-1550
Pa Pittsburgh, Carter, McCormic & Peirce, Inc. 412-824-3760
RI Rumford, R. J. Hoder 401-438-2726
Tex Dallas, R. Martin Associates 214-358-3704
Tex Dallas, Techn. Prods., Inc. 214-357-9603
Tex Houston, R. Martin Assoc. 713-462-4077
Wash Seattle, Brett Associates, Inc. 206-935-8054
Wisc Waukesha, SEA, Inc. 414-547-6637
For: Can., Calgary, Alberta, Intertechnology, Ltd. 403-265-8552
For: Can., Don Mills, Ontario, Intertechnology, Ltd. 416-447-0738

TRANSICOIL, INC., Worcester, Pa., 19490, Tel: 215-277-1300, TWX: 510-660-0132; V.P. Mktg: E.F. Hall

TRANSITRON ELCTRN. CORP., 168 Albion St., Wakefield, Mass., 01880, Tel: 617-245-4500, TWX: 710-643-6718; Mktg. Mgr: A. Berry; Nat'l. Sls. Mgr: E. Youck; Mgr. Mktg. Svcs: A. DeMeo

Local Sales Offices & Reps.
Ariz Phoenix, Transitron Elctrn. Corp. 602-278-3596
Cal Long Beach, Transitron Elctrn. Corp. 213-595-5472
Cal Mountainview, Transitron Elctrn. Corp. 415-968-1710
Colo Denver, R. G. Entprs. 303-744-2464
Fla Orlando, Transitron Elctrn. Corp. 305-241-4526
Ill Chicago, Transitron Elctrn. Corp. 312-693-3360
Ill Oak Brook, Schuten Assocs. 312-654-8645
Kans Prairie Village, Engrg. Svcs. 913-649-4000
Md Baltimore, Callas Elctrns. 301-744-7711
Mich Novi, Miltimore Sls. 313-349-5820
Minn St. Louis Park, Transitron Elctrn. Corp. 612-546-4331
Mo St. Louis, Engrg. Svcs. 314-726-2233
NJ Nutley, Necco 201-661-5059
NJ South Orange, Transitron Elctrn. Corp. 201-763-4780
NY Rochester, Ontario Tech. Sls. 716-464-8636
NC Raleigh, A. B. Andrews 919-833-5567
Ohio Dayton, Transitron Elctrn. Corp. 513-276-4141
Pa Ambler, G.C.M. Inc. 215-646-7535
Tex Richardson, Transitron Elctrn. Corp. 214-234-2406
Wash Bellevue, ElecSel Corp. 503-649-6177

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Ala Huntsville, Hall-Mark Elctrns., Box 1133 205-539-0691
Ariz Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave. 602-269-1391
Cal Chatsworth, Westates Elctrns. Corp., 20151 Bahama St. 213-341-4411
Cal Culver City, Hamilton Electro Sales 213-870-7171
Cal Gardena, Bell Inds., 306 E. Alndndra Blvd 213-321-5802
Cal Goleta, Radio Prods. Sls., 350 S. Kellogg Ave 805-964-6823
Cal Los Angeles, Radio Prods. Sls., 1501 S. Hill St. 213-748-1271
Cal Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr 415-323-9431
Cal San Carlos, Intermark, 100 Industrial Way 415-592-1641
Cal San Diego, Intermark, 7354 Convoy Ct. 714-279-5200
Cal San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd. 714-292-5611
Cal Santa Ana, Intermark, 2920 W. Warner St. 714-540-1322
Cal Sepulveda, Milgray/California, 8718 Woodley Ave 213-894-4011
Cal Van Nuys, Intermarket, 71110 Gerald Ave
Cal Woodland Hills, Semiconductor Concepts, 21201 Oxnard St. 213-884-4560
Colo Denver, Intermark, 2600 W. Second St. 303-936-8284
Fla Orlando, Milgray/Florida, 5400 Diplomat Circle 305-647-5747
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Ill Rosemont, Advent Elctrns, 7110 N. Lyndon Ave. 312-298-4210
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Wichita, Radio Supply Co., 115 Laura 316-267-5216
Md Hyattsville, Milgray/Washington, 5405 Lafayette Pl. 301-864-1111
Mass Burlington, Hamilton/Avnet Elctrns. 617-273-2120
Mass Burlington, Milgray/New England, 79 Terrace Hall Ave 617-272-6800
Mass Lexington, Harvey R & D Electrnc., 44 Hartwell Ave. 617-861-9200
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Minn Minneapolis, Harry Stark Electrns. Supply, 112 3rd Ave., N. 612-332-1325
NJ Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd. 609-424-1300
NY Binghamton, Federal Elec., Inc., Box 1208 607-748-8211
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY Freeport, Milgray/Int'l, 191 Hanse Ave 516-546-6000
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
NY Hauppauge, Semiconductor Concepts Inc., Div JACO Elctrns., Engineers Rd. 516-273-1234
NY Hauppauge, Time Elctrncs., 70 Marcus Blvd. 516-273-0100
NY New Hyde Park, Lafayette Ind'l. Elctrns., Inc., 1327 Second Ave. 516-488-6600
NY Syracuse, Hamilton/Avnet Elctrns. 315-437-2642
NY Westbury, Hamilton-Avnet Electrns., 70 State St.
NC Winston-Salem, Kirkman Elctrns., Inc., 901 W. Second St. 919-724-0541
Ohio Cleveland, Milgray/Cleveland, 1821 E. 40th ST. 216-881-8800
Pa Philadelphia, Milgray/Delaware Valley 215-228-2000
Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington
Tex Dallas, Solid State Elctrns. 214-352-2601
Wash Seattle, Hamilton/Avnet Elctrncs., 2320 6th Ave. 206-624-5930
Wash Seattle, Intermark, 621 S. Michigan Ave. 206-767-3160

TRANSMAGNETICS INC., 210 Adams Blvd., Farmingdale, N. Y., 11735, Tel: 516-293-3100, TWX: 510-224-6420; Pres: F. Haber; Chief Eng: A. Talbot; Prod. Mgr: I. Lawner .....Vol 1•379

Local Sales Offices & Reps.
Conn Bloomfield, Zaslow Sls. 203-242-7781
Minn Minneapolis, Thurston Assoc. 612-929-7801
Ohio Dayton, Berberich & Assoc. 513-252-9981

TRANSTECTOR SYSTEMS, 532 Monterey Pass Rd., Monterey Park, Cal., 91754, Tel: 213-283-9278; Sls. Mgr: R. Odenberg; Engr: B. Jameson .....Vol 2•1148

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SC Greenville, R. W. Bailey 803-233-5171

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Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
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Conn	North Haven, Cramer/Conn., 35 Dodge Ave.	203-239-5641
Fla	Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue	305-923-8181
Fla	Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214	305-894-1511
Ga	Atlanta, Cramer/Atlanta, 3923 Oakcliff Industrial Court	404-448-9050
Ill	Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave	312-437-8800
Kans	Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd.	913-888-4747
Md	Baltimore, Cramer/Baltimore, 922-24 Patapsco Avenue	301-354-0100
Md	Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive	301-948-0110
Mass	Boston, De Mambro Elctrns, 1095 Commonwealth Ave.	617-787-1200
Mass	Newton, Cramer Elctrn. Inc., 85 Wells Avenue	617-969-7700
Minn	Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St.	612-925-2944
Mo	St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave.	314-521-3800
NJ	Clifton, Eastern Radio, 312 Clifton Ave.	201-471-6600
NJ	Moonachie, Cramer/N.J., 1 Barrett Ave.	201-935-5600
NJ	Pennsauken, Cramer/Pa., 7300 Rte. 130 No.	215-923-5950
NM	Albuquerque, Cramer/N.M., 137 Vermont N.E.	505-265-5767
NY	East Syracuse, Cramer/Syracuse, 6716 Joy Road	315-437-6671
NY	Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue	516-231-5682
NY	Lynbrook, Peerless Radio, 19 Wilbur St.	516-593-2121
NY	Rochester, Cramer/Rochester, 3259 Winton Road South	716-275-0300
NY	Rome, Rome Elctrncs., 108-110 Spring St.	315-337-5400
NY	Vestal, Federal Elctrn., Vestal Pkwy.	
NC	Raleigh, Cramer/EW, 3901 Winton Road	919-876-2371
NC	Winston-Salem, Cramer/EW, 938 Burke Street	919-725-8711
Ohio	Columbus, Electronics Mktg Corp., 1150 W. Third Ave.	614-299-4161
Okla	Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave.	918-835-8458
Pa	Trevose, Hall-Mark Elctrns., Box 125	215-355-7300
Tex	Dallas, Hall-Mark Elctrns, 9100 Markville Dr.	214-AD-1-6111
Tex	Houston, Hall-Mark Elctrn., Box 36739	713-781-6100
Utah	Salt Lake City, Cramer/Utah, 391 West 2500 South	801-487-3681
Va	Charlottesville, Virginia Radio Supply Co., Box 1189	703-296-4184
Wash	Seattle, Liberty Elctrns., 5303 2nd Ave. S.	206-763-8200
Wisc	Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave.	414-476-1270
For:	Can., Ont., Scarborough, Lake Engrg. Co. Ltd., 123 Manville Rd.	416-751-5980

TRW ELCTRNC. FUNCTIONS, Davis & Copewood Sts., Candem, N.J., 08103, Tel: 609-365-5500, TWX: 710-891-7087; Sls. Mgr: J. Lundon

TRW/GLOBE MOTORS, 2275 Stanley Ave., Dayton, Ohio, 45404, Tel: 513-228-3171, TWX: 810-459-1642; Sls. Mgr: J.D. Bourque ..... Vol 2•664-667

Local Sales Offices & Reps.

Ala	Huntsville, TRW Elctrns.	205-772-9656
Ariz	Scottsdale, TRW Electronics	602-947-5791
Cal	Danville, Straube Assoc.	415-837-8151
Cal	Del Mar, TRW Electronics	714-755-8668
Cal	Los Angeles, TRW Elctrns.	213-649-1232
Cal	Menlo Park, Straube Assoc.	415-323-2476
Colo	Boulder, Straube Assocs.	303-443-8600
Conn	Rowayton, TRW Elctrns.	203-853-4466
Fla	Orlando, TRW Elctrns.	305-894-6881
Ill	Elk Grove Village, J. G. Twist Co.	312-593-0200
Ind	Fort Wayne, R. O. Whitesell & Assoc.	219-432-5591
Ind	Indianapolis, R. O. Whitesell & Assoc.	317-359-9283
Ind	Kokomo, R. O. Whitesell & Assoc.	317-453-6868
Iowa	Cedar Rapids, J. G. Twist Co.	319-365-1401
Kans	Prairie Village, J. G. Twist Co.	913-236-4646
Ky	Louisville, R. O. Whitesell & Assoc.	502-893-7303
Md	Silver Spring, NKA, Inc.	
Mass	Waltham, TRW Elctrns.	617-899-6100
Mich	Grand Rapids, R. O. Whitesell & Assoc.	616-451-8901
Mich	Southfield, R. O. Whitesell & Assoc.	313-358-2020
Mich	St. Joseph, R. O. Whitesell & Assoc.	616-983-7337
Minn	St. Paul, Northport Engrg.	612-698-3841
Mo	St. Louis, John G. Twist Co.	314-432-2830
NJ	Cherry Hills, NKA, Inc.	
NY	Garden City, Comtronic Assocs.	516-741-8966
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Ohio	Cleveland, R. O. Whitesell & Assoc.	216-333-2585
Ohio	Dayton, R. O. Whitesell & Assoc.	513-298-9546
Ore	Beaverton, N. R. Schultz Co.	503-646-1345
Pa	Narberth, TRW Elctrns.	215-667-3400
Pa	Pittsburgh, R. O. Whitesell & Assoc.	412-242-0100
Tenn	Bristol, R. O. Whitesell & Assoc.	615-968-4195
Tex	Houston, Vista Engrg. Assoc.	713-869-0109
Tex	Richardson, Vista Engrg. Assoc.	214-235-4547
Utah	Morgan, Straube Assocs.	801-829-6448
Va	Roanoke, TRW Elctrns.	703-774-5411
Wash	Bellevue, N. R. Schultz Co.	206-454-5224
Wisc	Waukesha, J. G. Twist Co.	414-786-6330
For:	Can., Port Credit, Ont., Leonard Elec. Ltd.	416-274-3454

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Ariz	Phoenix, Liberty Electrns., 3612 N. 16th St.	602-264-4438
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611

Cal Woodland Hill, Rampart Components, 21201 Oxnard St. 213-887-7260
Colo Commerce City, Elmar Electronics Inc., 6777 E. 50th Ave. 303-287-9611
Fla Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr. 305-855-4020
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747
Md Baltimore, Hall-Mark Elctrns., 6660 Security Blvd. 301-265-8500
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NY Farmingdale, Hall-Mark Elctrns., 167 Marine St. 516-293-7500
NY Hauppauge, Rampart Components, Engineers Rd. 516-273-1111
NC Raleigh, Hall-Mark Elctrns., 3000 Indust. Dr. 919-832-4465
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Wash Seattle, Liberty Elctrns., 5303 2nd Ave. S. 206-763-8200
Wisc Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave. 414-476-1270

TRW/HOLYOKE WIRE & CABLE, 720 Main St., Holyoke, Mass., 01040, Tel: 413-533-3961, TWX: 710-351-1337; Sls. Mgr: E.L. Bryon .....Vol 3•1414

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Colo Boulder 303-443-8600
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Mass Reading 617-944-3020
Mich Detroit 313-873-1150
Minn Minneapolis 612-835-5454
Mo St. Louis 314-727-7370
NJ Clifton 201-545-0990
NY Melville L.I. 516-293-9000
NY Rochester 716-461-3070
Ohio Dayton 513-298-9862
Pa Glenside 215-887-7520
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Wash Seattle 206-633-3160

TRW INSTRS., 139 Illinois St., El Segundo, Cal., 90245, Tel: 213-535-0854, TWX: 910-348-6676; Sls. Mgr: R.L. Wallstrom

TRW/IRC FIXED RESISTORS, Box 393, Boone, N.C., 28607, Tel: 704-264-8861, TWX: 510-936-3241; Sls. Mgr: J. Mac Williams .....Vol 3•1180,1182-1185

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Cal Menlo Park, Straube Assoc. 415-323-2476
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DC Washington, TRW EN 1-3155
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Ind Kokomo, R.O. Whitesell Assoc. 317-453-6868
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Ky Louisville, R.O. Whitesell Assoc. 502-893-7303
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NM Albuquerque, Straube Assoc. 505-294-1880
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Pa Narberth, TRW 215-667-3400
Pa Pittsburgh, R.O. Whitesell Assoc. 412-242-0100
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Utah Morgan, Straube Assoc. 801-829-6448
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Wisc Waukesha, J.G. Twist Co. 414-786-6330
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Exp: San Juan, Puerto Rico, M. Saliss 809-764-1842

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Cal Anaheim, R. V. Weatherford, 1550 Babbitt Ave. 714-547-0891
Cal Glendale, R. V. Weatherford, 6921 San Fernando Rd. 213-849-3451
Cal Irvine, Cramer/L. A., 17201 Daimler St. 714-979-3000
Cal Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr 415-323-9431
Cal Palo Alto, R. V. Weatherford, 3240 Hillview Ave. 415-493-5373
Cal Pomona, R. V. Weatherford, 1095 E. Third St. 714-623-1261
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Cal San Diego, R. V. Weatherford, 7872 Raytheon Rd. 714-278-7400
Cal Santa Clara, Moltronics, Inc., 337 Mathews St. 408-244-7600
Cal South Gate, Moltronics, Inc., 5610 E. Imperial Hwy. 213-773-6521
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Fla Orlando, Hall-Mark Elctrn., 7233 Lake Ellenor Dr. 305-855-4020
Ill Elk Grove Vi, Hall-Mark Elctrns. Corp., 180 Crossen Ave 312-437-8800
Kans Lenexa, Hall-Mark Elctrn., 9006 Rosehill Rd. 913-888-4747
La Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094 318-423-6131
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Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
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Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mass Newton, Cramer/International, 85 Wells Ave. 617-969-7700
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Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
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NY Hauppauge, Rampart Components, Engineers Rd. 516-273-1111
NY Rochester, Rochester Radio, 140 Main St. 716-454-6300
NC Raleigh, Hall-Mark Elctrns., 3000 Indust. Dr. 919-832-4465
NC Raleigh, Pytronic Inds., 4509 Creedmoor Rd. 919-782-6370
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
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Pa Montgomeryville, Pyttronic Inds. Inc., Stump Rd., Box 433 215-643-2850
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
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Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Wash Seattle, R.E. Priebe, 2211 5th Ave. 206-682-8242
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Wisc Milwaukee, Hall-Mark Elctrns., 11925 Ripley Ave. 414-476-1270

TRW/IRC FIXED RESISTORS, 2850 Mt. Pleasant St., Burlington, Iowa, 52601, Tel: 319-754-8491, TWX: 910-525-1135; Sls. Mgr: J. Krebill
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Ariz Scottsdale, TRW 602-947-5791
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Colo Boulder, Straube Assocs. 303-443-8600
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Fla Orlando, TRW 305-894-6881
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Cal San Diego, R. V. Weatherford, 7872 Raytheon Rd. 714-278-7400
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Cal South Gate, Moltronics, Inc., 5610 E. Imperial Hwy. 213-773-6521
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Mo Kansas City, Burstein Applebee 816-561-5460

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Neb Lincoln, Burstein Applebee 402-434-0678
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Pa Montgomeryville, Pyttronic Inds. Inc., Stump Rd., Box 433 215-643-2850
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
Pa Trevose, Hall-Mark Elctrns., Box 125 215-355-7300
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TRW/IRC FIXED RESISTORS, 401 N. Broad St., Philadelphia, Pa., 19108, Tel: 215-922-8900, TWX: 710-670-2286; Sls. Mgr: R.A. Glover
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Ohio Cleveland, R.O. Whitesell Assoc. 216-333-2585
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Md Baltimore, Hall-Mark Elctrns., 6660 Security Blvd. 301-265-8500
Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Minn Minneapolis, Hall-Mark Elctrns., 4555 W. 77th St. 612-925-2944
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
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NJ Clifton, Eastern Radio, 312 Clifton Ave. 201-471-6600
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NM Albuquerque, Williams-Assocs. Inc. 505-255-1638
NY E. Syracuse, Ossmann Instrs., Inc. 315-437-6666
NY Rochester, Ossmann Instrs., Inc. 716-328-2230
NY Vestal, Ossmann Instruments, Inc. 607-785-9947
NY Wappingers Falls, Ossmann Instruments Inc. 914-297-7777
Ohio Cleveland, WKM Assocs., Inc. 216-267-0445
Ohio Dayton, W K M Assocs., Inc. 513-434-7500
Pa Pittsburgh, WKM Assocs., Inc. 412-892-2953
Tex Garland, Tucker Elctrns. Co. 214-348-8800
Wash Seattle, R.S. Drake Assocs., Inc. 206-763-2755

TURNER DIV., Conrac Corp., 909 17th St., N.E., Cedar Rapids, Iowa, 52402, Tel: 319-365-0421; Sls. Mgr: J. Andrews; OEM Sls. Mgr:; B. Hite

Local Sales Offices & Reps.
Ala Birmingham, M. F. Taylor Co. Distr. only 205-853-3673
Cal Culver City, Wes Alderson Co., Inc. Distr. & OEM 213-837-1398
Cal Redwood City, Sinai-Johnson Distr. & OEM 415-365-6263
Colo Colorado Springs, Norris & Company Dist. only 303-635-9319
Fla Casselberry, M. F. Taylor Co. Distr. only 305-838-0821
Haw Waianae, F. Blackwell Distr. only 808-696-3283
Ind Carmel, Weeks Assocs., Inc. Distr. only 317-846-0296
Iowa Des Moines, K-S-W Assocs. Distr. & OEM 515-279-9235
La Lacombe, Scott Ormsby & Assocs. Distr. only 504-882-7248
Md Catonsville, M. F. Taylor Co. Distr. only 301-747-5718
Md Gatihersburg, M. F. Taylor Co. Distr. only 301-869-3470
Md Silver Springs, M. F. Taylor Co. Distr. only 301-589-4002
Md Silver Springs, M. F. Taylor Co. Distr. only 301-946-3569
Mass Needham, Piper Assocs., Inc. Distr. & OEM 617-449-1144
Mass Plymouth, Piper Assocs., Inc. Dist. & OEM 617-746-6522
Mich Rochester, R. A. Albrecht Co. Distr. only 313-651-7081
Minn Minneapolis, S. Clothier Co., Inc. Distr. & OEM 612-869-3231
Mo Kansas City, K-S-W Assocs. Distr. & OEM 816-363-5651
Mo St. Louis, K-S-W Assocs. Dist. & OEM 314-781-6111
NY Buffalo, R. W. Mitscher Co., Inc. Distr. & OEM 716-854-2518
NY Rockville Centre, Willgold Elctrn. Sls. Corp. Distr. & OEM 516-764-4022
NC Charlotte, M. F. Taylor Co. Distr. only 704-537-4878
Ohio Columbus, Weller Elctrns. Sls., Inc. Distr. only 614-885-7819
Ore Salem, M. K. Widdekind Co. Distr. & OEM 503-363-6445
Pa Philadelphia, M. F. Taylor Co. Distr. only 215-676-5332
Tex Addison, Parvin Sls. Co. OEM only 214-239-9148
Tex Dallas, E. L. Wilks Co. Distr. only 214-242-5321
Tex Houston, Parvin Sls. Co. OEM only 713-721-1054
Wash Seattle, M. K. Widdekind Co. Distr. & OEM 206-284-8020
Wisc Brookfield, Steffen Sls. Distr. only 414-781-7596

TURNER Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

TYCO FILTERS DIV. INC., 3940 W. Montecito St., Phoenix, Ariz., 85019, Tel: 602-272-7945; Sls. Mgr: H. Schinaman .....Vol 2•454

Local Sales Offices & Reps.
Ariz Phoenix, Lange Assocs. 602-942-0724
Cal Mt. View, Nor-Cal Assocs. 415-961-8121
Cal Placentia, K'SON Corp. 714-524-1700
Colo Denver, Omega Ltd. 303-758-1508
Fla Orlando, G.F. Bohman Assocs. 305-855-0274
Ill Franklin Park, Dekotech, Inc. 312-455-5100
Ind Fort Wayne, TYCO 219-432-5591
Ind Indianapolis, R.O. Whitesell & Assocs.
Ind Kokomo, TYCO 317-453-6868
Ky Louisville, TYCO 502-893-7303
Md Millerville, Tomco Sls. Co. 301-987-1650
Mass Needham, A & M Elctrn. Reps. 617-444-8172
Mich Southfield, TYCO 313-358-2020
Mich St. Joseph, TYCO 616-983-7337
Minn Minneapolis, Stan Clothier Co. 612-869-3231
Mo Kansas City, Admack Sls. Co.
NJ Cherry Hill, J. N. Barrett Assocs. 609-429-1551
NY Dewitt, Tri-Tech Elctrns. 315-446-2881
Ohio Cincinnati, TYCO 513-521-2290
Ohio Cleveland, TYCO 216-333-2585
Ohio Columbus, TYCO
Ohio Dayton, TYCO 513-298-9546
Pa Pittsburgh, TYCO 412-242-0100
Tenn Bristol, TYCO 615-968-4195
Tex Richardson, Air Quip Sls. Company 214-239-8991
For: Can., Ste. Dorothee - Laval, Que., Harnett Entprs.

TYLAN CORP., 4203 Spencer St., Torrance, Calif., 90503, Tel: 213-370-3521, TWX: 910-344-6420; Sls. Mgr: D.B. LeMay; Sls: S.F. Ely; Sls: R. Howe

Local Sales Offices & Reps.
Cal Santa Clara, Tylan Corp. 408-248-8718
NJ Morris Plains, Tylan Corp. 201-540-8333

UBER GRAFIC INSTRS., Box 4, Palo Alto, Calif., 94302, Tel: 415-327-4732; Pres: D. Kroener

UID ELCTRNS. CORP., 4105 Pembroke Rd., Hollywood, Fla., 33021, Tel: 305-981-1211, TWX: 510-954-9810; V.P. Mktg: R.J. Stanish .....Vol 2•1149

Local Sales Offices & Reps.
Ala Huntsville, Powertronics 205-852-6347
Ariz Scottsdale, Barnhill Five 602-947-7841
Ark El Dorado, D. Bellew Sls., Inc. 501-863-8325
Cal Garden Grove, Impact Elctrns. 213-431-3581
Cal Menlo Park, G.R. McKnight Co. 415-325-2844
Colo Denver, Barnhill Five 303-934-5505
Conn Manchester, G-M Assoc. 203-646-4443
Fla Altamonte Spg., W.M.M. Assocs. 305-831-4645
Fla Clearwater, W.M.M. Assocs. 813-726-8871
Fla Miami Lakes, Man Rep. Corp. 305-822-7630
Fla Pompano Beach, W.M.M. Assocs. 305-943-3091
Ill Elk Grove Village, J. G. Twist 312-593-0200
Ind Ft. Wayne, R. O. Whitesell 219-432-5591
Ind Indpls., R. O. Whitesell 317-359-9283
Ind Kokomo, R. O. Whitesell 317-453-6868
Iowa Cedar Rapids, J. G. Twist Co. 319-365-1401
Kans Prairie Village, J. G. Twist Co. 913-236-4646
Ky Louisville, R. O. Whitesell 502-893-7303
Md Baltimore, J.R. Daniel & Co. 301-825-3330
Mass Framingham, G-M Assocs. 617-872-0333
Mich Grand Rapids, R.O. Whitesell & Assoc. 616-451-8901
Mich Southfield, R.O. Whitesell & Assoc. 313-358-2020
Mich St. Joseph, R. O. Whitesell & Assoc. 616-983-7337
Minn Mpls., R. J., Inc. 612-922-1425
Mo St. Louis, J. G. Twist Co. 314-432-2830
NM Albuquerque, Barnhill Five 505-299-7658
NY Jamaica, S. J. Sls. 212-291-3232
NY New York, Multiparts Corp. 212-944-4370
NY Rochester, L. Hart 716-244-3253
NC Greensboro, J.R. Daniel & Co. 919-294-1067
NC Thomasville, Powertronics 919-476-6727
Ohio Dayton, J. C. Hofstetter 513-298-0662

Ohio Medina, J. C. Hofstetter 216-241-4880
Pa Pittsburgh, J.C. Hoffstetter Co. 412-561-5454
Pa Willow Grove, J.R. Daniel & Co. 215-674-3850
SC Greenville, Powertronics, Inc. 803-244-1336
Tenn Bristol, R. O. Whitesell 615-968-4195
Tex Dallas, E. B. Robertson 214-942-2711
Tex Houston, E. B. Robertson 713-785-6800
Wash Seattle, R. Johnston 206-524-5170
Wisc Waukesha, J. G. Twist 414-786-6330
For: Montreal 261, Que., Can., Atlas Elctrns. 514-489-8495
For: Toronto 19, Ontario, Can., Atlas Elctrns. 416-781-6174

ULTRA-VIOLET PRODS., INC., 5100 Walnut Grove Ave., San Gabriel, Cal., 91778, Tel: 213-285-3123; Dir. Mktg: R.F. Vogelsang; Sls. Mgr. Sci. Div: J.R. Norton

ULTRASONIC CORP., Box 672, Pipestone, Minn., 56164, Tel: 507-825-5441; Sls. Mgr: S. Lodahl; Pres: B. Brual

ULTRASONIC INSTRS. INT'L., INC., 165 EM Marine St., Farmingdale, N.Y., 11735, Tel: 516-293-5577; Sls. Mgr: P. Platzman ..... Vol 1•938

ULTRONIX, INC., 461 N. 22nd St., Grand Junction, Colo., 81501, Tel: 303-242-0810, TWX: 910-929-6965; Sls. Mgr: B. Moore; Mktg. Mngr: J. Stinson

UNDERWRITERS SAFETY DEVICE CO., 4332 N. Kedzie Ave., Chicago, Ill., 60618, Tel: 312-583-4080; Sls. Mgr: H.R. Ege

UNGAR, Div. Eldon Inds., Inc., 233 E. Manville St, Compton, Calif., 90220, Tel: 213-774-5950; Pres: W.L. Nehrenz

Local Sales Offices & Reps.
Cal Burlingame, Elvey-Proctor 415-347-2994
Cal Inglewood, Ungar Sls. 213-678-5371
Colo Denver, K-C Marketers, Inc. 303-733-5561
Ill Chicago, G. McL. Cole 312-774-3535
Ind Indianapolis, F.J. McSweeney 317-255-3777
Iowa Des Moines, K.S.W. Assocs.
Md Silver Spring, M.F. Taylor 301-589-4002
Mass Needham, Mullin Tech. Sls. 617-444-4780
Mich Detroit, R. Milsk 313-342-6660
Minn Minneapolis, Heimann 612-861-6051
Mo Kansas City, K.S.W. Assocs. 816-363-5651
NY Buffalo, R.W. Mitscher 716-854-2517
NY Oceanside, Bittan Assocs. 516-593-3833
Ohio Cleveland, Baehr-Greenleaf 216-221-9030
Pa Pittsburgh, Covert & Newman Co. 412-563-0303
Tex Dallas, Texport 214-358-3435
Wash Seattle, J.J. Backer 206-285-1300

UNGAR Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Cal San Diego, Western Radio, 1415 India St. 714-235-6571
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Colo Denver, Burstein-Applebee 303-244-3336
Conn Fairfield, Utronic Inc., 273 Linwood Ave. 203-255-4521
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Burstein-Applebee 312-763-4848
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Iowa Cedar Rapids, Iowa Radio Supply Co. Inc., 719 Center Point Rd. NE 319-364-6154
Kans Kansas City, Burstein-Applebee 816-561-5460
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Mich Muskegon, Western Elctrn Supply, 1781 5th St 616-722-7628
Mich Romulus, Pioneer/Michigan, 6337 N. Beverly Plaza 313-729-8500
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Mo Kansas City, Burstein Applebee 816-561-5460
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Lincoln, Burstein Applebee 402-434-0678
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NJ Springfield, Federated Elctrns. Div. Federated Purchaser, Inc., 155 Rte. 22 201-376-8900
NY Binghamton, Wilshire Elctrns., 617 Main St., Westover Plaza 607-797-1236
NY Buffalo, Radio Equip. Corp., 196 Vulcan St 716-874-2690
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Ohio Akron, Sun Radio Co., 110 E. Market St. 216-HE-4-2171
Ohio Cleveland, Pattison Supply Co., 4550 Willow Pkwy. 216-441-3000
Ohio Cleveland, Pioneer Standard Elctrns., Inc., 4800 E. 131st St. 216587-3600
Ohio Dayton, Pioneer/Dayton, 1900 Troy St. 513-236-9900
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Ohio Warren, REM Elctrns. Supply Co., 264 W. Market St. 216-399-2777
Okla Tulsa, Oil Capitol Elec., 708 S. Sheridan 918-836-2541
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Erie, Mace Elctrn., 2631 W. 8th St. 814-838-3544
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Tex Houston, Geophysical Supply Co., Box 52230 713-224-0621
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Tex Houston, Lenert Co., Box 2184 713-225-1465
Utah Salt Lake City, Standard Supply Co., 225 E. 6th So. 801-355-2971
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Va Roanoke, Peoples Radio & Tv Supply Co., 1015 Moorman Rd
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801

UNHOLTZ-DICKIE CORP., 3000 Whitney Ave., Hamden, Conn., 06518, Tel: 203-288-3358; Pres: J.A. Dickie; V. Pres: K. Unholtz L. Shaw ..... Vol 1•530

Local Sales Offices & Reps.
Ala Huntsville, W. Brown 205-539-6884
Cal Redondo Beach, Unholtz-Dickie Corp. 213-378-9418
Conn Hamden, W.W. Jarowey Co. 203-288-3010
Fla Ft. Lauderdale, W. Brown 305-564-8000
Fla Orlando, W. Brown 305-425-5505
Ill Northfield, Torkelson Assocs. 312-446-9085
Ind Indianapolis, Torkelson Assocs. 317-244-7867
Kans Wichita, Aero-Hill Sls. 316-943-6371
Mich Farmington, Anderson Elctrns. 313-476-9161
Minn Minneapolis, Torkelson Assocs. 612-920-1046
NM Albuquerque, Elctrn. Entprs. 505-256-3561
NM Las Cruces, Elctrn. Enterprises 505-524-0126
NY No. Merrick, Space-Tronics 516-TN-8-1800
NC Winston-Salem, W. Brown 919-725-5384
Ohio Cleveland, Dietrich & Assocs. 216-781-1855
Ohio Dayton, Dietrich & Assocs. 513-223-6042
Pa Pittsburgh, Dietrich & Assocs. 412-892-2992
Tex Dallas, Merit Co. 214-352-8040
Va Alexandria, W. Brown 703-836-1800

UNIFORM TUBES, MicroDelay Division, Collegeville, Pa., 19426, Tel: 215-539-0700, TWX: 510-660-6107; Div. Mgr: A.W. McCrea ..... Vol 3•1415

Local Sales Offices & Reps.
Ariz Scottsdale, Gleason Sls. 602-946-3992
Cal Los Altos, Marketek, Inc. 415-941-0882
Cal Newport Bch., Uniform Tubes 714-833-1470
Cal Van Nuys, C.W. Swift & Assoc. 213-989-1133
Colo Denver, Crump Co. 303-534-5183
Conn Meriden, J. Anderson 203-269-1812
Fla Winter Park, Floritronics Inc. 305-886-4818
Ga Atlanta, Knapp-Richardson 204-233-3204
Ill Des Plaines, Coombs Assocs. 312-298-4830
Ill Schiller Pk., Uniform Tubes 312-671-2717
Ind Fort Wayne, Coombs Assocs. 219-747-0402
Mass Newburyport, J. Murphy 617-465-0304
Mass Seekonk, J. Murphy 617-SO-1-7153
Mo St. Louis, Coombs Assocs. 314-567-3399
Mo St. Louis, C.S. Ryan Co. 314-993-0350
NY Fairport, L. Bagley 716-377-2059
NY Mt. Vernon, Friedman-Smith Elctrn. Sls. 914-664-4866
NC Charlotte, J. H. Smith 704-394-4210
Ohio Cleveland, R. Reich 216-331-0541
Okla Tulsa, G.V. Peck Co. 918-585-5853
Pa Bala Cynwyd, Vantage Sls. 215-667-0990
Tex Dallas, G.V. Peck Co. 214-328-3511
Tex Houston, G.V. Peck Co. 713-664-1435
Wash Bellevue, Barrett Sls. 206-885-6991
Exp: Can., Nobleton, Ont., Braydon Electro 416-859-0712
Exp: Can., Toronto, Ont., Braydon Electro 416-787-1941
Exp: N.Y., New York, Ad. Auriema, Inc.

UNIMAX SWITCH CORP., Riker-Maxson Sub., Ives Rd., Wallingford, Conn., 06492, Tel: 203-269-8701, TWX: 710-476-1397; V.P. Mktg: A.J. Schweitzer ..... Vol 2•1150

Local Sales Offices & Reps.
Ala Huntsville, Rep., Inc. 205-881-9270
Ariz Scottsdale, DeAngelo, Rothman & Cheever, Inc. 602-947-8626
Cal LA, M.A. Stolaroff 213-295-7781
Cal Los Altos, Ewing-Foley 415-941-4525
Colo Boulder, Straube Assocs. 303-443-8600
Conn Bloomfield, Zaslow Sls. 203-242-7781
Fla Oviedo, Conley & Assoc. 305-365-3283
Ga Atlanta, Rep., Inc. 404-876-1592
Ill Chicago, Wasson-Gallagher 312-261-7517
Ill Oak Pk., Wasson-Gallagher 312-383-6572
Ind Marion, O.H. Bromberg 317-664-5384
Ky Louisville, O. H. Bromberg 502-245-8916
Md Silver Spring, L.G. White 301-585-3141
Mass Lowell, Zaslow Sls. 617-458-8452
Mass Northboro, Zaslow Sls. 617-393-8150
Mich Grosse Pointe Park, Skip Greiner 313-499-0188
Minn Mpls., Jos-Co. Sls. Engrg. 612-835-5858
Mo St. Louis, Hill & Co. 314-621-1818
NJ Clifton, Grimm, Siegel Assoc. 201-546-5010
NM Albuquerque, Straube Assoc. 505-294-1880
NY Binghamton, Canavan-Scanlon Assoc. 607-724-7220
NY Buffalo, Canavan-Scanlon Assoc. 716-839-3373
NY Rochester, Canavan-Scanlon Assoc. 716-442-0720
NY Syracuse, Canavan-Scanlon Assoc. 315-463-9161
NC Winston-Salem, L.G. White 919-725-3612
Ohio Cincinnati, O.H. Bromberg 513-381-5728
Ohio Medina, J. Hofstetter 216-241-4880
Pa King of Prussia, White-Keystone 215-265-1817
Tenn Little Rock, Electra-Tech 501-562-4090
Tex Dallas, Glidden Electro & Equip. 214-363-6539
Tex Houston, Glidden Electro & Equip. 713-681-1415
Utah Salt Lake City, Straube Assoc. 801-272-2197
Wash Mercer Island, J. H. Andersen 206-232-0484
For: Can., Burlington, Ont., Motion Control Dev. 416-637-9369

UNIMAX Local Distributors
Ariz Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave. 602-269-1391
Cal Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd. 415-961-7000
Colo Denver, Hamilton/Avnet Electronics 303-534-1212
Ga Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd. 404-448-0800
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400
Mo Hazelwood, Hamilton/Avnet Electronics 314-731-1144
Tex Dallas, Hamilton/Avnet Elctrns., 2403 Farrington
Tex Houston, Hamilton/Avnet Elctrns., 1216 W. Clay
Utah Salt Lake City, Hamilton/Avnet Elctrns. 801-262-8451
For: Can., Montreal, Hamilton/Avnet Elctrns. 514-735-6393
For: Can., Ottawa, Ont., Hamilton/Avnet Elctrncs., 880 Lady Ellen Pl.
For: Can., Toronto, Ont., Hamilton/Avnet Elctrns. 416-789-1838

UNION CARBIDE, Carbon Prods. Div., 270 Park Ave., New York, N.Y., 10017

UNION CARBIDE, CHEMICALS & PLASTICS, 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-4641

UNION CARBIDE, Consumer Prods., 270 Park Ave., New York, N.Y., 10017, Tel: 212-551-2345; Mgr: R.J. Price ..... Vol 1•919

Local Sales Offices & Reps.
Cal El Monte 213-579-0401
Cal San Francisco 415-765-1400
Ga Atlanta 404-633-6161
Ill Chicago, East Central Div. 312-822-7000
Ill Chicago, West Central Div. 312-822-7445

Kans Shawnee Mission 913-362-2203
Mass Needham Hts 617-444-5400
Minn Mpls 612-333-0415
NJ Cherry Hill 609-235-6200
NJ Westwood 201-664-7400
Ohio Cleveland 216-621-4207
Ore Portland 503-223-7175
Tenn Memphis 901-526-7421
Tex Dallas 214-631-0012

UNION CARBIDE, Films Packaging Div., 6733 W. 65th St., Chicago, Ill., 60638, Tel: 312-735-1234

UNION CARBIDE, Linde Div., 270 Park Ave., New York, N. Y., 10017, Tel: 212-551-2345

UNION CARBIDE, Mat'ls. Sys. Div. Comps. Dept., Box 5928, S.E. Greenville, S.C., 29606, Tel: 803-963-7421, TWX: 810-287-2536; Mgr. Mktg. Svcs: R.J. Irion Vol 3*511

Local Sales Offices & Reps.
Ariz Phoenix, Union Carbide 602-264-7332
Cal Marina Del Rey, Union Carbide 213-821-8824
Cal Mt. View, Union Carbide 415-969-9390
Cal San Diego, Celtec Co. 714-279-7961
Colo Denver, Parker-Webster Co. 910-935-0881
Fla Orlando, G. F. Bohman Assocs. 305-855-0274
Ill Chicago, Union Carbide 312-298-8340
Ind Indianapolis, L. M. DeVoe Co. 317-257-1227
Iowa Cedar Rapids, Seltec Sls. 319-362-8155
Kans Andover, Palatine Engrg. Sls. 316-683-7512
Kans Overland Park, Palatine Engrg. Sls. 913-262-5643
Mass Needham Heights, Union Carbide 617-444-5400
Mich Detroit, R. C. Merchant Co. 313-535-6000
Mich St. Joseph, R. C. Merchant Co. 616-983-7378
Minn Minneapolis, S Clothier Co. 612-869-3231
Mo St. Louis, Palatine Engrg. Sls. 314-426-7055
NY Liverpool, Union Carbide 315-451-0720
NY Tarrytown, Union Carbide 914-345-2047
Ohio Cincinnati, Baehr, Greenleaf & Assocs. 513-891-3826
Ohio Columbus, Baehr, Greenleaf & Assocs. 614-486-4046
Ohio Lakewood, Baehr, Greenleaf & Assocs. 216-221-9030
Ore Beaverton, Arneson Assocs. 503-646-3416
Pa King of Prussia, Union Carbide 215-265-0525
SC Greenville, Union Carbide 803-963-7421
Tex Addison, Parvin Sls. Co. 214-239-9148
Tex Houston, Parvin Sls. Co. 713-721-1054
Wash Seattle, Arneson Assocs. 206-762-7664
For: Can., Malton, Ont., Deskin Sls. Corp. 416-677-5517
For: Can., Montreal, Que., Deskin Sls. Corp. 514-384-1420

UNION Local Distributors
Ariz Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave. 602-269-1391
Cal Culver City, Hamilton Electro Sales 213-870-7171
Cal Gardena, Bell Industries, 306 E. Alondra Blvd. 213-321-5802
Cal Hollywood, Hamilton/Avnet Elctrncs. 305-925-5401
Cal Los Angeles, Kierulff-Los Angeles, 2585 Commerce Way 213-685-5511
Cal Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr 415-323-9431
Cal Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd. 415-961-7000
Cal San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd. 714-279-1550, 279-2421
Cal Woodland Hills, JACO Elctrncs. 213-887-6400
Colo Denver, Hamilton/Avnet Electronics 303-534-1212
Fla Hollywood, Schweber Elctrns. 305-927-0511
Ga Atlanta, Hamilton/Avnet Elctrncs., 6700 1-85 Access Rd. 404-448-0800
Ga Atlanta, Schweber Elctrns. 404-449-9170
Ill Chicago, Schweber Elctrns. 312-593-2740
Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000
Ill Rosemont, Kierulff - Chicago, 9340 William St. 312-678-8560
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Cal Downey, Sierra Pacific 213-738-1815
Colo Littleton, Western Image 303-798-8830
Fla Orlando, Buchanan & Abrams 305-423-8795
Kans Leawood, Vasen Sales 913-649-0679
Md Randallstown, J. M. Chavis Assoc. 301-484-6349
Mass No. Andover, R.C. Ashworth & Assoc. 617-688-4333
Minn St. Paul, Knox Assocs. 612-488-5412
NJ Plainfield, Allied Sls. Corp.
Ohio Cincinnati, Val-Skol Sales
Pa Newtown Square, Hagy Assocs.
Tex Dallas, Stasco
Wash Seattle, F. Haight Co.

U.S. SCIENTIFIC INSTRS., 36 Pleasant St., Watertown, Mass., 02172, Tel: 617-923-0940; Sls. Mgr: S. Eric Kondi

Local Sales Offices & Reps.
Cal Newport Beach, Wolff Engrg. Corp. 714-646-1754
Ill Northfield, Laub Engrg. 312-446-4166
Md Silver Spring, Spectroscopy Sys. 301-949-8261
Mich Detroit, Harvey Tpelitz & Co. 313-537-9058
NJ Leonia, B. Kohl 201-944-6488
NY N. Syracuse, NACO Elctrns. 315-699-2651
Ohio Cleveland, H. Teplitz & Co. 216-371-2044

USM CORP., Fastener Group, 510 River Rd., Shelton, Conn., 06484, Tel: 203-735-9341, TWX: 710-451-3734; Prod. Mgr. Eyelet Div: C.P. Losh; Prod. Mgr. "Pop" Rivet Div: E. Dalterio

UTAH ELCTRNS., Div. Utah American Corp., 1124 E. Franklin St., Huntington, Ind., 46750, Tel: 219-356-5800; Mktg. Mgr: A. Altenhof; Gen. Sls. Mgr: J. Neumann

UTAH Local Distributors
Cal Garden Grove, Allied Elctrns., 12311 Industry St. 213-598-6605
Cal San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.
Ill Chicago, Allied Elctrns., 2400 W. Washington Blvd. 312-421-2400
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021

UTE MICROWAVE, 3500 Sunset Ave., Asbury Park, N.J., 07712, Tel: 201-922-1009; G.M: L. Nilson

UTICA TOOL CO., INC., Cameron Rd., Orangeburg, S.C., 29115, Tel: 803-534-7010, TWX: 810-664-2460; Sls. Mgr: R.L. Carlson

UTICA Local Distributors
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700

UTHE TECHNOLOGY INT'L., 320 Soquel Way, Sunnyvale, Cal., 94086, Tel: 408-738-3301; Sls. Mgr: S.R. Goldfarb; Sls. Mgr: V.D. Quandt

VACO PRODS. CO., 510 N. Dearborn St., Chicago, Ill., 60610, Tel: 312-467-0123, TWX: 910 221 2231; Sls. Mgr: B. Broude ..... Vol 3•952,953,1242

VACO Local Distributors
Ariz Tucson, Inland Elctrn Supply Co., Inc, Box 4010, 715 E. Broadway
Cal San Diego, Shanks and Wright Inc., 2045 Kettner Blvd. 714-239-0176
Ga Atlanta, Jackson Elctrncs., 1135 Chattahoochee Ave. NW 404-355-2223
Ill Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.
Ill Palatine, Ohm/Elctrns, 645 Vermont Ave 312-359-5500
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Minn Duluth, Northwest Radio, 123 E. First St. 218-727-1565
Neb Omaha, J-B Distributing Co., 1616 Cass St 402-341-5525
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Pa Altoona, Allegheny Elctrns, Inc, 800 Chestnut Ave
Pa Reading, Barbey Elctrn., 333 N. 4th St.
Tex Ft. Worth, Swieco, Inc., Box 670, 1518 E. Lancaster St 817-335-6521
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801
Wisc Milwaukee, Marsh Elctrns., 6047 W. Beloit Rd. 414-545-6500

VACTEC, 2423 Northline Ind'l. Blvd., Maryland Hgts., Mo., 63043, Tel: 314-872-8300; Sls. Mgr: M.D. Levy Vol 2•679

Local Sales Offices & Reps.
Cal Encino, King-Way Assocs. 213-788-4124
Cal Santa Barbara, E.B. Schwerin 805-967-7317
Colo Arvada 303-423-5556
Conn Madison, A & M Elctrn. Reps. 203-245-1031
Fla Orlando, Buchanan & Abrams 305-423-8995
Ill Chicago, T.B. Hunter 312-777-2500
Ind Fort Wayne, Scott Elctrns. 219-743-1586
Ind Indianapolis, Scott Elctrns. 317-635-8951
Kans Prairie Village, Engrg. Svcs. Co. 913-649-4000
Md Baltimore, R. L. Wilkinson 301-377-7800
Mass Needham, A & M Elctrn. Reps. 617-444-8170
Mich Detroit, H. Mysing 313-537-5460
Minn Mpls., M. Foster 612-835-2252
Mo St. Louis, Engrg. Svcs. 314-726-2233
NY Syracuse, C.W. Beach 315-446-9587
Ohio Cincinnati, Scott Elctrns. 513-791-2513
Ohio Cleveland, Scott Elctrns. 216-291-2600
Ohio Columbus, Scott Elctrns. 614-236-8619
Ohio Dayton, Scott Elctrns. 513-223-2652
Pa Pittsburgh, Scott Elctrns. 412-781-3112
Pa Willow Grove, Tech. Parts 215-659-6900
Tex Dallas, Allied Comps. 214-348-6660
Tex Houston, Allied Comps. 713-782-5406
Utah Salt Lake City, Arrowhead Sls. Corp. 801-487-3444
Va Lynchburg, Royelec Elctrns. 703-846-7717
Wash Seattle, Blair Hirsh 206-783-3423
Exp: Mass., Plainville, Teknis 617-695-3591
For: Can., Montreal, Que., Ben-Manis Assoc. 514-336-4500

VACTRONIC LAB. EQUIP., INC., 65 Brightside Ave., E. Northport, N.Y., 11731, Tel: 516-AN-1-2660; Sls. Mgr: R. Morris

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VACUUM RESCH. MFG., 3100 Crow Canyon Rd., San Ramon, Cal., 94583, Tel: 415-837-7241; Sls. Mgr: N.A. Carter

VALIDYNE ENGRG. CORP., 19414 Londelius St., Northridge, Cal., 91324, Tel: 213-886-8488; Sls. Mgr: M.J. Kopp

VALPEY CORP., A Valtec Co., 1400 Highland St., Holliston, Mass., 01746, Tel: 617-429-4322; Sls. Mgr: N.E. Benoit

VANGUARD RELAY CORP., 225 Cortland St., Lindenhurst, N.Y., 11757, Tel: 516-884-5000; Sls. Mgr: B.S. Gilman

VARADYNE CAPACITORS, 2110 Broadway, Santa Monica, Cal., 90404, Tel: 213-829-2984, TWX: 910-343-6856; Mktg. Mgr: K. Miller; Sls. Mgr: P. Bowling Vol 3•512-514

Local Sales Offices & Reps.
Ala Huntsville, Tech Rep. Associates 205-881-2786
Ariz Phoenix, Hecht, Henschen & Assoc. Inc. 602-275-4411
Cal Menlo Park, Straube Assoc. 415-323-2476
Cal Northridge, Orion Sls. 213-240-3151
Cal Tustin, Orion Sls. 714-832-9687
Colo Boulder, Straube Rocky Mountain 303-443-8600
Conn North Haven, Kitchen & Kutchen 203-239-0212
Fla Indian Rocks Beach, Tech Rep Assocs. 813-595-2834
Fla Melbourne, Tech Rep Assocs. 305-723-9140
Ill Skokie, Mar-Con 312-675-6450
Ind Fort Wayne, TX Sales 219-485-0805
Md Baltimore, Callas Elctrns. 301-744-7711
Mass Lexington, Kitchen & Kutchen 617-862-8230
NJ Teaneck, R. T. Reid Assocs. 201-692-0200
NM Albuquerque, Straube Assoc. 505-294-1880
NY Buffalo, Bowser & Sapecky 716-839-4170
NY DeWitt, Bowser & Sapecky 315-446-5920
Pa Ambler, G.C.M. Assocs. 215-646-7535
Tex Dallas, Evans & McDowell Assoc. 214-238-7157
Tex Houston, Evans & McDowell Assoc. 713-777-1282
Utah Salt Lake City, Straube Rocky Mountain 801-328-4513
Wash Bellevue, Vantage Corp. 206-455-3460

VARFLEX CORP., 514 W. Court St., Rome, N.Y., 13440, Tel: 315-336-4400; Sls. Mgr: J.H. Finnegan Vol 3•1088

Local Sales Offices & Reps.
Ariz Phoenix, Elec. Specialty 602-275-5736
Cal Los Angeles, Electrical Spec. Co. 213-724-9600
Cal San Diego, Elec. Specialty Co. 714-239-1345
Cal So. San Francisco, Electrical Spec. Co. 415-589-9611
Colo Denver, Elec. Specialty 303-321-0226
Ga Chamblee, Prehler Elec. Insulation 404-451-4266
Ill Chicago, Prehler Elec. Insulation 312-384-6100
Ky Louisville, E & H Elec. Supply 502-587-0991
Mass Nahant, F.H. Hart 617-581-0381
Minn St. Paul, Prehler Elec. Insulation 612-776-1541
Mo University City, E.P. Gund 314-862-1650
NM Albuquerque, Elec. Specialty 505-842-5555
NY Carle Pl., W. R. Murphy 516-333-6122
NY Liverpool, W.T. Elliott 315-652-3690
Ohio Cleveland, Prehler Elec. Insulation 216-267-2650
Ore Portland, Elec. Specialty 503-227-3601
Pa Ardmore, Martin Elec. Co. 215-649-6332
Pa Phila., Prehler Elec. Insulation 215-725-5913
Pa Pittsburgh, E.B. Beach Co. 412-242-0400
Tex Houston, Hisco Elec. Insulation 713-228-6662
Utah Salt Lake City, Elec. Specialty 801-487-9805
Wash Seattle, Elec. Specialty 206-682-3434
For: Can., Toronto, Ont., Elec. Insulation & Fibre Co., Ltd. 416-251-1174

VARI-L CO., INC., 3833 Monaco Pkwy., Denver, Colo., 80207, Tel: 303-321-1511, TWX: 910-931-0590; V.P. Mktg: J. Kiser Vol 2*584,585,622-628; Vol 3*1308-1310

Local Sales Offices & Reps.

Cal	San Jose, All-Good North	408-288-6731
Cal	Santa Ana, Calif. Elctrn. Mktg.	714-835-2702
Cal	Woodland Hills, Calif. Elctrn. Mktg.	213-884-7867
Colo	Denver, Thorson Co.	303-355-3521
Fla	Longwood, Saber Assocs.	305-241-0742
Kans	Leawood, H.C. Heyde	913-649-8628
Md	Ellicott City, Applied Eng.	301-465-1272
Mass	Burlington, Tritek	617-272-4550
Mich	Southfield, T. Luebbe	313-357-0355
NM	Albuquerque, Cleveland Entprs.	505-298-7671
NY	Fayetteville, Graydon-Sherman	315-637-9861
NY	Hicksville, Salsbury	516-938-1080
Ohio	Cincinnati, Luebbe Sls.	513-871-4211
Pa	Cornwall, Applied Engrg.	202-783-7319
Tex	Dallas, Texas Avionics	214-368-3566
Wash	Seattle, D. Smith	206-633-3160
Exp:	N.Y., NY; S. Ginsbury	212-689-5212
For:	Can., Toronto, Ont., Wilson Entprs.	416-231-7536

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VARI-LIGHT CORP., Sub. Polacoat Inc., 9770 Conklin Rd., Cincinnati, Ohio, 45242, Tel: 513-791-6330

VARIAN ASSOCS., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731

VARIAN ASSOCS., Eastern Tube Div., 8 Salem Rd., Beverly, Mass., 01915, Tel: 617-922-6000, TWX: 710-347-1394; Mkt. Mgr: G.W. Karlsruher

Local Sales Offices & Reps.

Ariz	Scottsdale, Varian Assocs.	602-947-5461
Cal	Los Altos, Varian Assocs.	415-968-7630
Cal	Santa Monica, Varian Assocs.	213-828-5588
Fla	Clearwater, Varian Assocs.	813-446-8513
Fla	Lighthouse Point, Varian Assocs.	305-943-9495
Ga	Atlanta, Varian Assocs.	404-252-0045
Ill	Park Ridge, Varian Assocs.	312-825-6686
Md	Cheverly, Varian Assocs.	301-773-7010
Mass	Waltham, Varian Assocs.	617-890-4560
NJ	Cherry Hill, Varian Assocs.	609-428-6800
NJ	Springfield, Varian Assocs.	201-376-6600
NM	Albuquerque, Varian Assocs.	505-345-3827
NY	Syracuse, Varian Assocs.	315-437-2568
Ohio	Dayton, Varian Assocs.	513-298-7318
Tex	Richardson, Varian Assocs.	214-235-2385

VARIAN ASSOC., Solid State East Div., Micro-Link Prods., 8 Salem Rd., Beverly, Mass, 01915, Tel: 617-922-6000, TWX: 710-347-1394; Sls. Mgr: D.D. Milne

Local Sales Offices & Reps.

Ariz	Scottsdale, Varian Assocs.	602-947-5461
Cal	Los Altos, Varian Assocs.	415-968-7630
Cal	Santa Monica, Varian Assocs.	213-828-5588
Fla	Clearwater, Varian Assocs.	813-446-8513
Fla	Lighthouse Point, Varian Assocs.	305-943-9495
Ga	Atlanta, Varian Assocs.	404-252-0045
Ill	Park Ridge, Varian Assocs.	312-825-6686
Md	Cheverly, Varian Assocs.	301-773-7010
Mass	Waltham, Varian Assocs.	617-890-4560
NJ	Cherry Hill, Varian Assocs.	609-428-6800
NJ	Springfield, Varian Assocs.	201-376-6600
NM	Albuquerque, Varian Assocs.	505-345-3827
NY	Syracuse, Varian Assocs.	315-437-2568
Ohio	Dayton, Varian Assocs.	513-298-7318
Tex	Richardson, Varian Assocs.	214-235-2385

VARIAN ASSOCS., Travel Wave Tube Div., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731; Mktg. Mgr: J. Middaugh

VARIAN ASSOCS., Vacuum Div., 611 Hansen Way, Palo Alto, Cal., 94303, Tel: 415-493-4000, TWX: 910-373-1731; Ad. Mgr: N.F. Gross

Local Sales Offices & Reps.

Cal	Downey, Varian Vacuum Div.	213-927-2601
Cal	Los Altos, Varian Vacuum Div.	415-968-4936
Fla	Clearwater, Varian Vacuum Div.	813-446-8513
Ill	Park Ridge, Varian Vacuum Div.	312-825-3103
Md	Cheverly, Varian Vacuum Div.	301-772-7433
Mass	Waltham, Varian Vacuum Div.	617-890-5750
NJ	Springfield, Varian Vacuum Div.	201-376-6610
NY	Syracuse, Varian Vacuum Div.	315-437-3307
Ohio	Euclid, Varian Vacuum Div.	216-261-2115
Tex	Richardson, Varian Vacuum Div.	214-235-4586

VARIAN DATA MACHINES, 2722 Michelson Dr., Irvine, Cal., 92664, Tel: 714-833-2400, TWX: 910-596-1358; V.P. Mktg: H. Stover

Local Sales Offices & Reps.

Ala	Huntsville, BCS Assocs.	205-881-6220
Ariz	Scottsdale, Williams Assocs.	602-947-4297
Cal	Garden Grove	213-598-4438
Cal	San Diego	714-298-9292
Cal	Sunnyvale	408-736-5630
Colo	Denver, Williams Assocs.	303-388-4391
Conn	Hartford, Instr. Assocs.	203-525-9367
Fla	Orlando, Varian Data Mach.	305-645-2577
Ga	Atlanta, Varian Mach.	404-252-0047
Ill	Park Ridge	312-692-7184
Ind	Indianapolis, Carter Elctrns.	317-293-0696
Md	Cheverly	301-773-6770
Mass	Waltham	617-890-6072
Mich	Southfield	313-645-9950
Minn	Minneapolis, Carter Elctrns.	612-544-9393
Mo	St. Louis, Varian Data Mach.	314-524-0880
NJ	Union, SBM Assocs.	201-687-8737
NM	Albuquerque	505-298-5570
NY	Englewood Cliffs	212-325-5248
NY	Rochester, Varian Data Mach.	716-586-3273
NC	Greensboro, BCS Assocs.	919-273-1918
Ohio	Euclid, Varian Data Mach.	216-261-2115
Pa	Ft. Washington	215-643-2355
Tex	Houston	713-781-0105
Tex	Richardson	214-231-5145
Tex	San Antonio, Data Mktg. Assoc.	512-828-0937
Wisc	Milwaukee, Carter Elctrns.	414-464-5555

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VARIAN Local Distributors

Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
La	Baton Rouge, Ralph's, Inc., 1732 Plank Rd.	504-344-3761
La	Lafayette, Ralph's Inc., 3004 Cameron St.	318-234-4507
La	New Orleans, Ralph's, Inc., 4334 Stemway Dr.	504-242-2731
Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
NY	New York, Midway Ind'l. Elec., 38 E. 29th St.	212-889-0370
Tex	Beaumont, Ralph's, Inc., 1270 Broadway	713-833-9443

VARIAN, Solid State East Div., Salem Rd., Beverly, Mass., 01915, Tel: 617-922-6000, TWX: 710-347-1394; Mktg. Mgr: T. Soldano

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Local Sales Offices & Reps.

Ariz	Scottsdale	602-947-5461
Cal	Los Altos	415-968-7630
Cal	Santa Monica	213-828-5588
Fla	Clearwater	813-446-8513
Fla	Lighthouse Point (Ft. Lauderdale), Varian Assocs.	305-943-9495
Ga	Atlanta	404-252-0045
Ill	Park Ridge	312-825-6686
Md	Cheverly	301-773-7010
Mass	Waltham	617-890-4560
NJ	Cherry Hill	609-428-6800
NJ	Springfield	201-376-6600
NM	Albuquerque	505-345-3827
NY	Syracuse	315-437-2568
Ohio	Dayton	513-298-7318
Tex	Richardson	214-235-2385
For:	Can., Georgetown, Ont., Varian Assocs. of Can. Ltd.	416-877-6901

VARO, INC., Electrokinetics Div., 402 E. Gutierrez St., Santa Barbara, Cal., 93102, Tel: 805-963-2055, TWX: 910-334-1177; Mktg. Mgr: N.G. Otis

VARO, Electron Devices Inc., Box 1437, 2203 Walnut St., Garland, Tex., 75040, Tel: 214-272-3561, TWX: 910-860-5194; Sls. Mgr: R. Sherrod

VARO SEMICONDUCTOR, INC., Box 676, Garland, Tex., 75040, Tel: 214-272-4551, TWX: 910-860-5178; V.P: H. Hess; Prod. Sls. Mgr: C. Merz; Prod. Sls. Mgr: J. Garvin Vol 2*968-974

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Ariz	Phoenix, W.W. Posey Co.	602-934-1335
Cal	Los Altos, W. W. Posey Co.	415-948-7771
Cal	Los Angeles, Corcoran Assoc.	213-823-2425
Colo	Golden, J.F. Hurlbut Co.	303-279-7138
Conn	No. Haven, Comp. Rep. Assoc., Inc.	203-239-9762
Del	Wilmington, T Davis Marketers	302-998-0123
Fla	Orlando, Buchanan & Abrams Assoc.	305-423-8995
Ill	Lombard, Olson Sls., Co.	312-627-3802
Ind	Indpls., Tech. Reps., Inc.	317-546-4967
Mass	Needham, Comp. Rep. Assoc., Inc.	617-444-2484
Mich	Farmington, Davis-Martensen Co.	313-474-8300
Minn	Mipls., L.F. Green Assoc.	612-781-1611
Mo	St. Louis, Coombs Assoc.	314-567-3657
NY	Great Neck, Cooper-Simon & Co.	516-487-1142
NY	Ithaca, Bob Dean, Inc.	607-272-2187
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Ohio	Medina, J. Hofstetter Co.	216-241-4880, 725-4477
Ohio	Twinsburg, J.C. Hofstetter Co.	216-425-4133
Ore	Portland, C.K. Shanks Assoc.	503-292-5656
Pa	Pittsburgh, J.C. Hofstetter Co.	412-561-5454
Tex	Garland, Whiteside Sls. Co.	214-231-9771
Tex	Houston, Whiteside Sls. Co.	713-498-2551
Va	Fairfax, T. Davis Mktrs.	703-591-7390
Wisc	Brookfield, Olson Sls. Co.	414-782-7590
For:	Can., Ontario, Downsview, Cantronics, Inc.	514-733-0749
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Cal	Chatsworth, Westates Elctrns. Corp., 20151 Bahama St.	213-341-4411
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Menlo Park, Bell Inds., Elctrn Distr. Div., 1070 Obrien Dr	415-323-9431
Cal	Sepulveda, Milgray/California, 8718 Woodley Ave	213-894-4011
Colo	Denver, Electronic Parts	303-266-3755
Fla	Orlando, Milgray/Florida, 5400 Diplomat Circle	305-647-5747
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ill	Skokie, Bell Inds. Elctrn. Distr. Div., 7701 N. Austin Ave.	312-282-5400
Md	Hyattsville, Milgray/Washington, 5405 Lafayette Pl.	301-864-1111
Mass	Burlington, Milgray/New England, 79 Terrace Hall Ave	617-272-6800
Mich	Livonia, Cramer/Detroit, 13193 Wayne Road	313-425-7000
NJ	Cherry Hill, Milgray/Delaware Valley, 1165 Marlkress Rd.	609-424-1300
NY	Freeport, Milgray/Int'l, 191 Hanse Ave	516-546-6000
NY	Freeport, Milgray/New York, 191 Hanse Ave	516-546-6000
Ohio	Chesterland, Bridgefield Supply	216-729-9451
Ohio	Cleveland, Milgray/Cleveland, 1821 E. 40th ST.	216-881-8800
Pa	Philadelphia, Milgray/Delaware Valley	215-228-2000
Tenn	Memphis, Bluff City Distr. Co., Box 418, 234 East St.	901-725-9500
Tex	Ft. Worth, Allied Elctrns., 401 E. 8th St.	817-336-5401
Tex	Richardson, Altair Co., 405 N. Plano Rd.	214-231-5166
Wash	Bellevue, Bell Industries	206-747-1515
For:	Can., Hamilton, Ont., Western Radio Supply	416-528-0151
For:	Can., Montreal, Prelco Elctrns., 480 Port Royal St. W.	514-389-8051
For:	Can., Ont., Toronto, Electro Sonic, 543 Yonge St.	416-924-9301
For:	Can., Vancouver, B.C., R.A.E. Ind. Elctrns.	604-687-2621

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Local Sales Offices & Reps.

Exp: Cal., Santa Monica, Trans-World Trade

VECTOR Local Distributors

Ala	Huntsville, Powell Elctrns/Huntsville, Box 1095, 803 Oster Dr.	205-539-2731
Cal	Garden Grove, Allied Elctrns., 12311 Industry St.	213-598-6605
Cal	Goleta, Radio Prods. Sls., 350 S. Kellogg Ave	805-964-6823
Cal	Los Angeles, Radio Prods. Sls., 1501 S. Hill St.	213-748-1271
Cal	Mt. View, Abacus Elctrns. Co., Inc., 1065 Terra Bella Ave.	415-961-1500
Cal	Mt. View, Elmar Elctrn., 2288 Charleston Rd.	415-961-3611
Cal	Mt. View, Powell Elctrns/California, Box 997, 411 Fairchild Dr.	415-964-0820
Cal	San Diego, Radio Prods. Sls., 7889 Clairemont Mesa Blvd.	714-292-5611
Cal	San Jose, Quement Ind'l. Elctrns., 1000 S. Bascom Ave.	
Fla	Miami Springs, Powell Elctrns/Florida, Box 514, 1740 NW 69th Ave	305-885-8761
Fla	Orlando, Powell Elctrns/Florida, Box 5604, 2032 Palmridge Way	305-859-1450
Ill	Chicago, Allied Elctrns., 2400 W. Washington Blvd.	312-421-2400
Ind	Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave.	219-742-4346
Ky	Louisville, Burks, P.I., 842 S. 7th	502-589-3960
La	Shreveport, Interstate Elec. Co., 1419 Culpepper, Box 1094	318-423-6131
Md	Beltsville, Powell Elctrns/Washington, 10728 Hanna St.	301-937-4030
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565

Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700
NJ Pennsauken, Recso Eltrns.-Div. of Astex, Airport & Central Hwys. 609-662-4000
NY Lynbrook, Peerless Radio, 19 Wilbur St. 516-593-2121
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Ohio Akron, Akron Elctrn. Supply, 107 S. Arlington St 216-762-8818
Ohio Cincinnati, United Radio Co., Summit & Reinhold Dr. 800-582-7080
Ore Portland, Almac/Stroum Elctrns, 8888 SW Canyon Rd 503-292-3534
Pa Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave 215-365-1900
Tex Ft. Worth, Allied Elctrns., 401 E. 8th St. 817-336-5401
Tex Houston, Harrison Equip. Co. Inc., 1616 McGowen St. 713-224-9131
Va Norfolk, Priest Elctrn., 6431 Tidewater Dr. 703-855-2021
Wash Seattle, Almac/Stroum Elctrns, 5811 Sixth Ave S. 206-763-2300
Wisc Madison, Satterfield Elctrn., 1900 S.Park St. 608-257-4801

VECTOR ENGRG., See American Vector Inc.

VECTOR INDUSTRIES, A Teledyne Co., 821 San Antonio Rd.,,Palo Alto, Cal., 94303, Tel: 415-327-2955, TWX: 910-373-1770; Sls. Mgr: J.L. Mongillo

VECTROL, INC., 1010 Westmore Ave., Rockville, Md., 20850, Tel: 301-424-6900, TWX: 89-8354; VP - Sls: R. Mitchell; VP-Engrg: N. Muskovac; Sls. Mgr: B. Strayton

Local Sales Offices & Reps.
Cal Little Rock, Electra Tech Midsouth 501-562-4090
Cal Redondo Beach, Control Switches Inc. 213-372-2181
Cal San Francisco, Artwell Elec. Co. 415-467-1880
Fla Tequesta, Dell-Tech Control Co. 305-746-7483
Ga Roswell, Cascade Control Co. 404-993-1667
Ill Chicago, Markson Assocs. 312-267-1905
Md Baltimore, B. White & Co. Inc. 301-484-5400
Mass Braintree, Bordewieck Eng. Sls. Co. 617-843-0845
Mich Southfield, Sterling-Lowell 313-352-8881
NJ Ridgewood, Ballou Inc. 201-444-6990
NY Lancaster, Lawrence Industrial Sls. 716-685-1993
Ohio Cleveland, Adcon Engineering Co. 216-888-7977
Ohio Dayton, Wheland Corp. 513-434-7551
Ore Portland, Dyna Tech. 503-265-1455
Pa Valley Forge, Gil-Tronics 215-933-8525
Tex Hurst, Southwest Transformer 817-267-0011
Wisc Milwaukee, E.A. Dickinson & Assocs. 414-264-1080

VECTRON LABS., INC., 121 Water St., Norwalk, Conn., 06854, Tel: 203-853-4433; Sls. Mgr: L. Jawitz; Gen. Mgr: A. Camhi ..... Vol 2•455

Local Sales Offices & Reps.
Ala Huntsville, FM Assocs. 205-536-9990
Cal Los Angeles, Fetty/Schoenduve 213-651-4050
Cal Palo Alto, Fetty/Schoenduve 415-321-7041
Colo Loveland, Kelley Entprs. 303-667-1376
Fla Orlando, FM Assocs. 305-851-5710
Fla Tequesta, FM Assocs. 305-746-3126
Ill Skokie, Heth Inc. 312-282-8737
Ind Indianapolis, RF Specialists 317-783-7630
Kans Overland Park, Ensco-Rep., Inc. 913-381-7557
Mich Grand Rapids, R. P. Urban Assocs. 616-245-0511
Minn Fridley, Heth, Inc. 612-333-8494
Mo St. Louis, Ensco-Rep 314-567-3935
NJ Woodcliff Lake, F & F Assoc. 201-778-6767
NY Flushing, F & F Assoc 516-334-1160
NY Syracuse, Rep Tech 315-437-2845
NC Greensboro, FM Assocs. 919-294-2754
Ohio Brecksville, A. Nace Co. 216-526-4323
Ohio Englewood, A. Nace Co. 513-836-7548
Pa Newtown Sq., SWR Assocs. 215-356-8550
Pa Pittsburgh, A. Nace Co. 412-922-7225
Tex Dallas, Texas Avionics 214-363-6324
Va Falls Church, Jay Co. 703-534-7800
Wash Seattle, Datacom 206-285-2525

VEEDER-ROOT, 70 Sargeant St., Hartford, Conn., 06102, Tel: 203-527-7201; Sls. Mgr: O.T. Olsen Vol 2•378

Local Sales Offices & Reps.
Cal Glendale 213-245-8421
Ill Des Plaines 312-824-0188
Mich Detroit 313-886-7473
Minn Minneapolis 612-866-4811
NJ Ridgewood 201-445-2401
NY Rochester, Veeder-Root 716-244-0500
Ohio Cincinnati 513-271-6200
Ohio Cleveland 216-462-2634
Pa Willow Grove 215-887-0708
SC Greenville 803-288-2133
Tex Arlington 214-252-3360
For: Can., Toronto, Ont. 416-239-3094

VEGA PRECISION LABS., 800 Follin La., Vienna, Va., 22180, Tel: 703-938-6300; Sls. Mgr: D.M. Kruchko Vol 1•568,569

Local Sales Offices & Reps.
Cal El Cajon, R. B. Nowlan 714-448-3240
Fla Panama City, E. L. Loyall 904-763-9666
Kans Mission, Inland Assocs. 913-362-2366
Md Ellicott City, H Doss 301-465-1336
NY New York, TECHNITRON 212-758-2790
NY Rome, B. DiMaggio 315-337-2900

VELONEX, Instrument Div., 560 Robert Ave., Santa Clara, Calif., 95050, Tel: 408-244-7370, TWX: 910-338-0114; Mktg. Mgr: Elliott Rudee

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Ala Huntsville, E. G. Holmes & Assoc. 205-837-6900
Ariz Phoenix, R. A. Mayes Co. 602-279-5243
Ark Wichita, Winco, Inc. 316-684-8224
Cal Costa Mesa, Measurement Assocs. 714-540-7160
Cal Palo Alto, Mauldin Co. 415-326-5291
Colo Broomfield, R. A. Mayes Co. 303-466-6311
Conn Hamden, P. Jenks Assocs., Inc. 203-248-9361
Fla Orlando, E. G. Holmes & Assoc. Inc. 305-894-8901
Ga Chamblee, E. G. Holmes & Assoc. Inc. 404-451-6161
Ill Chicago, K. W. Meyers Co. 312-774-6440
Ind Indianapolis, K. W. Meyers Co. 317-243-6681
Kans Wichita, Winco, Inc. 316-684-8224
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Mich Detroit, Hocker Assocs. Inc. 313-531-1403
Minn Minneapolis, K. W. Meyers Co. 612-920-7080
NM Albuquerque, R. A. Mayes Co. 505-265-7989
NY Liverpool, Scientific Devices 315-457-7420
Ohio Cleveland, Hocker Assocs. Inc. 216-743-4433
Ohio Dayton, Hocker Assocs. Inc. 513-298-8638
Tex Richardson, R. A. Mayes Co. 303-466-6311
Va Arlington, 703-527-3262 Co.
For: Can., Montreal 252, P. Q., Baytronix Ltd. 514-733-5331

VEMALINE PRODS. CO., 455 W. Main St., Wyckoff, N.J., 07481, Tel: 201-891-3200; Sls. Mgr: C.J. Dawkins; Sls. Eng: C. Rotzler; Sls. Corres: A. Biondo

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Cal Encino, El/Tec 213-981-9881
Cal Santa Clara, Ruby Sls. Corp. 408-243-1694
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Conn Meriden, Electro Prods. Sls. 203-235-4040
Fla Delray Beach, CES Assoc. 305-276-5071
Ill Chicago, Ropek-Cahill 312-287-7292
Ind Indianapolis, Skidmore Assoc. 317-844-3429
Mass Waltham, Electro Prods. Sls. 617-899-1570
Mich Grand Rapids, R. P. Urban Assoc. 616-245-0511
Minn Bitronics Sls. Co., 7700 Morgan Ave. S.E. 612-866-3035
NY Kingston, Ossmann Comps. Sls. 914-338-5505
NY Rochester, Ossmann Comps. Sls. Corp. 716-442-3290
NY Syracuse, Ossmann Comps. Sls. 315-454-4477
Ohio Cleveland, Loesch Assoc. 216-241-4581
Pa Abington, IMS Co. 215-659-0444
SC Greenville, Egun Assoc. 803-288-4450
Tex Dallas, Blackburn Assoc. 214-351-9991
Wash Seattle, F.W. Aurich & Co. 206-284-5561
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NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370

VENT-RAK, Div. General Devices Co., 525 S. Webster Ave., Indianapolis, Ind., 46219, Tel: 317-359-5407; Div. Mgr: H.L. Crouch ..... Vol 3•320,321

Local Sales Offices & Reps.
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Ariz Scottsdale, F. Schoeffler Assoc. 602-948-3470
Cal Mtn. View, G. C. Woempner Co. 415-964-5454
Cal W. Covina, Groh Assoc. 213-338-8217
Conn Waterbury, Coakley, Boyd & Abbett, Inc. 203-756-8766
Fla Winter Pk., Young & Lawrence Assocs. 305-647-6929
Ill Chicago, R.M. Krueger Co. 312-282-8444
Ind Indianapolis, Marketing Engineers 317-546-1523
Kans Overland Park, Lowell Kangas & Assoc. 913-888-3200
Md Bethesda, G. Rosen & Assocs., Inc. 301-530-8448
Mass Needham, Coakley, Boyd & Abbett, Inc. 617-444-5470
Minn Minneapolis, Hasse & Assocs. 612-588-0551
Mo St. Louis, Lowell-Kangas & Assoc. 314-821-4050
NM Albuquerque, Toltec Corp. 505-268-4366
NY Manhasset, Kaelber & Mack 516-627-6620
Ohio Cleveland, Components Co. 216-842-2737
Tex Houston, R. Martin Assocs. 713-468-3577
Wash Seattle, Bergford Assoc. 206-937-6664

VENTRON CORP., Elctrn. Materials Div., Bradford, Pa., 16701, Tel: 814-362-3586, TWX: 510-695-5110; Gen. Sls. Mgr: C.R. Smith

VENUS SCIENTIFIC, 399 Smith St., Farmingdale, N.Y., 11735, Tel: 516-293-4100, TWX: 510-224-6492; Sls. Secy: R. Becker; Sls. Engr: T. Krilovich; Sls. Engr: T. Tucker Vol 1•928-930

Local Sales Offices & Reps.
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Fla Lighthouse Point, Saber Assocs. 305-943-3076
Ga Atlanta, Immco 404-435-0079
Ill Chicago, Delta Tech. Sls. 312-693-3380
Kans Overland Park, B. Rush Assocs. 913-831-4259
Mass Norwood, S. Pierce Inc. 617-762-3164
Minn St. Paul, H. Cullen Assocs. 612-646-7371
NJ Cherry Hill, H. J. White Co. 609-428-4544
NY Great Neck, E.R.A. Inc. 516-HU-2 -9320
NY Syracuse, Nycom Inc. 315-437-8343
Tex Richardson, P.J. Scanlon Co. 214-AD-1-4661
Va Alexandria, Vanguard Engrg. 703-768-1660
Exp: N.Y., NY, Sylvan Ginsbury 212-689-5212

VERNITECH, Div. of Vernitron Corp., 300 Marcus Blvd., Deer Pk., N.Y., 11729, Tel: 516-586-5100, TWX: 510-227-6079; Mktg. Mgr: C.W. Joiner Vol 1•380,381; Vol 2•543,669

Local Sales Offices & Reps.
Cal Los Angeles, Halbar 213-387-8283
Cal San Mateo, Halbar Assocs. 415-349-4700
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DC , Dyna Rep 703-321-8630
Fla St. Petersburg, Orbe, Inc. 813-894-0687
Ga Jonesboro, EEMCO 404-432-4276
Ill Hinsdale, Momak 312-654-4524
Kans Overland Park, Dy-Tronix 816-931-3030
Md Bel Air, Dyna Rep 301-879-2586
Mass Lexington, Kitchen & Kutchin 617-VO-2-8230
Mich Grand Rapids, Urban Assoc.
Mo Hazelwood, Dy-Tronix 314-731-5799
NJ Cherry Hill, A. C. Lanson 609-424-4670
NM Albuquerque, Technology Mktg. 505-268-4321
NY Ridgewood, E.V. Lauria & Assoc. 212-497-5347
NY Rochester, E.V. Lauria & Assoc. 716-235-4613
NC Winston-Salem, Radco 919-722-9671
Ohio Dayton, Rixan Assocs. 513-BA-2-0011
Va Springfield, Dyna-Rep. 703-321-8630

VERNITRON CONTROL COMPS., Div. Vernitron Corp., 2440 W. Carson St., Torrance, Cal., 90501, Tel: 213-328-2504, TWX: 910-349-6250; Sls. Mgr: S.W. Silverman ..... Vol 2•992

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Mass Lexington, Kitchen & Kutchin 617-862-8230
Mich Lathrup Vlg., R. C. Nordstrom 313-444-4417
Minn Eden Prairie, F. Peterson 612-941-5400
Mo Hazelwood, Dy-Tronix 314-731-5799
NJ Cherry Hill, A. Lanson 609-424-4670
NJ Harrington Pk., Metro Tech. Sls. Corp. 201-768-8495
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NY Fairport, Tech-Mark 716-377-5531
NY Jericho, Metro Tech. 516-935-3330
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Cal Santa Clara, Nova-Tronics Elec.Sls. 408-243-9530
Colo Denver, R.G. Bowen Co. 303-722-4641
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Conn Trumbull, R. Perron & Co. 203-268-9631
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Fla Orlando, Cartwright & Bean 305-896-2031
Ga Atlanta, Cartwright & Bean 404-237-2273
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Ind Indianapolis, Scott Elctrns., Inc. 317-635-8951
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Md Baltimore, ME & Assocs. 301-825-1130
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NY Jackson Heights, C. Landis Sls. Co. 212-458-7900
NY Rochester, B.H. Tollefson Assocs. 716-271-4141
NY W. Winfield, B.H. Tollefson 315-822-5916
NC Charlotte, Cartwright & Bean 704-333-6457
NC Raleigh, Cartwright & Bean 919-832-7128
Ohio Cincinnati, Scott Elctrns., Inc. 513-791-2513
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Pa Pittsburgh, Scott Elctrns. 412-781-3112
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Tex Dallas, W. Reese Assoc. 214-638-6575
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Iowa Cedar Rapids, Iowa Radio Supply Co. Inc., 719 Center Point Rd. NE 319-364-6154
Mass Woburn, Abbott Elctrn., 902 Main St. 617-935-2040
Minn Minneapolis, Elctrn Center Inc., 127 3rd Ave. N. 612-338-5881
NY Rochester, Simcona Elctrncs. Corp., 275 Mt. Read Blvd. 716-328-3230
Ohio Solon, REPCO, 6835 Cochran Rd. 216-248-8900
Pa Philadelphia, Simco Inc., 3907-11 N. Broad St. 215-BA-9-1880

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Fla Orlando, J.L. Highsmith & Co. 305-293-5202
Md Chevy Chase, Mount & Co. 301-652-5612
Mass S. Natick, W. Beaver Assoc. 617-655-1529
Minn Minneapolis, E. C. Elctrns. Sls. 612-831-0229
NY New York, Metro-Long Island Corp. 212-682-5844
NY Rochester, E.J. Schomberg Co.
NC Charlotte, J.L. Highsmith & Co. 704-333-7743
Tex Houston, Oeler & Menelaides 713-772-0730
Tex Richardson, Oeler & Menelaides 714-239-1121
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Md Baltimore, J&B Assocs. 301-823-0070
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Neb Lincoln, Mktg. Assoc. 502-434-5244
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Ga Atlanta, B. Smith 404-577-2736
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Md Laurel, D. Caulk 703-548-8446
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Ill	Chicago, Elctrn. Distr. Co., Inc., 4900 N. Elston Ave.	
Ill	Palatine, Ohm/Elctrns, 645 Vermont Ave	312-359-5500
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Mass	Woburn, Abbott Elctrn., 902 Main St.	617-935-2040
Minn	Duluth, Northwest Radio, 123 E. First St.	218-727-1565
Minn	Minneapolis, Elctrn Center Inc., 127 3rd Ave. N.	612-338-5881
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Mo	St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave	314-MA-1-5000
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Pa	Philadelphia, Powell Elctrns, Inc., Box 8765, S. Island Rd & Enterprise Ave	215-365-1900
Pa	Reading, Barbey Elctrn., 333 N. 4th St.	
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NY Utica, Naco Elctrns. 315-732-1801
NC Greensboro, BCS 919-273-1918
Okla Tulsa, C. Wolf Co. 918-622-9233
Pa King of Prussia, Sonco 215-242-8460
Tex Ft. Worth, C. Wolf Co. 817-738-1702
Tex Houston, C. Wolf Co. 713-643-2114
Wash Seattle, R. Drake 206-763-2755

WELCH ALLYN, INC., Skaneateles Falls, N.Y., 13153, Tel: 315-685-5788; Sls. Mgr: W.F. Allyn

WELCH RELAY DIVISION, Glassco-Ward-Davis, 1871 S. Orange Drive, Los Angeles, Calif., 90019, Tel: 213-933-9541, TWX: 910-321-3942; Sls. Mgr: C.F. McKee

WELLS ELCTRNS., INC., Dynablast Div., 1701 S. Main St., So. Bend, Ind., 46623, Tel: 219-287-5941; Gen'l. Mgr: D.P. Mydlach

WELWYN CANADA LTD., Box 2484, London, Ont., Can., Tel: 519-451-9490; S/M: K. Davis
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Refer to Dale Elctrns., Columbus, Neb. for sales off. Information

WEN PRODS., INC., 5810 Northwest Hwy., Chicago, Ill., 60631, Tel: 312-763-6060; Sls. Mgr: G.L. Guernsey

WEN Local Distributors
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ky Louisville, Burks, P.I., 842 S. 7th 502-589-3960
Mo St. Louis, Van Sickle Radio Elctrns, Inc, 1915 Washington Ave 314-MA-1-5000
Neb Omaha, Radio Equipment Co., Box 3843, 625 N. 18th St. 402-341-7700

WENTWORTH LABS, INC., Rte. 7, Broadfield, Conn., 06804, Tel: 203-775-1750; Sls. Mgr: A. Evans

WER INDUSTRIAL, Div. Emerson Elec. Co., 3036 Alt Blvd., Grand Island, N.Y., 14072, Tel: 716-773-2321; Mktg. Mgr: R.D. Bob

WESCO ELEC. CO., INC., 27 Olive St., Greenfield, Mass., 01301, Tel: 413-774-4358; Sls. Mgr: J.R. DeSanty
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Local Sales Offices & Reps.
Ala Huntsville, Leigh Sls., Inc. 205-852-3270
Ariz Tempe, G.R. McKnight Co., Inc. (John Cain) 415-325-2844
Cal Los Angeles, C. E. Holmes Co. 213-256-2255
Cal Menlo Park, G.R. McKnight Co., Inc. 415-325-2844
Conn Madison, A & M Elctrn. Reps., Inc. 203-245-1031
Fla Altamonte Springs, Semtronic Assoc., Inc. 305-831-8233
Ill Chicago, L-TEC, Inc. 312-286-1500
Ind Columbus, J. H. Weaver Co. 812-372-3625
Md Towson, Habco Elctrns., Inc. 301-825-9637
Mass Needham, A. & M. Elctrn. Reps., Inc. 617-444-8170
Mich Plymouth, Scott Elctrns., Inc. 313-455-2440
NJ Madison, Livera-Polk Assocs., Inc. 201-377-3220
NY Roslyn Heights, Livera-Polk Assocs., Inc. 516-484-1276
NC Raleigh, Leigh Sls., Inc. 919-787-9090
Pa Philadelphia, Eastern Components, Inc. 215-927-6262
Tex Dallas, Blackburn Assocs., Inc. 214-351-9991

WEST COAST RESCH. CORP., Box 25061, Los Angeles, Calif., 90025, Tel: 213-GR-8-8833; Gen'l. Mgr: H.M. Spivack

WESTAMP, INC., 1542 15th St., Santa Monica, Cal., 90404, Tel: 213-393-0401; Sls. Mgr: J. Manda

WESTERN COATING CO., Box 598, Royal Oak, Mich., 48073, Tel: 313-JU-8-3311; Pres: F.B. Evans

Local Sales Offices & Reps.
Cal Alhambra, Western Coating Co. 213-283-9331
Conn Farmington, R.M. Jones & Co. 203-677-2654
Fla Miami, Palmer Supplies Co. of Florida 305-633-8007
NY Garden City, Hogan Solvents & Chemicals 516-747-8460
Ohio Rocky River, G. Otte, Jr. 216-331-4139
Tex Dallas, Ahart Tool & Engrg. Co. 214-747-6004
Wisc Milwaukee, A.B. Plating Supply Co. Div. 414-383-1010

WESTERN COIL & ELEC. CO., 215 State St., Racine, Wisc., 53403, Tel: 414-632-4741; Sls. Mgr: W.T. Lewis

WESTERN ELCTRN. PRODS. CO., 107 Los Molinos, San Clemente, Cal., 92672, Tel: 714-492-4677; A/M: A. Schreiber

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Ariz Phoenix, B. Kinkner Assocs. 602-944-4691
Cal Palo Alto, Engrg. Assocs. 415-326-7842
Cal Pasadena, P. Nurches Co. 213-681-8957
Conn Sherman, R. P. Mahan Co. Inc. 203-355-0231
Fla Delray Beach, Dearie & Farrell Co. 305-276-7462
Ill Glenview, F. William Castle Co. 312-724-3075
Mass Wellesley, R. P. Mahan Co., Inc. 617-237-1040
Minn St. Louis Park, Xylem Co. 612-920-9626
Mo Joplin, RM Engrg. & Sls. 417-781-4591
NJ Mountain Lakes, Dearie & Farrell Co. 201-334-4848
NY Syracuse, Dearie & Farrell Co. 315-463-4507
Ohio Cincinnati, Schlemmer Assocs. 513-522-8340
Pa Philadelphia, Dearie & Farrell Co. 215-563-1818
Tex Stafford, Jordan Equip. Co., Inc. 713-498-6212
Wash Seattle, F. H. Haight Co. 206-322-1818

WESTERN GEAR CORP., Electro Prods. Oper., Dept. E, 75 W. Green St., Pasadena, Cal., 91105, Tel: 213-796-4395, TWX: 213-639-6541; Sls. Mgr: J.A. Neumayer

WESTERN INDICATOR CO., 9835 Dupree St., So. El Monte, Cal., 91733, Tel: 213-442-4700; Sales: J.D. Pon

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Fla Merritt Island, L. Meldeau 305-452-5975
Ind Fort Wayne, McDonald Sls. Co. 219-745-9214
Kans Mulvane, R. Elston 316-267-2572
Mass Cambridge, Gilway Sls. Co. 617-465-7568
NY Lynbrook, H.B. Heft Co. 516-599-3351
NY Rochester, Gislason Sls. Co. 716-454-4741
Pa Wayne, Emlen-Peterson Co. 215-687-3535
Tex Irving, Lee Sls. Co. 214-255-5043
Wash Seattle, Norwest Co. 206-282-3707

WESTERN MAGNETICS, INC., 1733 Flower St., Glendale, Cal., 91201, Tel: 213-245-7311; Dir. of Mktg: Richard R. Fried

WESTERN RESERVE ELCTRNS., 2150 Highland Rd., Twinsburg, Ohio, 44087, Tel: 216-425-4951; Pres: D.S. Wise

WESTERN TELEMATIC, INC., 3001 Red Hill Ave., Costa Mesa, Cal., 92626, Tel: 714-979-0363; Sls. Mgr: D. Story

WESTINGHOUSE ELEC., Architectural Sys., 4300 36th St., S.E., Grand Rapids, Mich., 49508, Tel: 616-949-1050; Sls. Mgr: J. Munsey

WESTINGHOUSE ELEC. CORP., Computer & Instr. Div., Westinghouse Bldg., Pittsburgh, Pa., 15222, Tel: 412-255-3321; Mktg. Mgr: H.E. Six

Local Sales Offices & Reps.
Ala Birmingham, Westinghouse Elec. Corp., Computer & Instrumentation Div. 205-879-2089
Cal Orange, Westinghouse Elec. Corp., Computer & Instrumentation Div. 714-637-8100
Cal San Francisco, Westinghouse Elec. Corp., Computer & Instrumentation Div. 415-445-2000
Colo Denver, Westinghouse Elec. Corp., Computer & Instrumentation Div. 303-825-0441
Conn Hartford, Westinghouse Elec. Corp., Computer & Instrumentation Div. 203-249-5792
Ga Atlanta, Westinghouse Elec. Corp., Computer & Instrumentation Div. 404-636-3390
Ill Chicago, Westinghouse Elec. Corp., Computer & Instrumentation Div. 312-461-7162
Kans Lenexa, Matney & Co., Inc. 913-888-6900
La New Orleans, Westinghouse Elec. Corp., Computer & Instrumentation Div. 504-486-6141
Md Cheverly, Westinghouse Elec. Corp., Computer & Instrumentation Div. 301-341-5330
Mass Boston, Westinghouse Elec. Corp., Computer & Instrumentation Div. 617-542-0600
Mich Southfield, Westinghouse Elec. Corp., Computer & Instrumentation Div. 313-352-9000
Mo St. Louis, Westinghouse Elec. Corp., Computer & Instrumentation Div. 314-421-6911
NJ Hillside, Westinghouse Elec. Corp., Computer & Instrumentation Div. 201-465-2943
NY Buffalo, Westinghouse Elec. Corp., Computer & Instrumentation Div. 716-854-0321
NC Charlotte, Westinghouse Elec. Corp., Computer & Instrumentation Div. 704-377-3471
Ohio Cincinnati, Westinghouse Elec. Corp., Computer & Instrumentation Div. 513-948-7230
Ohio Cleveland, Westinghouse Elec. Corp., Computer & Instrumentation Div. 216-579-2165
Okla Tulsa, Westinghouse Elec. Corp., Computer & Instrumentation Div. 918-583-3191
Pa Philadelphia, Westinghouse Elec. Corp., Computer & Instrumentation Div. 215-667-7600
Pa Pittsburgh, Westinghouse Elec. Corp., Computer & Instrumentation Div. 412-255-4511
Tex Houston, Westinghouse Elec. Corp., Computer & Instrumentation Div. 713-621-9000
Wash Seattle, Westinghouse Elec. Corp., Computer & Instrumentation Div. 206-623-7001

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WESTINGHOUSE ELEC., Elctrn. Tube, Box 284, Elmira, N.Y., 14902, Tel: 607-739-7951; Mktg. Mgr: J. Baker

WESTINGHOUSE ELCTRN. TUBE Local Distributors
Ala Birmingham, J.W. Clary Co., 1713 Second Ave. S. 205-322-2488
Cal Mt. View, Elmar Elctrn., 2288 Charleston Rd. 415-961-3611
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Md Baltimore, Radio Elec. Service Co., 1026 Cromwell Bridge Rd. 301-823-0070
NJ Paterson, United-Page, Inc, 481 Getty Ave 201-279-7500
NY New York, Midway Ind'l. Elec., 38 E. 29th St. 212-889-0370
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400

WESTINGHOUSE ELEC., General Control, Buffalo, N. Y., 14240, Tel: 716-631-2440; Mktg. Mgr: A.R. Whittemore

WESTINGHOUSE ELEC., Ind'l. Equip., Box 300, Sykesville, Md., 21784, Tel: 301-795-2800; Mktg. Mgr: R.E. Recka

WESTINGHOUSE ELEC., Ind'l. Plastics, 1585 Lebanon School Rd., W. Mifflin, Pa., 15122, Tel: 412-256-3971; Mktg. Mgr: E.G. Bittner

WESTINGHOUSE ELEC. CORP., Ind'l. Systems Div., Westinghouse Bldg., Pittsburgh, Pa., 15222, Tel: 412-255-3321

WESTINGHOUSE ELEC. CORP., Industry Srvcs. Div., 1530 Westinghouse Bldg., Pittsburgh, Pa., 15222, Tel: 412-255-3580; Mktg. Mgr: R.J. Alke

WESTINGHOUSE ELEC., Lamp Div., Parts Sls., 1 Westghse Plaza, Bloomfield, N. J., 07003, Tel: 201-465-3325; Mktg. Mgr: R.M. Harris

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WESTINGHOUSE ELEC. CORP., Relay-Instr. Div., 95 Orange St., Newark, N.J., 07101, Tel: 201-465-0222; Mktg. Mgr: R.G. Lakin

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Ala Mobile 205-344-4273
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Ark Little Rock 501-376-3462
Cal Bakersfield 805-327-7633
Cal Compton 213-638-7781
Cal Emeryville 415-652-3770
Cal Fresno 209-233-0576
Cal Los Angeles 213-482-9660
Cal Riverside 714-682-6551
Cal Sacramento 916-922-7071
Cal San Diego 714-279-0233
Cal San Francisco 415-445-2000
Cal Sunnyvale 408-735-2601
Colo Denver 303-825-0441
Conn Hartford 203-249-5792
DC Washington 202-833-5000
Fla Jacksonville 904-356-5811
Fla Miami 305-634-5461
Fla Tampa 813-837-7171
Ga Albany 912-436-0144
Ga Atlanta 404-885-5200
Haw Honolulu 808-839-0311
Idaho Boise 208-344-2502
Ill Aurora 312-897-4293
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Ill Danville 217-442-1901
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Ill Rockford 815-398-3591
Ind Evansville 812-425-7146
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Ind So. Bend 219-287-1051
Iowa Cedar Rapids 319-366-0781
Iowa Davenport 319-323-2761
Iowa Des Moines 515-283-2081
Kans Wichita 316-263-2295
Ky Louisville 502-459-5440
La Baton Rouge 504-344-9448
La New Orleans 504-486-6141
La Shreveport 318-425-2435
Me Augusta 207-623-4571
Md Towson 301-828-5400
Mass Boston 617-542-0600
Mass Springfield 413-734-3101
Mass Worcester 617-853-2680
Mich Grand Rapids 616-456-1531
Mich Jackson 517-787-3630
Mich Saginaw 517-793-8680
Mich Southfield 313-352-9000
Minn Duluth 218-727-1541
Minn Minneapolis 612-927-6551
Miss Jackson 601-354-2373
Mo Kansas City 816-421-7122
Mo St. Louis 314-421-6911
Mont Butte 406-792-2301
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NJ E. Orange 201-465-0222
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NY New York 212-692-3211
NY Olean 716-372-0040
NY Rochester 716-232-4380
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NC Greensboro 919-273-5563
NC Raleigh 919-834-4375
Ohio Akron 216-376-2171
Ohio Cincinnati 513-475-7400
Ohio Cleveland 216-579-2121
Ohio Columbus 614-272-4000
Ohio Dayton 513-228-9601
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Ohio Youngstown 216-744-8911
Okla Oklahoma City 405-232-8565
Okla Tulsa 918-583-3191
Ore Eugene 503-342-3083
Ore Portland 503-224-4200
Pa Allentown 215-433-3296
Pa Bala Cynwyd 215-667-7600
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Pa Johnstown 814-288-1559
Pa Pittsburgh 412-255-3800
Pa Wilkes Barre 717-825-7337
Pa Williamsport 717-326-4289
SC Columbia 803-256-1511
SC Greenville 803-232-5695
Tenn Chattanooga 615-267-9146
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Tenn Memphis 901-526-8546
Tenn Nashville 615-327-4911
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Tex Beaumont 713-898-1157
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Tex Dallas 214-631-2811
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Tex Houston 713-621-9000
Tex Odessa 915-337-1822
Tex San Antonio 512-223-9181
Utah Salt Lake City 801-486-8751
Va Richmond 703-285-3909
Va Roanoke 703-342-8925
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Wash Spokane 509-535-3521
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WVa Charleston 304-346-9606
WVa Fairmont 304-363-0400
WVa Huntington 304-529-7146
WVa Wheeling 304-232-4100
Wisc Appleton 414-739-2313
Wisc Madison 608-257-4517
Wisc Milwaukee 414-264-6400

WESTINGHOUSE, RELAY-INSTR. Local Distributors

Cal Los Angeles, Metermaster-Main Off., 5646 Jillson St. 213-685-4340

WESTINGHOUSE ELEC., Semiconductor Div., Youngwood, Pa., 15697, Tel: 412-WA-5-7272, TWX: 510-468-2340; Power Prods. Sls. Mgr: S. Hunt; Volume Prod. Sls. Mgr: B. Burton

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Local Sales Offices & Reps.

Ala Huntsville, Tech-Rep Assocs. 205-881-2786
Cal Los Angeles 213-482-9660
Cal Sunnyvale 408-735-2191
Conn New Haven, Gerber Sls. Corp. 203-777-6279
Fla Indian Rocks Beach, Tech-Rep Assocs. 813-595-2834
Fla Melbourne, Tech-Rep Assocs. 305-723-9140
Ill Chicago 312-416-7200
Md Baltimore, R.L. Wilkinson Inc. 301-377-7800
Mass Boston 617-542-0600
Mass E. Longmeadow, Gerber Sls. Corp. 413-525-3059
Mass Waltham, Gerber Sls. Co. 617-890-8040
Mich Farmington, Sheridan Assocs. 313-477-3800
Minn Minneapolis 612-927-6551
Mo Florissant, Sheridan Assoc. 314-837-5200
Mo Hazelwood, Dy-Tronix Inc. 314-731-5799
Mo Kansas City, Dy-Tronix Inc. 816-761-6543
NY Clinton, Advanced Comps. Corp. 315-853-6438
NY Endicott, Advanced Comps. 607-785-3191
NY Great Neck, Cooper-Simon & Co. 516-487-1142
NY Mineola 516-248-9810
NY N. Syracuse, Advanced Components 315-699-2671
NY Rochester 716-232-4380
NY Scottsville, Advanced Comps. 716-889-1429
Ohio Cincinnati, Sheridan Assocs. 513-761-5432
Ohio Cleveland 216-579-2121
Ohio Cleveland, Sheridan Assocs. 216-524-8120
Ohio Dayton 513-228-9627
Ohio Dayton, Sheridan Assocs. 513-277-8911
Pa Bala Cynwyd 215-667-7600
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Wisc Milwaukee 414-264-6400

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Ala Huntsville, Cramer/Ew Huntsville, 2310 Bob Wallace Ave.SW 205-539-5722
Ariz Phoenix, Hamilton/Avnet Elctrncs., 1739 N. 28th Ave. 602-269-1391
Ariz Phoenix, Kierulff - Phoenix, 2633 E. Buckeye Rd. 602-273-7331
Cal Culver City, Hamilton Electro Sales 213-870-7171
Cal Inglewood, Newark Elctrns. Corp., 4747 W. Century Blvd. 213-678-0441
Cal Los Angeles, WESCO Elctrns.-L.A., 5650 Jillson St. 213-685-9525
Cal Mt. View, Hamilton/Avnet Corp., 340 Middlefield Rd. 415-961-7000
Cal San Diego, Hamilton/Avnet Corp., 5569 Kearny Villa Rd. 714-279-1550, 279-2421
Colo Denver, Elctrn. Parts Co., 1212 S. Broadway 303-744-1992
Colo Denver, Hamilton/Avnet Electronics 303-534-1212
Conn North Haven, Cramer/Conn., 35 Dodge Ave. 203-239-5641
Fla Hollywood, Cramer/Ew Hollywood, 4035 North 29th Avenue 305-923-8181
Fla Orlando, Cramer/Ew Orlando, 345 North Graham Avenue, Box 20214 305-894-1511
Ga Atlanta, Specialty Distributing, 763 Juniper St. N.W. 404-873-2521
Ga Augusta, Specialty Distrg. Co., 1251 Gordon Pk. Rd., Box 1401 401-722-1526
Ill Chicago, Semiconductor Specialists, Inc. 312-279-1000
Ill Schiller Park, Hamilton-Avnet Elctrs., 3900 N. 25th Ave.
Ind Evansville, Ohio Valley Sound, Inc., 20 E. Sycamore St. 812-425-6173
Ind Ft. Wayne, Ft. Wayne Elctrns. Supply, 3606 Maumee Ave. 219-742-4346
Ind Indianapolis, Ra-Dis-Co., Inc., 814 N. Senate Ave., Box 1064 317-637-5571
Ind South Bend, Radio Distr Co Inc, 1212 High St 219-287-2911
Kans Prairie Village, Hamilton/Avnet Elctrncs., 3500 W. 75th St. 913-362-3250
Md Gaithersburg, Cramer/Ew Washington, 16021 Industrial Drive 301-948-0110
Md Hanover, Hamilton/Avnet Elctrns. 301-796-5000
Md Savage, Pyttronic Ind., 8200 Wellmoor Ct.
Mass Burlington, Hamilton/Avnet Elctrns. 617-273-2120
Mass Newton, Cramer Elctrn. Inc., 85 Wells Avenue 617-969-7700
Mass Waltham, Schweber Elctrns. 617-890-8484
Mich Detroit, Semiconductor Specialists, 25127 W. Six Mile Rd. 313-255-0300
Mich Farmington, Sheridan Sales Co., 33703 Grand River Ave. 313-477-3800
Mich Livonia, Hamilton/Avnet Elctrns. 313-522-4700
Minn Minneapolis, Hamilton/Avnet Elctrns. 612-854-8400
Minn Minneapolis, Harry Stark Electrns. Supply, 112 3rd Ave., N. 612-332-1325
Minn Minneapolis, Semiconductor Specialists, 8030 Cedar Ave. S. 612-854-8841
Mo Hazelwood, Hamilton/Avnet Electronics 314-731-1144
Mo No. Kansas City, LCOMP-Kan City, 1520 Taney St. 910-221-2400
Mo St. Louis, Hall-Mark Elctrn. Corp., 6100 Madison Ave. 314-521-3800
NJ Moorestown, Arrow Elctrns., Pleasant Valley Rd. 609-235-1900
NM Albuquerque, Kierulff-New Mexico, 2524 Baylor Dr., S.E. 505-247-1055
NY Buffalo, Summit Dist. Inc., 916 Main St. 716-884-3450
NY East Syracuse, Cramer/Syracuse, 6716 Joy Road 315-437-6671
NY Endwell, Cramer/Binghamtom, 3220 Watson Blvd. 607-754-6661
NY Farmingdale, Harrison Elctnc., 20 Smith St. 516-293-7990
NY Freeport, Milgray/New York, 191 Hanse Ave 516-546-6000
NY Hauppauge, L.I., Cramer/Long Island, 29 Oser Avenue 516-231-5682
NY New York, Metropolitan, 468 Park Ave., S. 212-686-2120
NY Syracuse, Hamilton/Avnet Elctrns. 315-437-2642
NY Westbury, Schweber Elctrns., Jericho Tpke 516-334-7474
Ohio Cincinnati, Sheridan Sales Co., 10 Kradlecrest Dr. 513-761-5432
Ohio Columbus, Hughes-Peters, Inc., 481 E. 11th Ave. 614-294-5351
Ohio Sheridan Sales Co., Box 4457, 215-524-3120 - 5351
Okla Tulsa, Hall-Mark Elctrn., 4846 S. 83rd Ave. 918-835-8458
Pa Pittsburgh, Cameradio Co., 2801 Liberty Ave. 412-391-7400
SC Greenville, Sawyer Elctrn., 1210 Poinsett Hghwy.
Tex Dallas, Hall-Mark Elcton Corp., 9333 Forest La. 214-231-5101
Tex El Paso, Midland Spec. Co., 2235 Wyoming Ave. 915-533-3555
Tex Houston, Hall-Mark Elctrn., Box 36739 713-781-6100
Tex Houston, Lenert Co., Box 2184 713-225-1465
Tex Richardson, Altair Co., 405 N. Plano Rd. 214-231-5166
Utah Salt Lake City, Hamilton/Avnet Elctrns. 801-262-8451
Wash Seattle, Hamilton/Avnet Elctrncs., 2320 6th Ave. 206-624-5930
Wisc Milwaukee, Taylor Elec. Co., 1000 W. Donges Bay Pk.

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For: Can., Ottawa, Ont., Hamilton/Avnet Elctrncs., 880 Lady Ellen Pl.
For: Can., Toronto, Ont., Hamilton/Avnet Elctrns. 416-789-1838

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WESTMORELAND PLASTICS CO., 135 Gertrude St., Latrobe, Pa., 15650, Tel: 412-539-1612; Sls. Mgr: E.R. Hatfield

Local Sales Offices & Reps.

Cal	Fremont, Hartfield, Kennan & Freytag	415-863-2200
Cal	Los Angeles, Hartfield, Kennan & Freytag	213-225-1318
Ill	Skokie, B. Brown Sls. Co.	312-673-0660
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Mass	Woburn, R. W. Hatfield Co.	617-933-2324
Mich	Detroit, F. R. Burczyk Assoc.	313-872-6620
Pa	Emmaus, J. S. Adams & Co.	215-965-2391
Pa	Emmaus, S. D. Adams & Co.	215-965-4544
Tenn	Hendersonville, B. Lucas Assocs.	615-824-5818
Wash	Vancouver, Hartfield, Kennan & Freytag	503-228-1683
For:	Can., Toronto, Ontario, Harvey Waldman & Co., Ltd.	416-787-0133

WESTON COMPS. DIV., Weston-Archbald, Archbald, Pa., 18403, Tel: 717-876-1500, TWX: 510 - 656 - 2902; Prod. Mgr: F.J. Butteri

Local Sales Offices & Reps.

Ala	Huntsville, J. L. Highsmith & Co.	205-881-3294
Ariz	Scottsdale, Piper Sls.	602-949-8424
Cal	Cupertino, PM Sales	408-255-1771
Cal	San Diego, Celtec	714-279-7961
Cal	Van Nuys, Wes-K Assocs.	213-989-3070
Colo	Denver, Vinson Assocs.	303-757-5151
Conn	Hamden, Impact Sls.	203-281-1331
Fla	Altamonte Springs, WMM Assocs.	305-831-4645
Fla	Clearwater, WMM Assocs.	813-726-8871
Fla	Pompano Beach, WMM Assocs.	305-943-3091
Ill	Skokie, Mar-Con Assocs.	312-675-6450
Iowa	Marion, C & M Sales	319-377-6313
Kans	Overland Park, Penzer Mankus	913-381-0004
Md	Baltimore, B. White & Co.	301-484-5400
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Mich	Dearborn, Mitronic Sls.	313-565-6330
Minn	St. Paul, R. Ragon	612-488-0201
Mo	Hazelwood, Penzer Mankus Assocs.	314-731-4334
NJ	Camden, QED Elctrns.	609-365-2450
NM	Albuquerque, Vinson	505-298-7442
NY	Albany, Compar Albany	518-489-4777
NY	Mt. Vernon, QED Elctrns.	914-664-0080
NC	Charlotte, J.L. Highsmith	704-333-7743
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This is the Last Page of the Manufacturers and Sales Office's Directory

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for DISTRIBUTORS Alphabetical DIRECTORY see Volume 1, Page 1594

Distributors Directory
GEOGRAPHICALLY ARRANGED

This is the geographic listing of more than 1,000 electronic distributors and their branch locations in geographic arrangement. It lists distributors by state, alphabetically, and alphabetically by city within that state. The listing for each distributor duplicates the information that appears for him in the preceding alphabetical listing. If you know the name of the distributor you want to reach, you can find it quickly in the alpha directory. If you need to know who the distributors are in your area, use this geo portion of the directory to determine a complete listing of distributors in any given city or state.

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This directory was completely revised and updated for this edition prior to publication. Thus the information is current as of Spring 1973.

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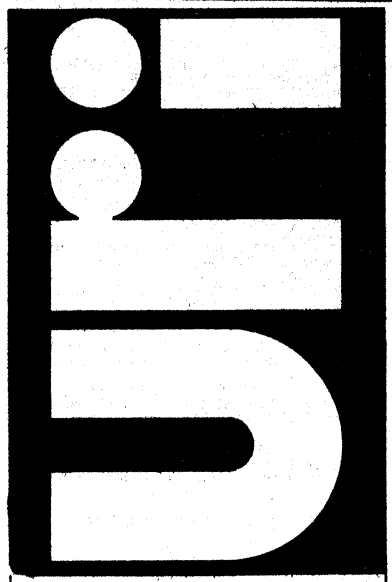

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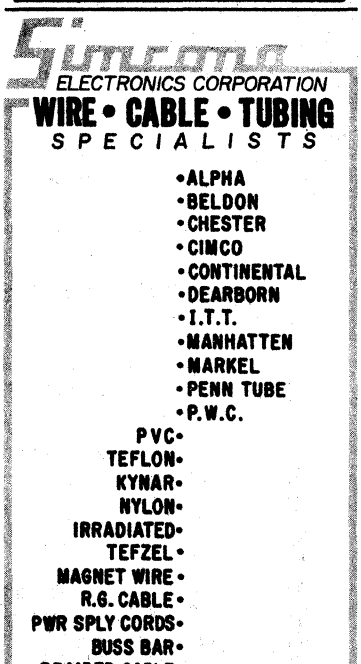

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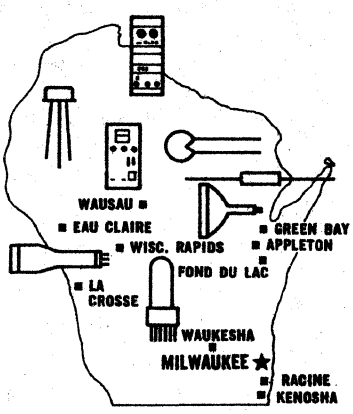

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P&B relay guide

Your quick reference to distributor-stocked P&B relays . . . see your P&B representative for any relay need.

GENERAL PURPOSE

Over 150 models ranging from dry circuit to 20 amps . . . from SPST to 8PDT in practically any contact arrangement desired.

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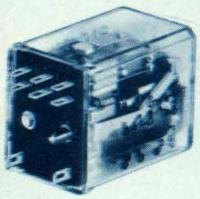
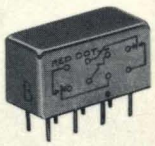


HI-RELIABILITY MINIATURE

Full and ½ crystal can models ranging from 650 mW to 1 watt input, and from 2 to 3 amps output. Will withstand high shock and vibration.

Page **Vol. 2 • 860**



POWER

From SPST to 4PDT up to 30 amps for 100,000 operations and more. Many are U/L - CSA approved and listed.

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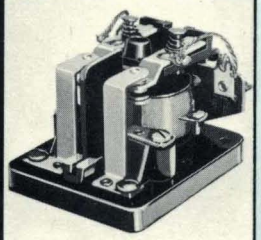

SOLID STATE HYBRIDS

Life expectancy to 10 million operations for use in computers, industrial, medical and office equipment. Inputs from 60 μW to 1.2 watts.

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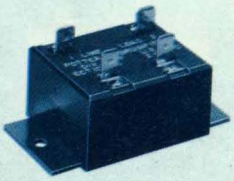

SPECIAL PURPOSE

Impulse sequencers, ratchet relays, stepping switches, latching relays, antenna switching, buzzers, and motor starting relays.

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DRY REED

Standard and miniature sizes, open and enclosed, and latching types . . . from 10 to 50 watts output. Standard grid spacings, 0.1" and 0.2".

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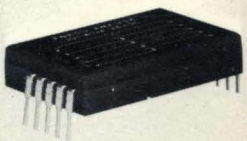

SENSITIVE

Lightweight models from 10 mW; amplifier driven from 60 μW. Contact arrangements from SPST to 4PDT rated from 2 to 7 amps.

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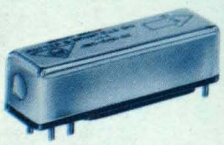
MERCURY WETTED

Think in terms of billions of operations! Single-side stable, bistable and choppers; bridging and nonbridging models; from dry circuit to 100 VA.

Page **Vol. 2 • 865**



TELEPHONE

Open and enclosed models from SPST to 6PDT, from 1 amp for use in computers, RF, AF and digital equipment, industrial, communications and office equipment.

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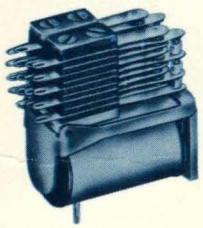

TIME DELAY RELAYS

More than 135 models ranging from 0.1 second to 300 seconds delay-on-operate, delay-on-release, and interval timer. Delay modes are knob adjustable, resistor adjustable and fixed.

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P&B makes more of more kinds of relays than anybody in the business. Anybody!

AMF

Potter & Brumfield